REVISED DRAFT

Priority Focus Area for Troy, Peacock, Lafayette Blue and Falmouth 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 or DEP) 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:

- <u>Groundwater travel time to the spring</u>, which could be based on empirical data from tracer studies and/or predicted travel time from modeling, if such data or studies are available.
- <u>Hydrogeology</u>, 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.
- <u>Nutrient load to the spring</u>, 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.
- <u>Other factors</u>, 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.
- <u>Identifiable boundaries</u>, which include roads, natural boundaries, and political jurisdictions.

Delineation of the combined PFA for Troy, Peacock, Lafayette Blue, and Falmouth Springs (due to their proximity to one another and shared springshed areas) is described in the following section.

Steps in Delineating Troy-Peacock-Lafayette Blue-Falmouth PFA

The PFA for the Outstanding Florida Springs of the Middle Suwannee River Basin (Troy, Peacock, Lafayette Blue and Falmouth 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 these springs used for this evaluation was developed jointly by DEP and Suwannee River Water Management District (SRWMD) staff with input by the Florida Geological Survey (FGS). The combined springshed was based on flow path analysis of potentiometric surface contour maps developed by the U. S. Geological Survey (USGS) and FGS in cooperation with the water management districts. Flow pathways were compared for multiple dates to develop a contributing area accounting for seasonal variation in flow. In addition, results from dye traces and cave explorations documented by FGS and SRWMD contributed to the determination that one combined springshed was most appropriate for this area.[1] The combined Troy-Peacock-Lafayette Blue-Falmouth 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 area of high recharge shown in **Figure 2** is from a GIS coverage developed for a 2002 USGS model.[2] Unfortunately this modeled area does not include the eastern edge of the springshed.

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[1] Greenhalgh, T., Kuersteiner, K., and White, K. February 2016. Middle Suwanee Basin Spring Recharge Area Delineation Project, Suwannee and Lafayette Counties, Florida, July 2014-November 2015. Florida Geological Survey report prepared for Suwannee River Water Management District under MOA 13/14-201.

[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.

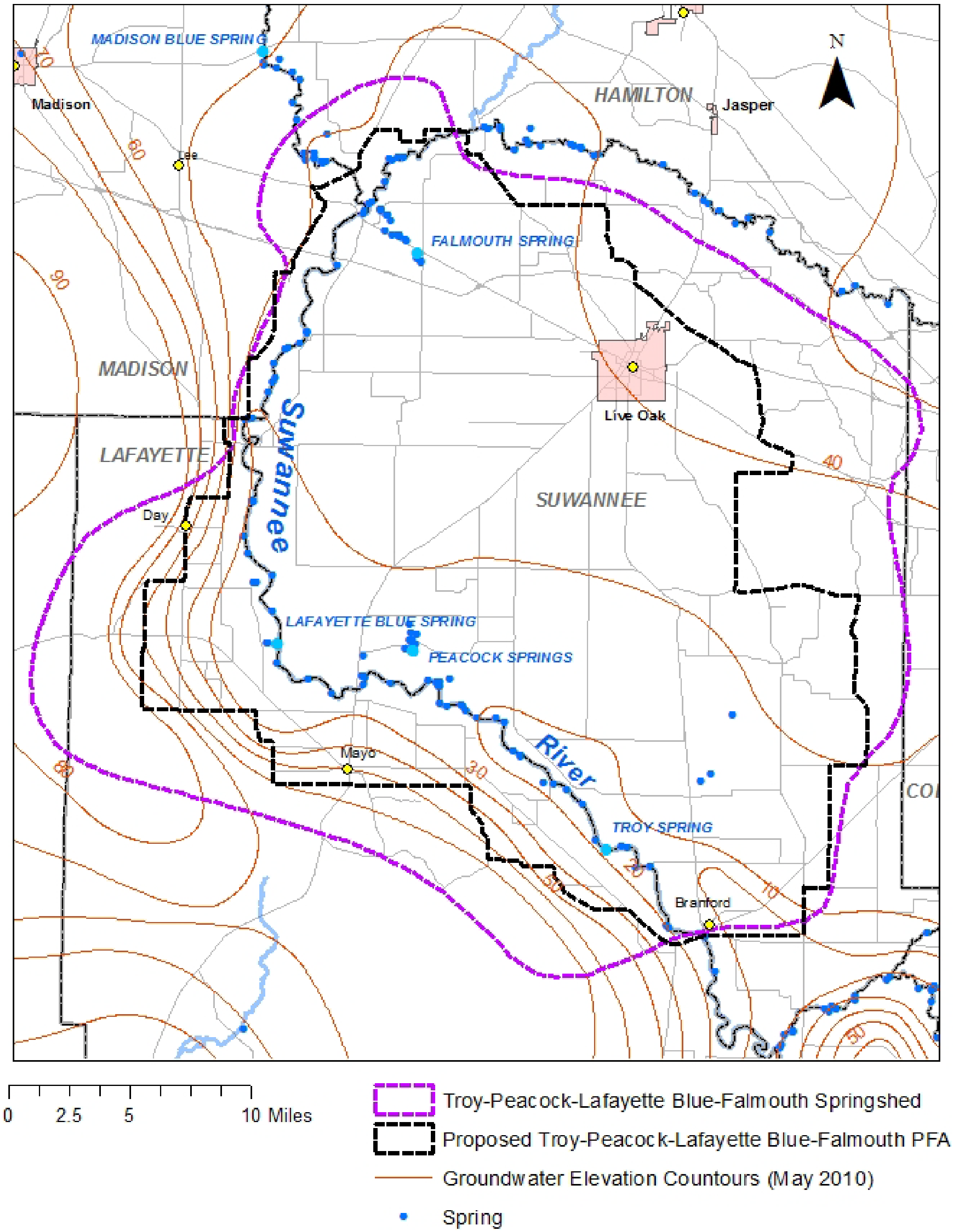

Figure 1. Combined Troy-Peacock-Lafayette Blue-Falmouth Springs springshed, proposed priority focus area, and groundwater elevation contours

