Priority Focus Area for Wacissa Springs

Division of Environmental Assessment and Restoration
Florida Department of Environmental Protection

December 2017

2600 Blair Stone Road, MS 3575
Tallahassee, FL 32399-2400
www.dep.state.fl.us

More Information

For more information about the priority focus area for Wacissa Springs, contact the following individual:

Terry J. Hansen, P.G.
Basin Coordinator
DEP Watershed Planning and Coordination Section
Email: Terry Hansen
Phone: (850) 245–8561

Introduction

Under the Florida Springs and Aquifer Protection Act, the Florida Department of Environmental Protection (DEP) is required to delineate priority focus areas (PFAs) for all Outstanding Florida Springs identified as impaired. According to the Florida Springs and Aquifer Protection Act, adopted by the Florida Legislature in 2016 (Chapter 373, Part VIII, Florida Statutes [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* [DEP] *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 the following:

- 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 the 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 probably influence water quality in the spring.

- Other factors, including 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, including roads, natural boundaries, and political jurisdictions.

Steps in Delineating the Wacissa PFA

The PFA for Wacissa 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 water quality restoration and protection perspectives. The steps listed below were taken to develop a PFA for review and input by stakeholders. The overlapping of mapped characteristics that express high vulnerability, a high potential for pollutant mobility, and likely pollutant sources provides 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 springshed boundary used for this evaluation was created jointly in November 2017 by Northwest Florida Water Management District (NWFWMD), Suwannee River Water Management District (SRWMD), and Florida Geological Survey (FGS) based on the U.S. Geological Survey (USGS) 2010 potentiometric surface contour map. **Figure 1** shows the Wacissa Springshed and the PFA boundary, as well as the groundwater elevation contour map for the Floridan aquifer for May 2010. Groundwater flow gradients from this representative measurement date were the basis for developing a generalized springshed for Wacissa Springs. This area is located in portions of Jefferson, Leon, Madison, and Taylor Counties in Florida and extends into parts of Thomas, Brooks, and Lowndes Counties in Georgia. Portions of the springshed are situated in both the NWFWMD and the SRWMD.

Step 2. Identify regions in the contributing area where the 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 those with the highest recharge to the aquifer. This recharge could occur as diffuse infiltration through permeable geological material as well as focused recharge to sinkholes that breach confining layers. Pollutant sources in higher recharge areas have the greatest potential for causing adverse impacts to groundwater and springs because water is impeded and attenuated the least as it infiltrates to the aquifer from the ground surface. In high-recharge areas, recharge is 10 inches per year (in/yr) or greater.

Unfortunately, available water management district or USGS recharge coverages do not include the Wacissa Springs area of interest. However, another GIS coverage is available to help define the recharge regime for priority setting and provide recharge information for the springshed. This layer, developed by the Florida Natural Areas Inventory (FNAI) for state land acquisition priority ranking, identifies areas of potential recharge important for natural systems and human use based on features that contribute to aquifer vulnerability as well as areas within springshed protection zones near public water supply wells.[1]

[1] FNAI. December 2000. *Florida Forever conservation needs assessment summary report to the Florida Forever Advisory Council.*