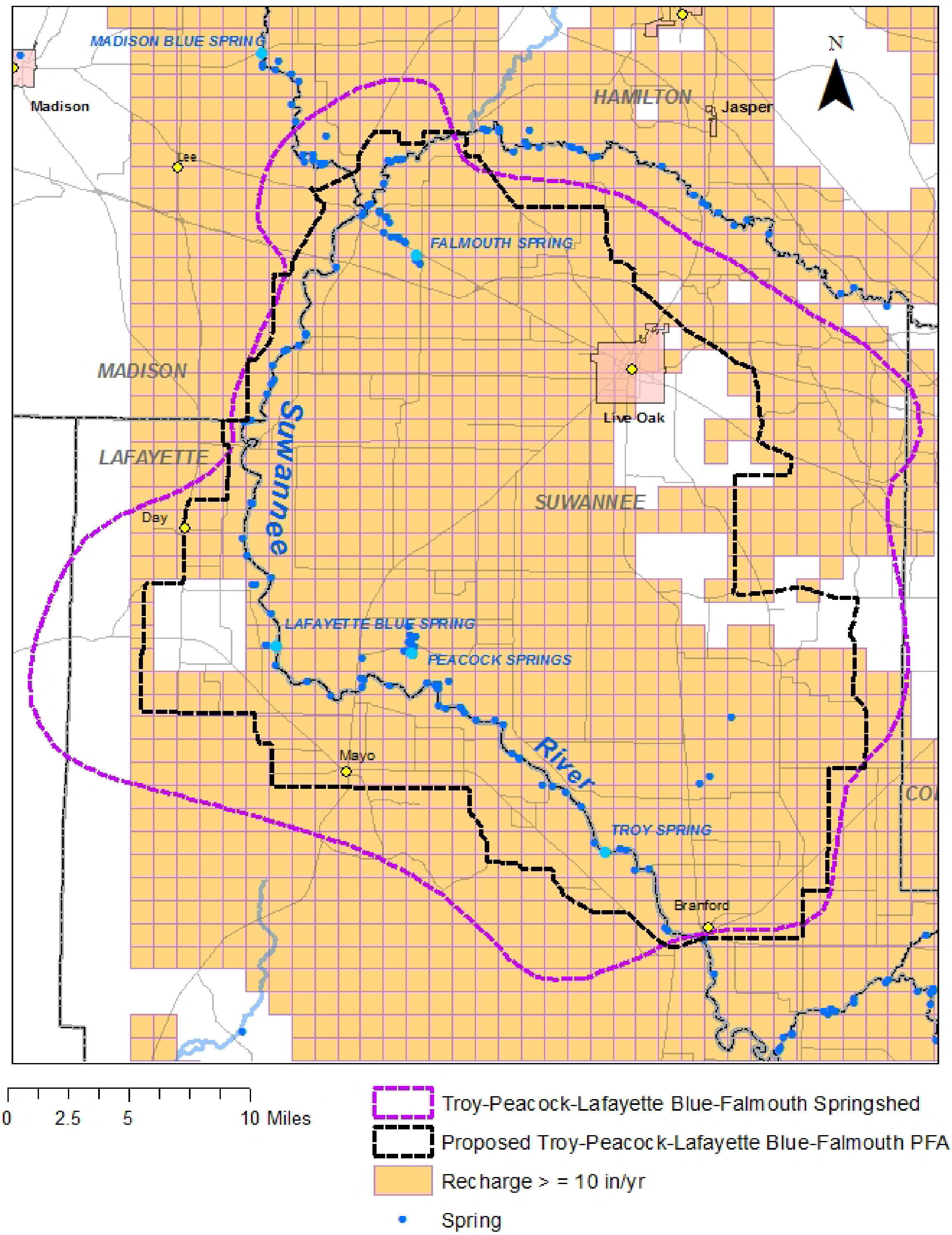

Figure 2. Areas of high recharge to Floridan aquifer (≥10 inches/year) based on USGS 2002 methodology in Troy-Peacock-Lafayette Blue-Falmouth Springs area

Step 3. Identify regions within the springshed where the Floridan Aquifer is most vulnerable. The FGS developed the Florida Aquifer Vulnerability Assessment (FAVA) model to provide a spatial coverage of aquifer vulnerability ranges across an area.[3] According to the statewide FAVA model for the Floridan aquifer system, most of the combined springshed of Troy, Peacock, Lafayette Blue and Falmouth Springs lies within the "more vulnerable" category except for an area in the eastern part which is identified as "vulnerable" (**Figure 3**). 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) that 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 and 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, shown in the coverage, can have associated subterranean conduit networks. Some sink features, known as "swallets" provide a direct conduit for surface water discharge into the aquifer. Swallets are sinkholes that capture stream flow. The FGS completed a project to map all known swallets in the state and produced a GIS layer that includes their locations. The DEM map (2009) and swallets in the Troy-Peacock-Lafayette Blue-Falmouth Springs region are shown in **Figure 4**.

Step 4. Consider nitrogen load. Nitrate-nitrogen is 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. Excess concentrations of nitrate nitrogen in the spring water have contributed to excessive growth of algae in the Suwannee River and these springs. The source of flow from most springs in Florida is groundwater from the Floridan aquifer system. This groundwater comes mainly from local precipitation that recharges the aquifer in the springshed area. The nitrate originates from atmospheric deposition and anthropogenic sources in the combined springshed. Recent nitrate concentrations based on 1/16/2017 readings from nitrate sensors in Falmouth, Lafayette Blue, Peacock, and Troy Springs were 1.14, 2.86, 2.77, and 2.19 milligrams per liter (mg/L), respectively (and provisionally). These concentrations are between 3 to 8 times greater, roughly, than Florida's numeric nitrate criterion for spring vents (0.35 mg/L). The load of nitrogen from these four springs depends on concentration and flow. Using the 1/16/2017 nitrate concentrations from the real-time monitoring stations and the latest measured flows at each of these springs of 38.2 cubic feet per second (cfs) 61.2 cfs, 2.4 cfs, and 142 cfs, respectively, estimated daily loads of nitrate nitrogen for the four springs were 235, 944, 36 and 1,677 pounds of nitrogen per day, respectively. Using these data, an estimated total nitrogen load (as nitrate) from the four springs combined would be about 1.05 million pounds per year (lb/yr).

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[3] 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.

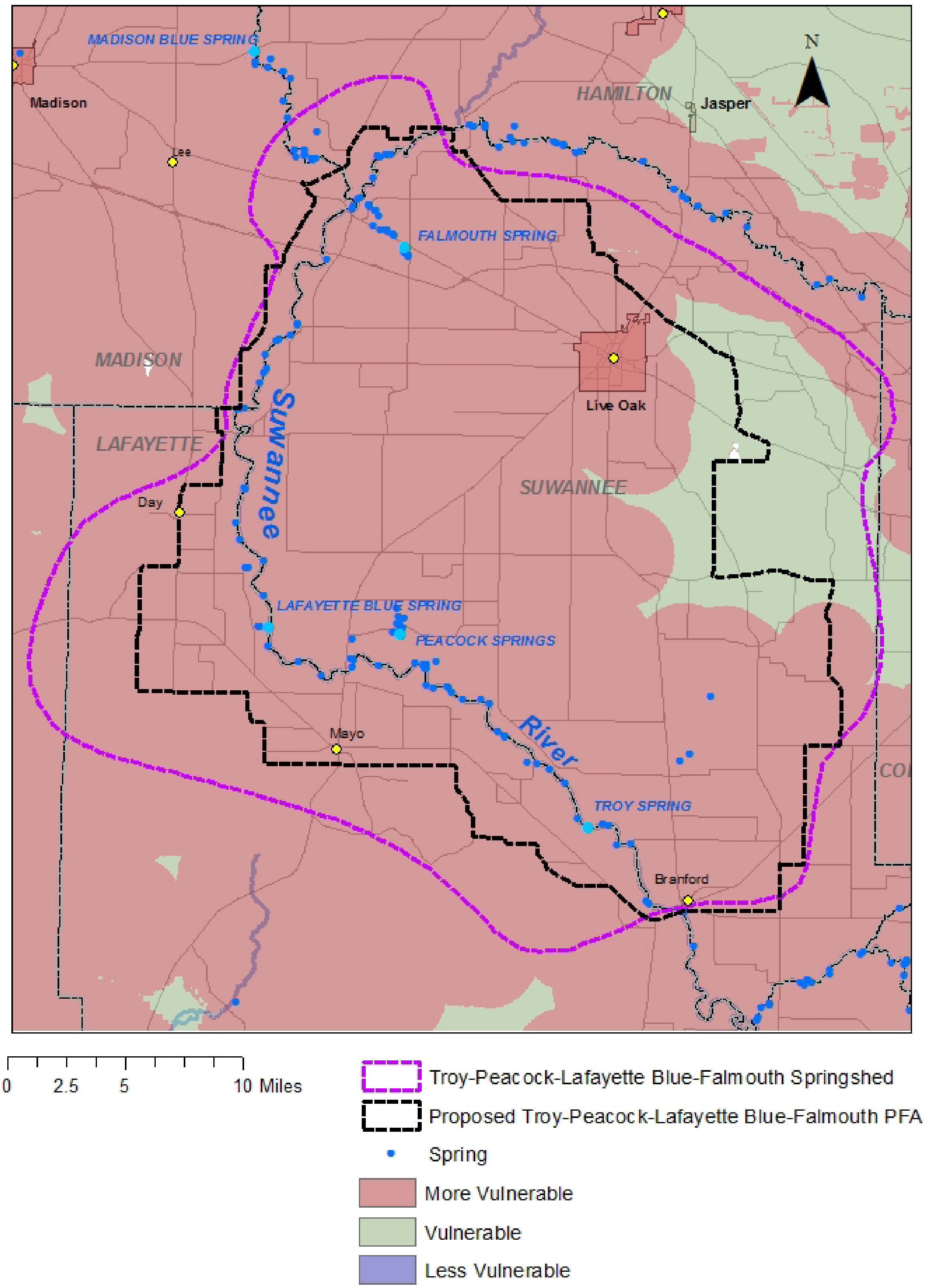

Figure 3. Floridan aquifer vulnerability based on the statewide Florida Aquifer Vulnerability Assessment in Troy-Peacock-Lafayette Blue-Falmouth Springs area