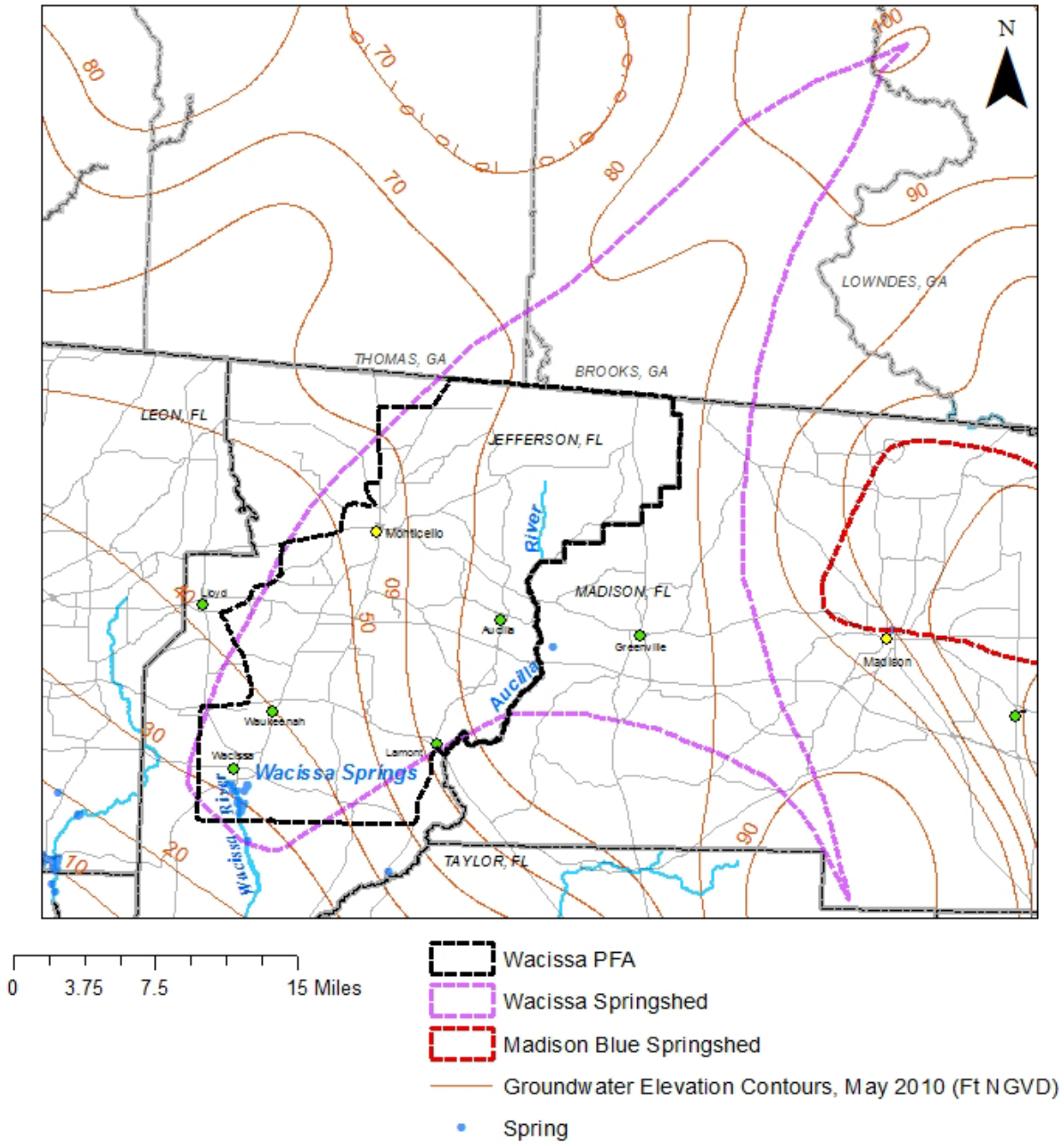

Figure 1. Wacissa Springshed and PFA boundary

In this coverage, higher priority areas are those with the greatest recharge to the Floridan aquifer. Based on this coverage, recharge to the Floridan aquifer in most of this springshed is moderate (mostly Priority 3 to 5). **Figure 2** shows the FNAI recharge coverage for the portion of the springshed in Florida.

Step 3. Identify regions in the springshed where the Floridan aquifer is most vulnerable. The FGS developed the Florida Aquifer Vulnerability Assessment (FAVA) model to provide

spatial coverage of aquifer vulnerability ranges across an area.[2] According to the generalized statewide FAVA model for the Floridan aquifer system in Florida, most of the Wacissa Springshed lies in the "more vulnerable" category, with a portion corresponding with lower recharge lying in the “vulnerable” category. **Figure 3** shows the FAVA map for the portion of the springshed in Florida.

As a further refinement, the vulnerability of the aquifer to local points of recharge through sinkholes and linear karst features was evaluated by using the statewide Digital Elevation Model (DEM), which is based on the light imaging, detection, and ranging (LIDAR) remote-sensing method. In this area, most closed topographic depressions form as solution or collapse sinkholes. Water flowing into these features can more rapidly reach the aquifer and erode and enlarge conduits in the limestone, and can be expressed in linear arrays across the landscape. Dry or intermittent stream traces can have associated subterranean conduit networks connected to sink features known as "swallets" that provide a direct conduit for surface water discharge into the aquifer.

In 2007, the FGS completed a project to map all known swallets in the state and produced a GIS layer that includes their locations. **Figure 4** shows the DEM map (2009), with outlines of closed depressions and swallets in the Wacissa Springs region in Florida. Swallets and greater concentrations of closed depressions are found in the part of the springshed west of the Aucilla River and east of the higher elevation areas shown in **Figure 4**.

Step 4. Consider nitrogen load. Nitrate-nitrogen is the major nutrient of concern in Florida's spring systems because of its pervasive nature in groundwater, its mobility, and its availability for uptake by aquatic flora when it is discharged from springs. Excess concentrations of nitrate nitrogen in the spring water have contributed to biological impairment in the upper Wacissa River. The source of flow from the springs delivering nitrate is groundwater in the Floridan aquifer system, coming from local precipitation that recharges the aquifer in the springshed area. The nitrate originates from atmospheric deposition and anthropogenic sources in the springshed.

[2] Bridger, K., J. Dodson, G. Maddox, and B. Katz, May 2017. *Nutrient TMDL for Wacissa River and Springs (WBIDs 3424 and 3424Z) and documentation in support of development of site-specific numeric interpretations of the narrative nutrient criterion.* Tallahassee, FL: DEP Division of Environmental Assessment and Restoration.

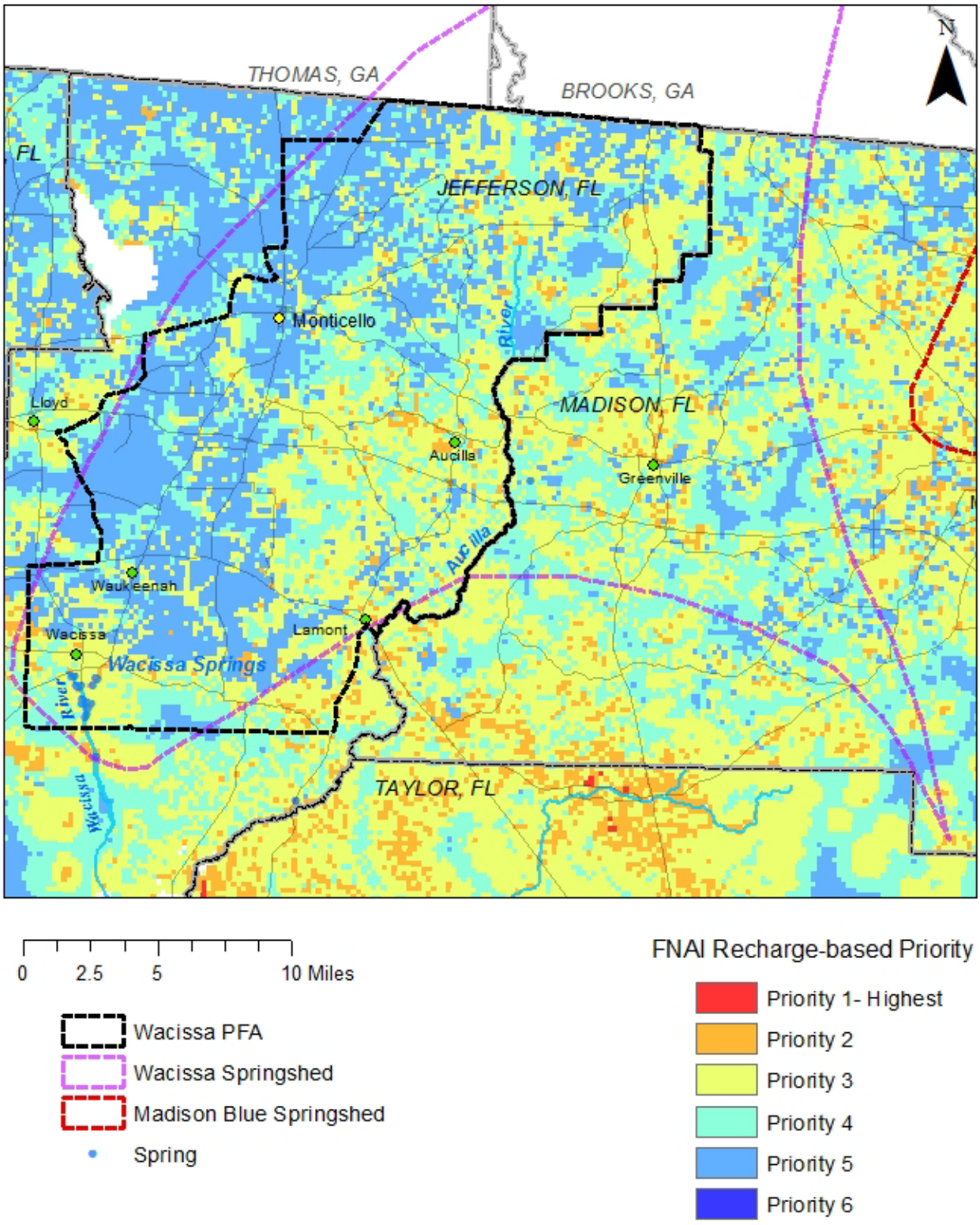

Figure 2. Florida state lands recharge-based prioritization coverage and PFA boundary