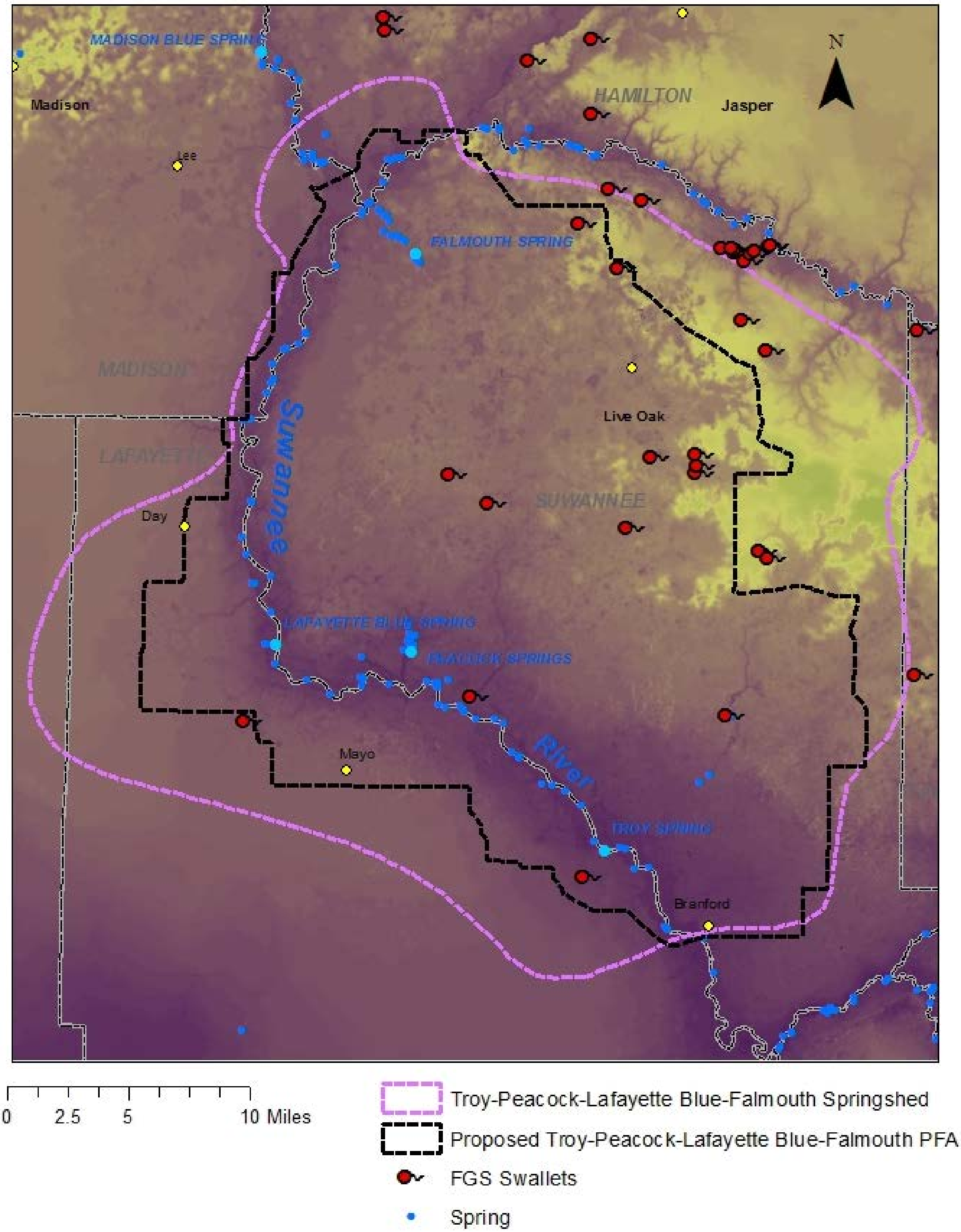

Figure 4. Digital elevation model and FGS swallets in Troy-Peacock-Lafayette Blue-Falmouth Springs area

DEP is developing a nitrogen source inventory for the Troy-Peacock-Lafayette Blue-Fallmouth Springs contributing area to serve as a tool for developing remediation strategies and projects for reducing nitrogen loads to the springs. Typical sources of nitrogen in spring contributing areas include inorganic fertilizer, livestock waste, onsite treatment and disposal systems (OSTDS or septic systems), treated domestic wastewater, and atmospheric deposition. The draft inventory shows that the main sources of nitrogen loading to the groundwater in the Troy-Peacock-Lafayette Blue-Falmouth Springs springshed are agricultural fertilizer and livestock waste from dairies.

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 Troy-Peacock-Lafayette Blue Springs springshed includes areas of dynamic flow potential where infiltrating water has caused dissolution and creation of sinkholes, pipes and conduits in the limestone matrix and areas where the limestone might be semi-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 within intergranular pore spaces in the limestone and is slower. However, in areas where development of conduits has been extensive the rate of groundwater movement can be very rapid.

As referenced previously, in 2014-2015, the FGS conducted dye traces to evaluate rate of groundwater flow and connectivity between springs in the system. In a trace originating at Falmouth Spring, dye was transported 2.6 to 2.8 miles westward to be detected at 4 springs along the Suwannee River at rates of 3,328 to 9,776 feet per day. To the south, a dye introduced into karst features along the Little River Trace was transported more than 10 miles southwestward to Troy, Mearson and Little River Springs along the Suwannee River, at rates ranging from 2,225 to 3,825 feet per day. Both dye traces confirmed that groundwater transport is rapid, multiple springs share common recharge areas, and that the Suwannee River does not form a flow boundary because contributing areas to individual springs include both sides of the river. Considering that development of karst solution features is common throughout much of the springshed, it is safe to assume that groundwater transport to the springs is very rapid from many points in the springshed and that recharge areas are shared. Development of these features is prevalent along the Suwannee River and may be more extensive in the areas of locally greater recharge.

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 nitrogen removal in the soil zone through denitrification and its tendency to leach can be related to soil drainage class.[4] 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 areas where soils 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 Resources Conservation Service soil survey geographic (SSURGO) database for Florida.[5] These excessively to well drained soils tend to occur in areas where aquifer recharge is highest and vulnerability is greatest. **Figure 5** shows the area where soil conditions are most favorable for nitrogen leaching, which includes soils in the excessively drained, somewhat excessively drained and well drained SSURGO drainage classes. The figure also shows areas of moderately well drained soils where leaching of nitrogen could also be significant.

<u>Step 7. Identify regions within the contributing area to exclude or include based on land use and potential for pollutant sources to occur</u>. Conservation lands, wetlands, and undeveloped open land that are protected from development are land areas that 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. However, most of the conservation land area in the Troy-Peacock-Lafayette Blue-Falmouth Springs springshed includes SRWMD-managed lands and privately owned conservation easements along the Suwannee River corridor that should reasonably be included in the PFA as a protection measure. In addition to the district-managed lands, publicly owned conservation lands within the proposed PFA include Troy Springs State Park, Peacock Springs State Park, Lafayette Blue Spring State Park, and Suwannee River State Park. Conservation lands from the Florida Natural Areas Inventory Conservation Lands (FNAI Managed Areas) GIS layer are shown in **Figure 6**.

The Troy-Peacock-Lafayette Blue-Falmouth Springs springshed includes a large aggregate area in agricultural land uses and scattered areas of urban land use. 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 that can contribute significant nitrogen inputs. Urban lands can include higher densities of OSTDS, domestic wastewater and urban fertilizer use, all of which can be sources of nitrogen to the aquifer and springs. Mapped urban and agricultural lands (based on the 2013-2014 SRWMD land use-land cover GIS coverage) are shown in **Figure 7.**

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[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 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.

[5] 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-

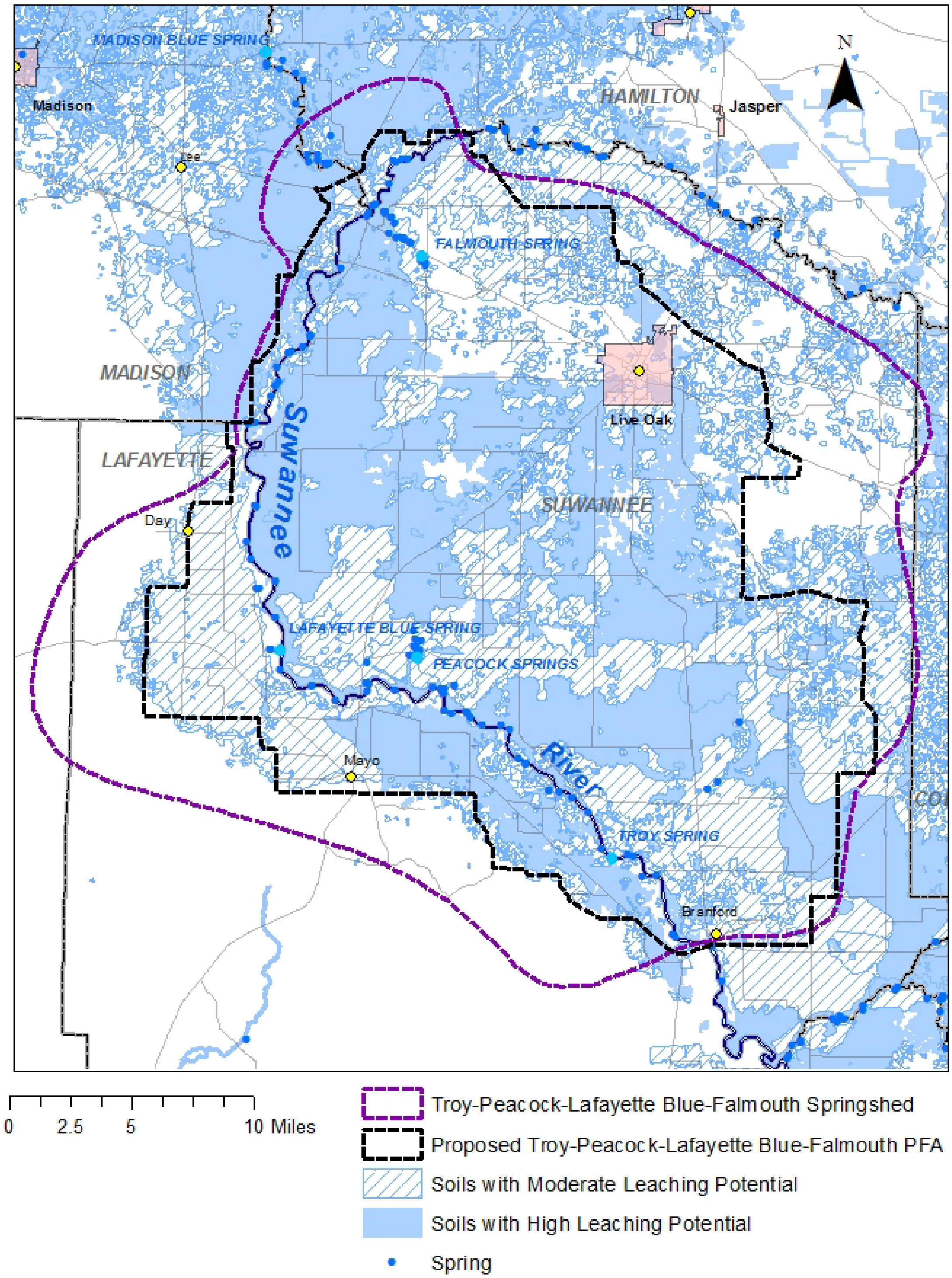

Figure 5. Areas of high nitrogen leaching potential soils in Troy-Peacock-Lafayette Blue-Falmouth Springs area