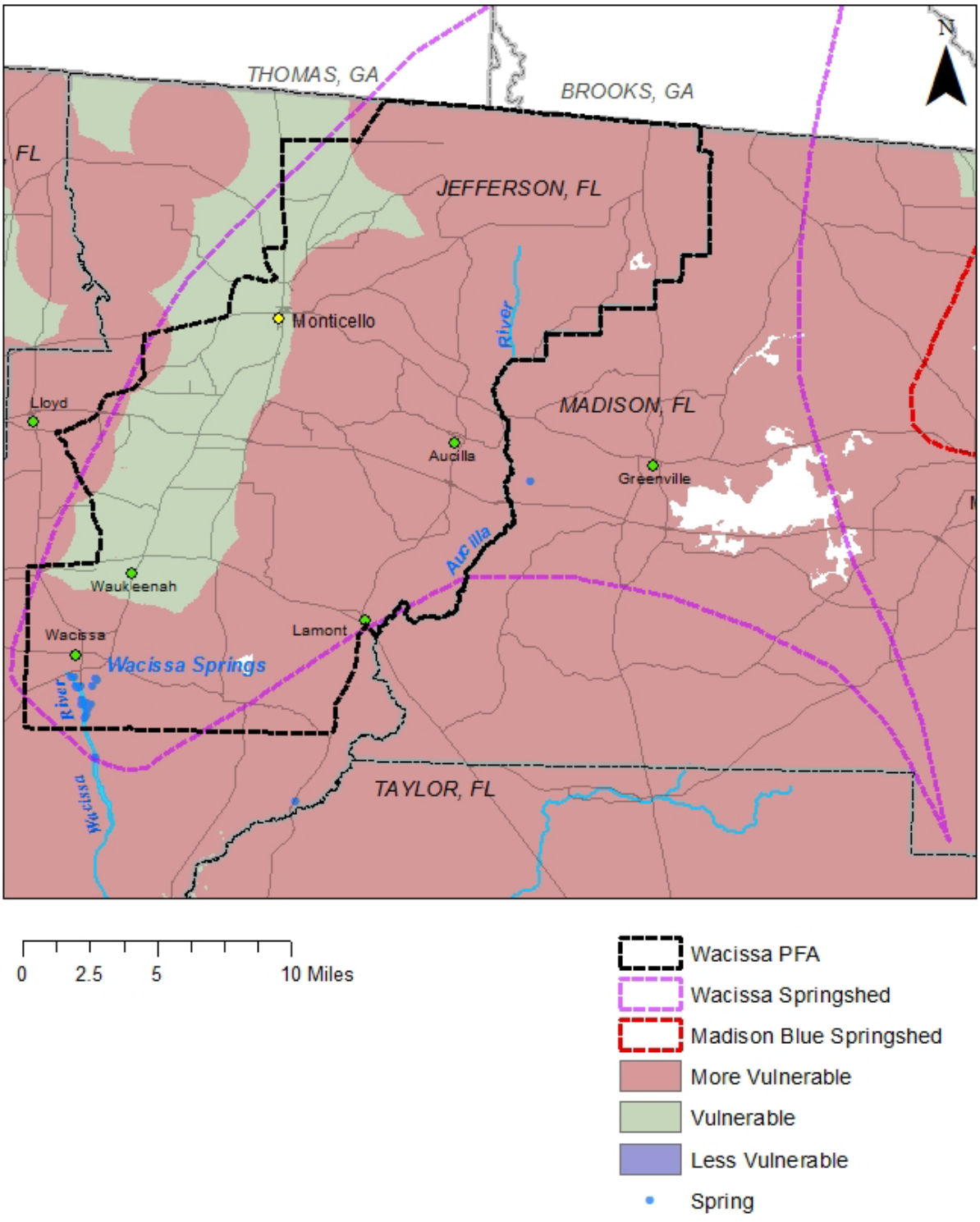

Figure 3. Floridan aquifer vulnerability based on statewide FAVA model

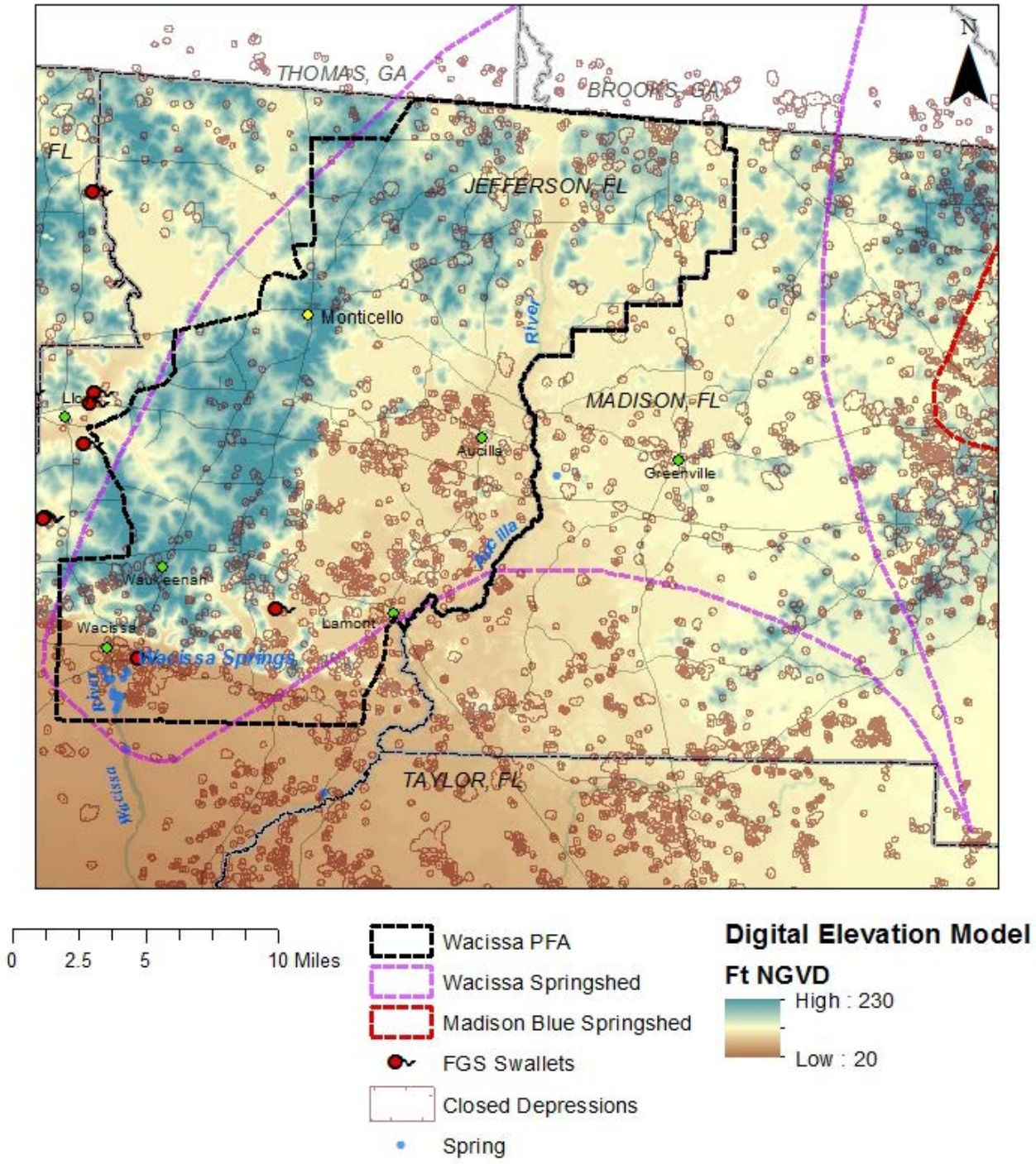

Figure 4. DEM projection showing locations of closed depressions and swallets in the Wacissa Springshed in Florida

The mean nitrate concentration in the Wacissa River in the headspring area from a 2011–14 monitoring period was 0.35 milligrams per liter (mg/L), as reported in the total maximum daily loads (TMDL) report for the Wacissa River and Wacissa Springs.[3] The nitrogen load from the Wacissa Springs Group depends on concentration and flow. The discharge of the Wacissa River includes contributions from several springs, some of which are not impaired. A USGS monitoring station in the Wacissa River downstream from the impaired segment measures nitrate concentration and discharge. On July 26, 2017, the nitrate and flow values at the station were 0.12 mg/L and 251 cubic feet per second (cfs), respectively. Using these values, the estimated daily load of nitrogen in the river at that station was about 162 pounds per day. Extrapolated to a year, assuming flow or concentrations did not fluctuate significantly, the annual load would be more than 59,000 pounds per year. Most of that load comes from the headspring area, where nitrate concentrations were at times greater than Florida's standard for spring vents, 0.35 mg/L.

DEP is developing a nitrogen source inventory for the Wacissa Springs contributing area to serve as a tool for identifying remediation alternatives and projects for reducing nitrogen loads to the springs. Typical nitrogen sources in spring contributing areas include inorganic fertilizer, livestock waste, onsite sewage treatment and disposal systems (OSTDS) (or septic systems), treated domestic wastewater, and atmospheric deposition.

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 the 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 these areas, groundwater can move rapidly from points where the water enters the aquifer to the spring vents. The Wacissa Springshed includes some areas of more dynamic flow where infiltrating water has caused dissolution and the creation of sinkholes, pipes, and conduits in the limestone matrix and areas where the limestone may be confined by layers of lower permeability material that inhibit the erosion of the limestone by percolating water. Where karst features are less prevalent, groundwater movement occurs in intergranular pore spaces in the limestone and is slower.

No dye trace studies have been conducted in the Wacissa Springs area to help predict the rate of groundwater travel to the springs. Because karst features are common in the springshed in lower elevations of the springshed west of the Aucilla River, groundwater travel times to the springs are most likely the greatest in that area.

Step 6. Identify regions in the contributing area where soil conditions are most favorable for nitrogen to leach from surface sources. Nitrogen is the target nutrient for spring restoration. Research has shown that both the amount of nitrogen removed in the soil zone through denitrification and the amount of leaching are related to soil drainage class.[4]

[3] Real-time water data from the Florida USGS website.

[4] 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 the Florida Department of Health (FDOH).

Hofstra, N., and A.F. Bouwman. 2005. Denitrification in agricultural soils: Summarizing published data and estimating global annual rates. *Nutrient Cycling in Agroecosystems* 72: 267–278.

Denitrification is lowest and nitrogen leaching 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 is least likely to occur in areas where soils are poorly drained, somewhat poorly drained, or very poorly drained because of their greater potential for denitrification.