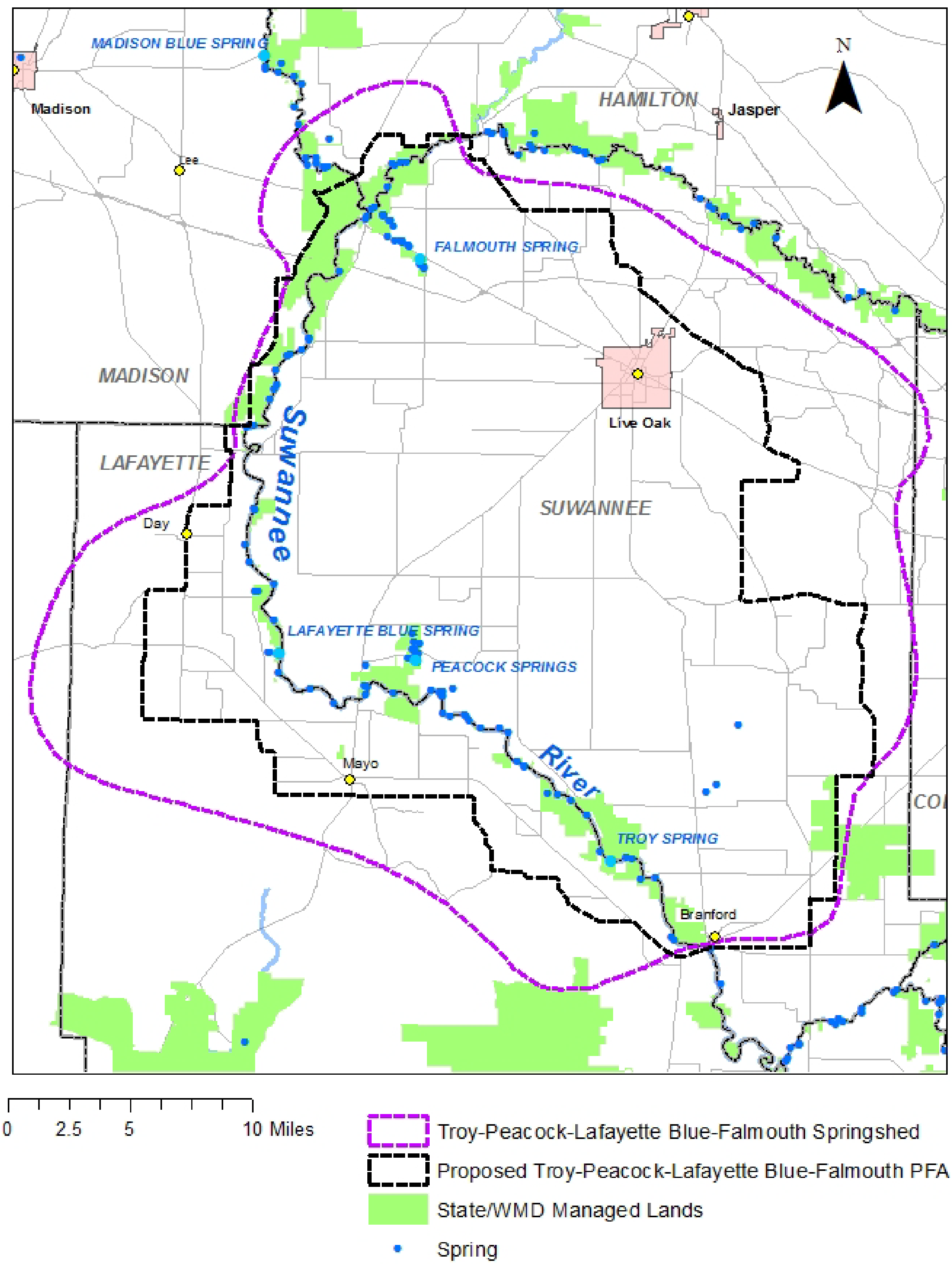

Figure 6. Conservation lands and proposed priority focus area

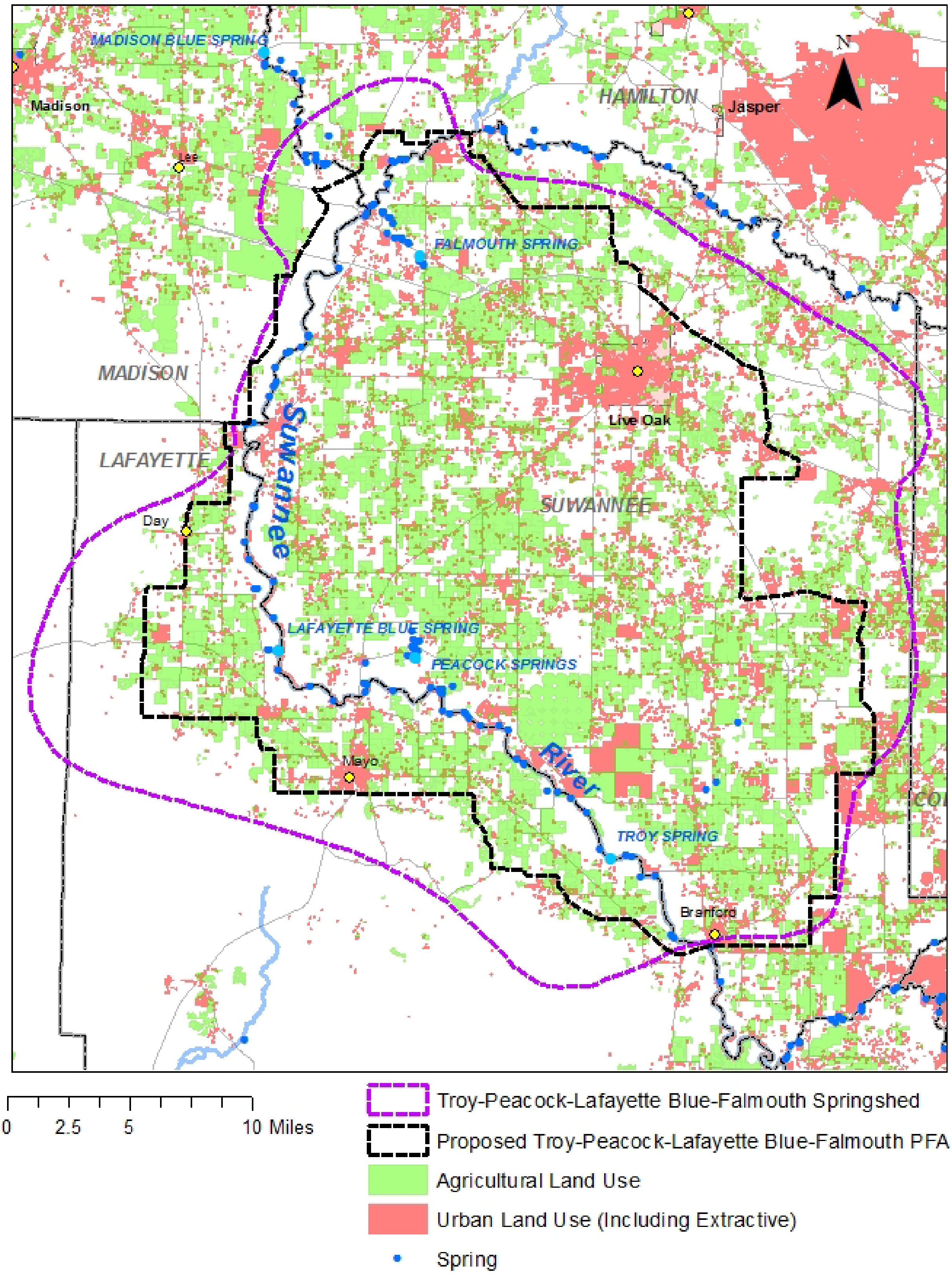

Figure 7. Urban and agricultural land use areas and proposed priority focus area

Onsite treatment and disposal systems can be potentially significant sources of nutrients to be considered when delineating the PFA. OSTDS in the area are shown in **Figure 8**. 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).

DEP-regulated wastewater facilities can also be significant nutrient sources to be considered. Existing domestic wastewater facilities, including large ones with design flows greater than or equal to 0.1 million gallons per day (mgd), are shown in **Figure 8** because they also have potential for contributing nitrogen to groundwater. The figure also includes locations of department-regulated confined animal feeding operations (CAFO), which in this area include several large dairy operations and one beef cattle operations. These facilities can also have significant inputs of nitrogen. DEP regulated 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 in the PFAs, the boundaries must be clearly defined and associated with features easily recognizable on a map. For that reason, the proposed boundary of the Troy-Peacock-Lafayette Blue-Falmouth Springs PFA was made to conform to easily recognizable natural features, roads, political boundaries, and major survey boundaries.

PFA Boundary for Fanning and Manatee Springs

The PFA boundary shown in **Figure 9** was developed by considering GIS coverages of recharge, vulnerability, soils, conservation lands, and potential contaminant nitrogen source information. The PFA includes a region including most of the combined springshed. This area includes high groundwater recharge/vulnerability conditions and soil conditions that tend to leach nitrogen. It includes potential areas of higher nitrogen loading from agriculture and urban land uses. It also includes an area within the springshed over which groundwater travel to the springs could occur rapidly. In addition, the PFA also includes interconnected areas of agricultural land use, urban development, areas of OSTDS, domestic wastewater facilities, and CAFOs which all have potential to contribute to nitrogen enrichment in the aquifer and springs.

The proposed PFA is mainly in Suwannee County with smaller portions in Lafayette, Madison, and Hamilton Counties. It includes the city of Live Oak, portions of the towns of Branford and Mayo, and part of the community of Day. The proposed PFA also includes Troy Spring State Park, Peacock Springs State Park, Lafayette Blue Spring State Park, Suwannee River State Park, and a corridor along the Suwannee River of SRWMD managed state land and conservation easements. Conservation land boundaries, natural features, political boundaries, roads, and survey boundaries in the area were all considered in the development of a readily identifiable PFA boundary.