The portions of the springshed where soil conditions are more favorable for nitrogen leaching can be mapped using the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Survey Geographic (SSURGO) Database for Florida.[5] These excessively drained to well-drained soils tend to occur in areas where aquifer recharge is highest and vulnerability is greatest. **Figure 5** shows that soil areas with a high potential for nitrogen leaching are scattered throughout the springshed but with the greatest coverage west of the Aucilla River. These areas include soils in the excessively drained, somewhat excessively drained, and well-drained SSURGO drainage classes. The figure also shows scattered areas of moderately well-drained soils where the potential for nitrogen leaching is moderate.

Step 7. Identify regions in the contributing area to exclude or include based on land use and the potential for pollutant sources to occur. Conservation lands, wetlands, and undeveloped open land protected from development in some cases may be excluded from the PFA if there is no expectation that they would include pollutant sources affecting springs in the foreseeable future and they are under protection. The springshed includes SRWMD-managed lands, privately owned conservation easements, and portions of the Aucilla Wildlife Management Area. None of these areas was used as a basis for delineating the PFA. **Figure 6** shows the conservation lands from the FNAI Conservation Lands (Managed Areas) GIS layer.

The Wacissa Springshed includes a large aggregate area in agricultural land uses and small, scattered areas of urban land use (mostly residential and commercial areas within and surrounding Monticello, Lamont, Greenville, Wacissa, Aucilla, and Waukeenah). The delineation of the PFA includes consideration of areas with significant potential for nitrogen leaching to groundwater based on the sources of nitrogen that occur there. Agricultural lands can include fertilizer use and livestock operations that can result in significant nitrogen inputs to the land surface. Urban lands can include higher densities of OSTDS, domestic wastewater application sites, and urban fertilizer use, all of which are potential sources of nitrogen to the aquifer and springs. **Figure 7** shows mapped urban and agricultural lands (based on the 2013–14 SRWMD land use–land cover GIS coverage).

OSTDS are potentially significant nutrient sources to be considered in delineating a PFA. **Figure 8** shows the locations of OSTDS, based on GIS coverage of parcels associated with OSTDS in the FDOH Florida Water Management Inventory Project.

[5] The SSURGO 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 online.

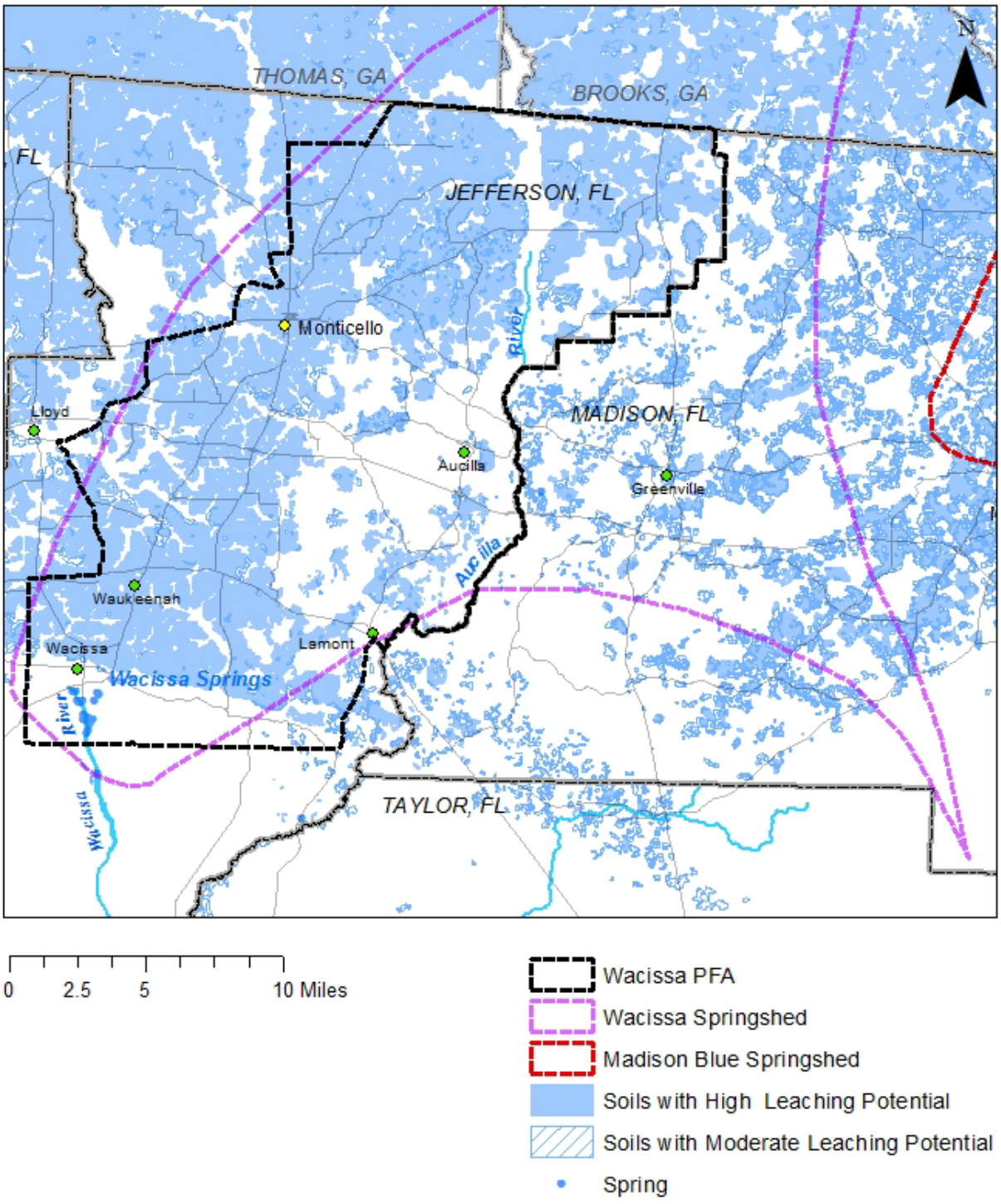

Figure 5. Areas of soils with high and moderate nitrogen leaching potential and PFA boundary

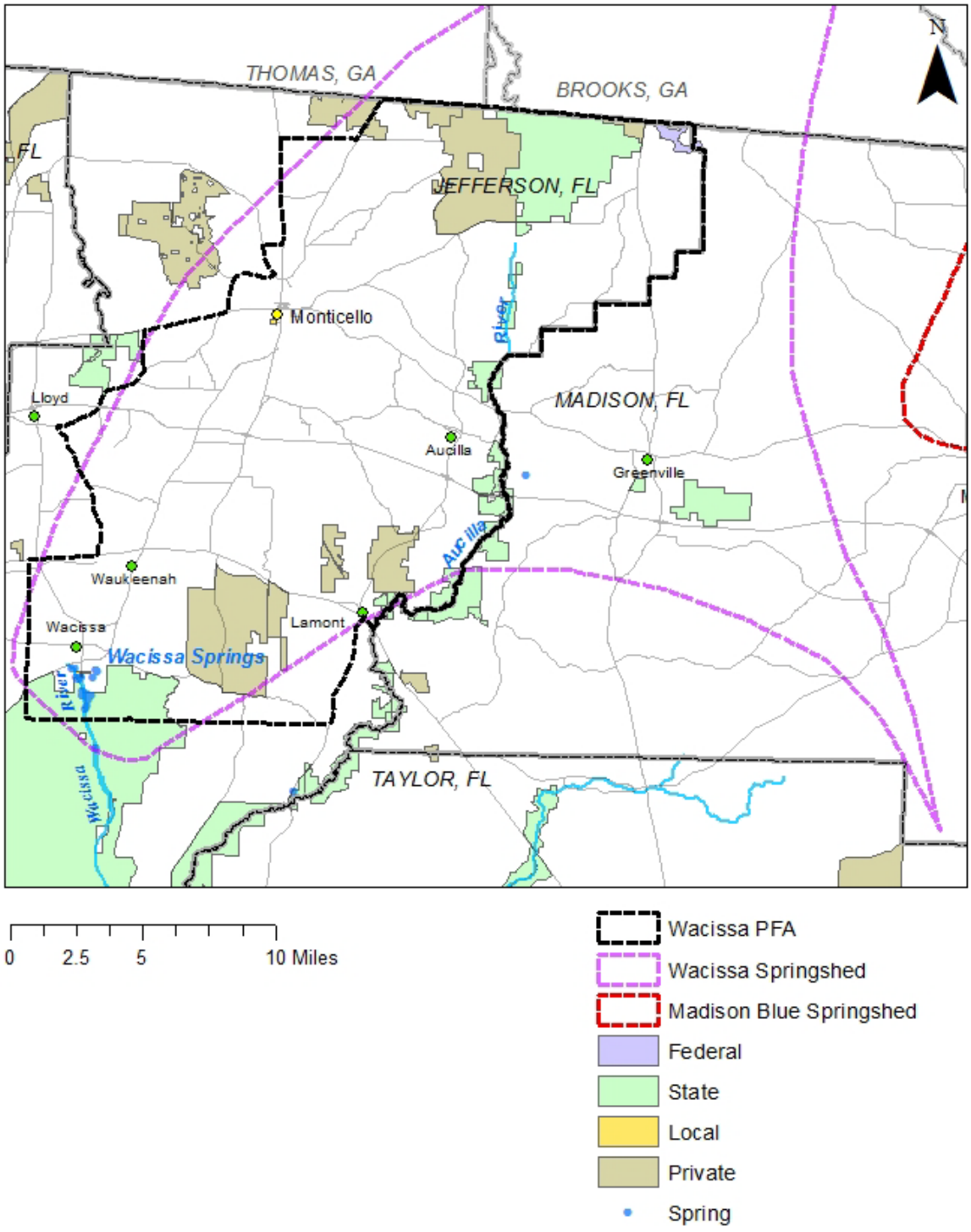

Figure 6. Florida conservation lands and PFA boundary

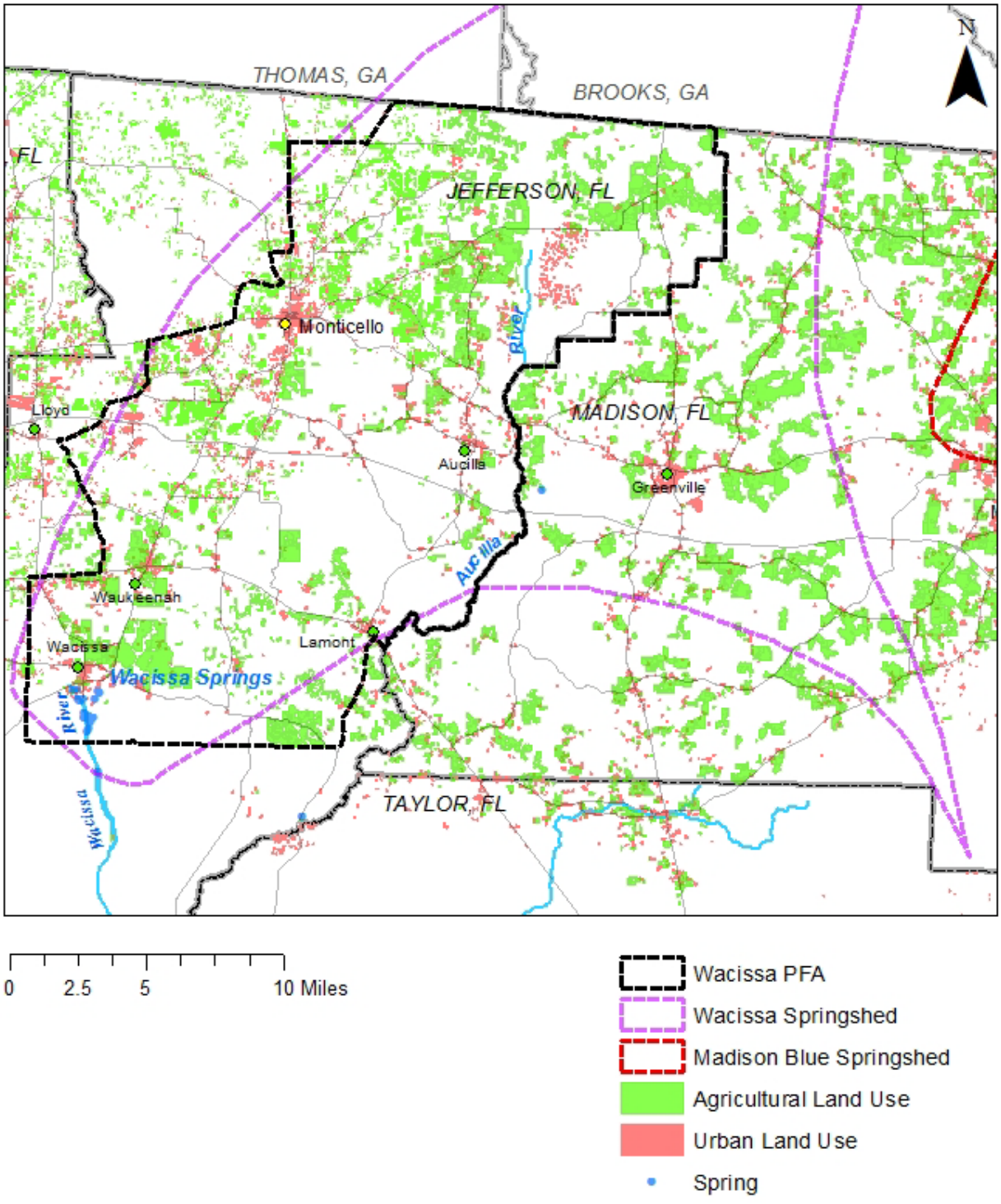

Figure 7. Urban and agricultural land use areas and PFA boundary

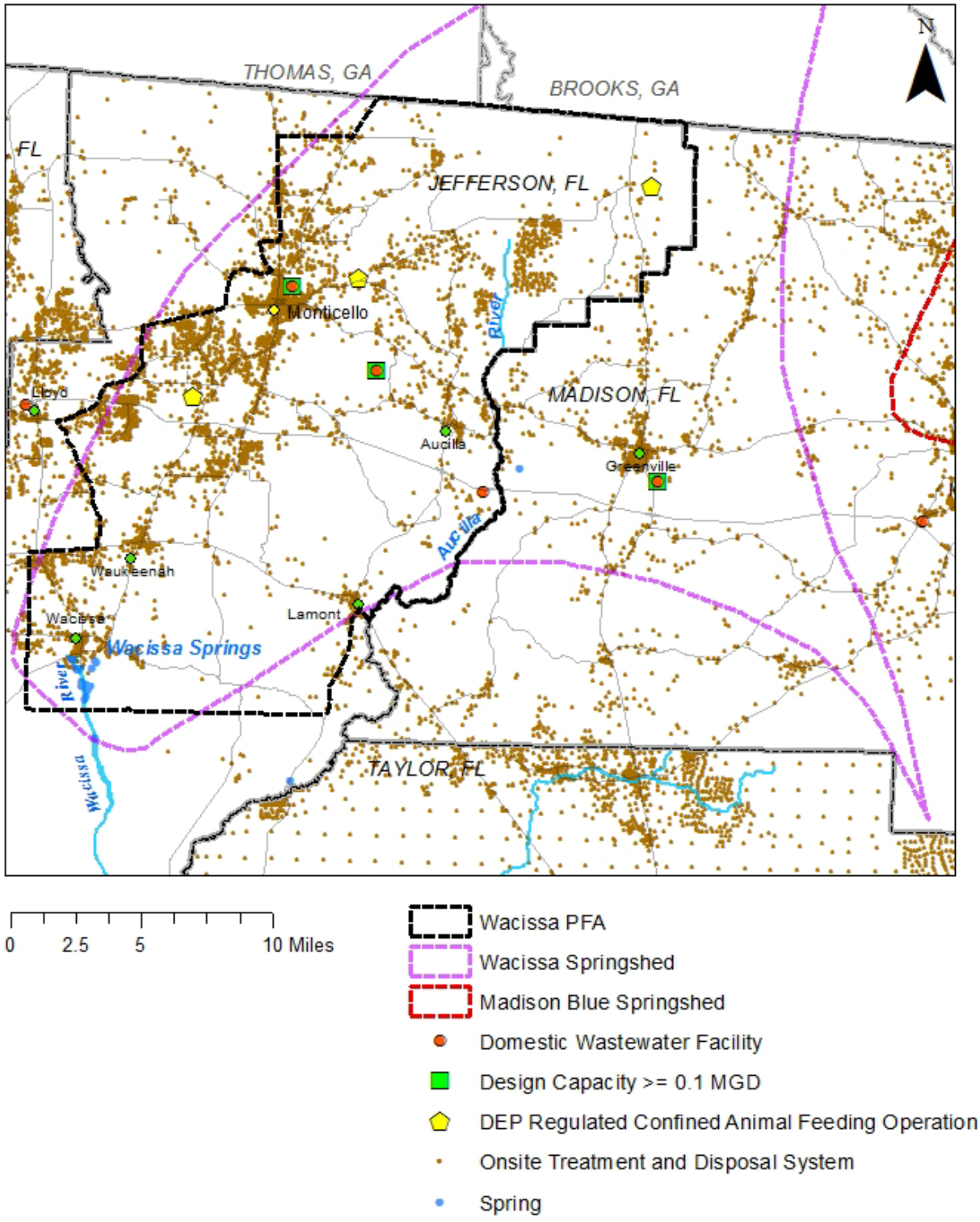

Figure 8. OSTDS, domestic wastewater treatment facilities (WWTFs), DEP-regulated confined animal feeding operations (CAFOs), and PFA boundary

DEP-regulated wastewater facilities can also be significant nutrient sources. Existing domestic wastewater facilities, including those with design flows greater than or equal to 0.1 million gallons per day (mgd), are shown in **Figure 7** because they too have the potential to contribute nitrogen to groundwater. Larger WWTFs include those at the City of Monticello, the Jefferson Correctional Institution, and the community of Greenville. The figure also includes the locations of DEP-regulated CAFOs, which in this area consist of large dairy operations. Three DEP-regulated CAFO dairies are located in the springshed. DEP-regulated wastewater facility and CAFO information for the springshed was obtained from the DEP Wastewater Facility Regulation (WAFR) Database.