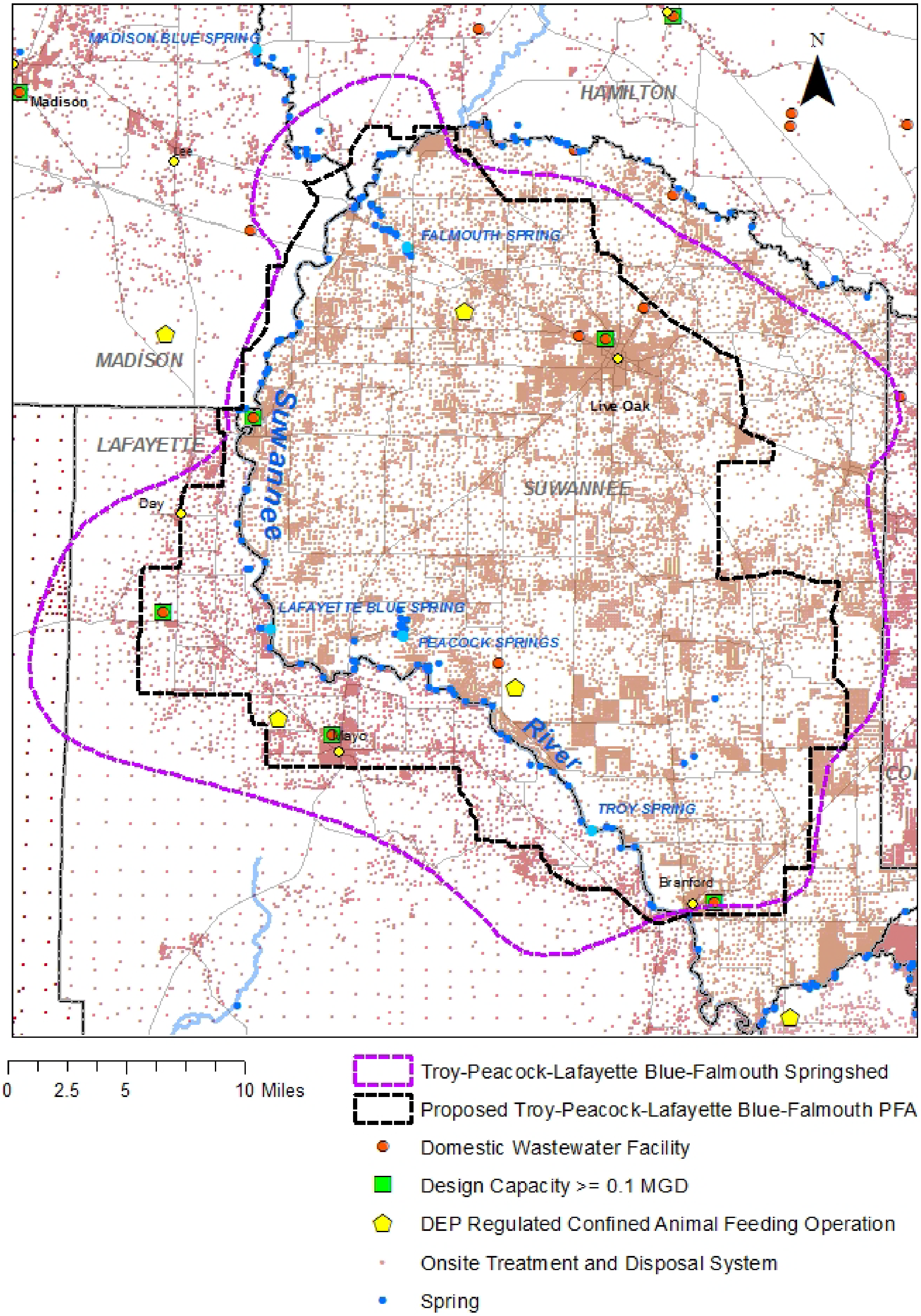

Figure 8. Onsite treatment and disposal systems, domestic wastewater treatment facilities, DEP regulated animal feeding operations, and proposed priority focus area

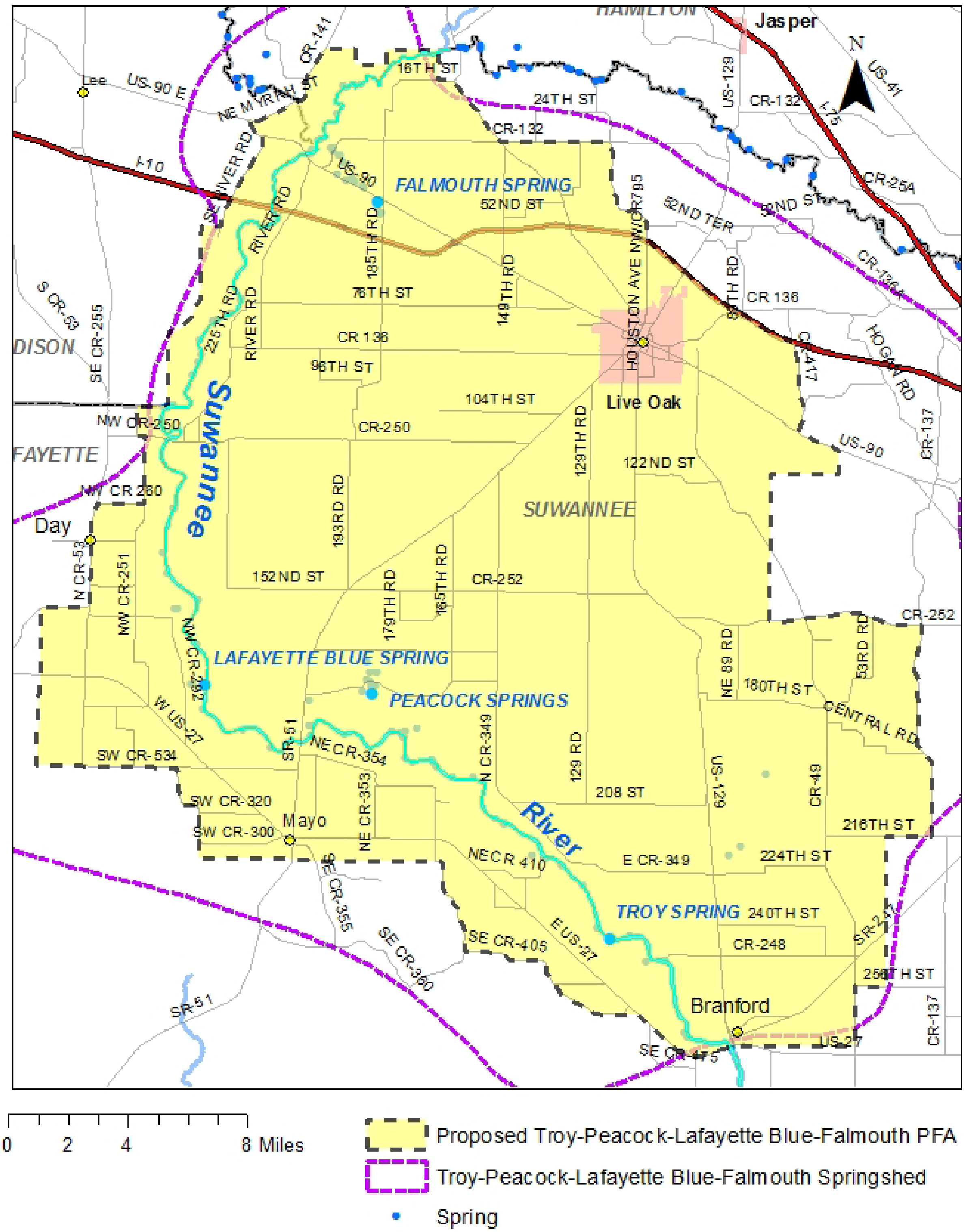

Figure 9. Proposed PFA boundary for Troy, Peacock, Lafayette Blue, and Falmouth Springs