Step 8. Create PFA boundaries that correspond with understood and identifiable boundaries. For stakeholders to implement restoration and protection actions, the PFA boundaries must be clearly defined and associated with features easily recognizable on a map. For that reason, the boundary of the Wacissa Springs PFA that will be used for planning and restoration was made to conform to easily recognizable natural features, roads, political boundaries, and major survey boundaries.

PFA Boundary for Wacissa Springs

The PFA boundary shown in **Figure 9** was developed by considering GIS coverages of recharge, vulnerability, soils, conservation lands, and information on potential nitrogen contaminant sources. The PFA is situated in Jefferson County, Florida, and includes a region extending west of the Aucilla River/Jefferson–Madison County line, south of the Florida–Georgia border and slightly east of the Jefferson–Leon County line. The southeastern and southern boundaries follow state survey lines east and south of the springs and the Jefferson–Taylor County line. The PFA includes the City of Madison; the communities of Wacissa, Waukeenah, Aucilla, and Lamont; and the Jefferson Correctional Institution. It also contains a segment of the Wacissa River that includes the springs, a portion of the Aucilla Wildlife Management Area, the western corridor along the Aucilla River, and several large conservation easements.

This area is characterized by higher groundwater recharge/vulnerability conditions and includes soil conditions that tend to leach nitrogen. It includes potential areas of nitrogen loading from agriculture and urban land uses, as well as an area where groundwater travel to the springs could occur rapidly. The PFA also includes areas of agricultural land use, urban development, OSTDS, domestic WWTFs, and CAFOs—all of which have the potential to contribute to nitrogen enrichment in the aquifer and springs.

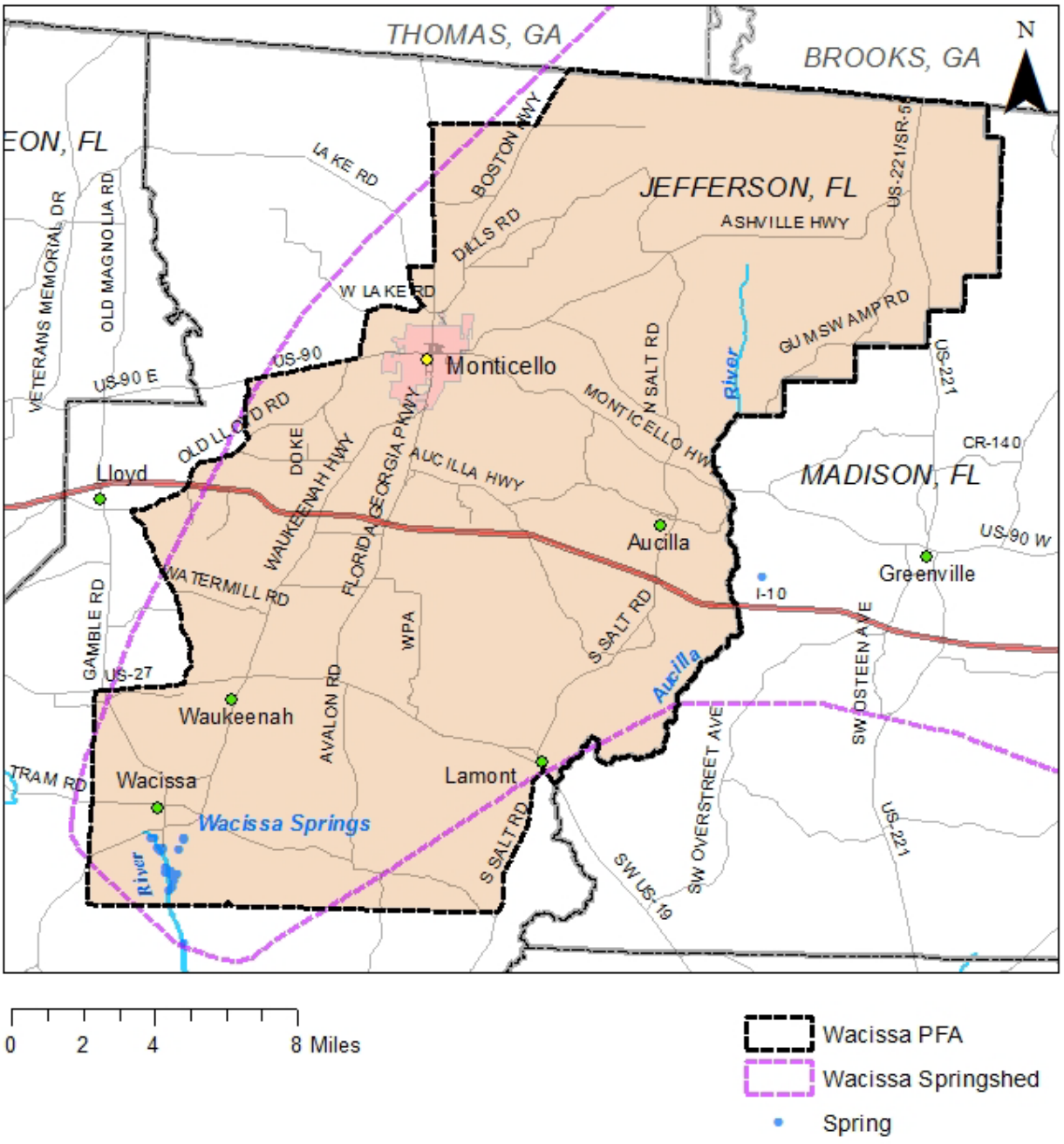

Figure 9. PFA boundary for Wacissa Springs

Appendix A: Important Links

Cover Page:
DEP website – www.dep.state.fl.us

More Information:
Email address for Terry Hansen – terry.hansen@dep.state.fl.us

Step 7:
Florida Department of Health (FDOH) Florida Water Management Inventory Project website – http://www.floridahealth.gov/environmental-health/onsite-sewage/research/flwmi/index.html

Footnotes:
Bridger et al. 2017 – http://publicfiles.dep.state.fl.us/DEAR/DEARweb/TMDL/Final_TMDL/gp1/WacissaTMDL_Final_052717.pdf

Florida USGS real-time water data website – https://fl.water.usgs.gov/

SSURGO Database metadata website – https://catalog.data.gov/dataset/soil-survey-geographic-ssurgo-database-for-various-soil-survey-areas-in-the-united-states-