REVISED DRAFT

Priority Focus Area for Homosassa and Chassahowitzka Spring Groups

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 springs, 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 springs, 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 a common PFA for both the Chassahowitzka and Homosassa Spring Groups, which have been documented as impaired by nitrate nitrogen, is described in the following section.

Steps in Delineating Homosassa and Chassahowitzka Springs PFA

The department determined that due to the proximity of the Homosassa and Chassahowitzka Spring Groups to one another and their adjacent and most likely shared groundwater contributing areas, that it would be difficult and unsupportable to create distinct PFAs for each spring group. Instead, a common PFA was delineated to include a priority restoration area for both spring groups. The PFA for the Homosassa and Chassahowitzka Spring Groups was developed using geographic information system (GIS) tools, spring-specific data, and published information to help identify the portion of the combined spring 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 area for the priority spring(s). The estimated springsheds for the Homosassa and Chassahowitzka Spring Groups were developed by the Southwest Florida Water Management District (SWFWMD) based on U. S. Geological Survey (USGS) potentiometric surface contour maps. These springsheds and the proposed PFA for both spring groups are shown in **Figure 1**.

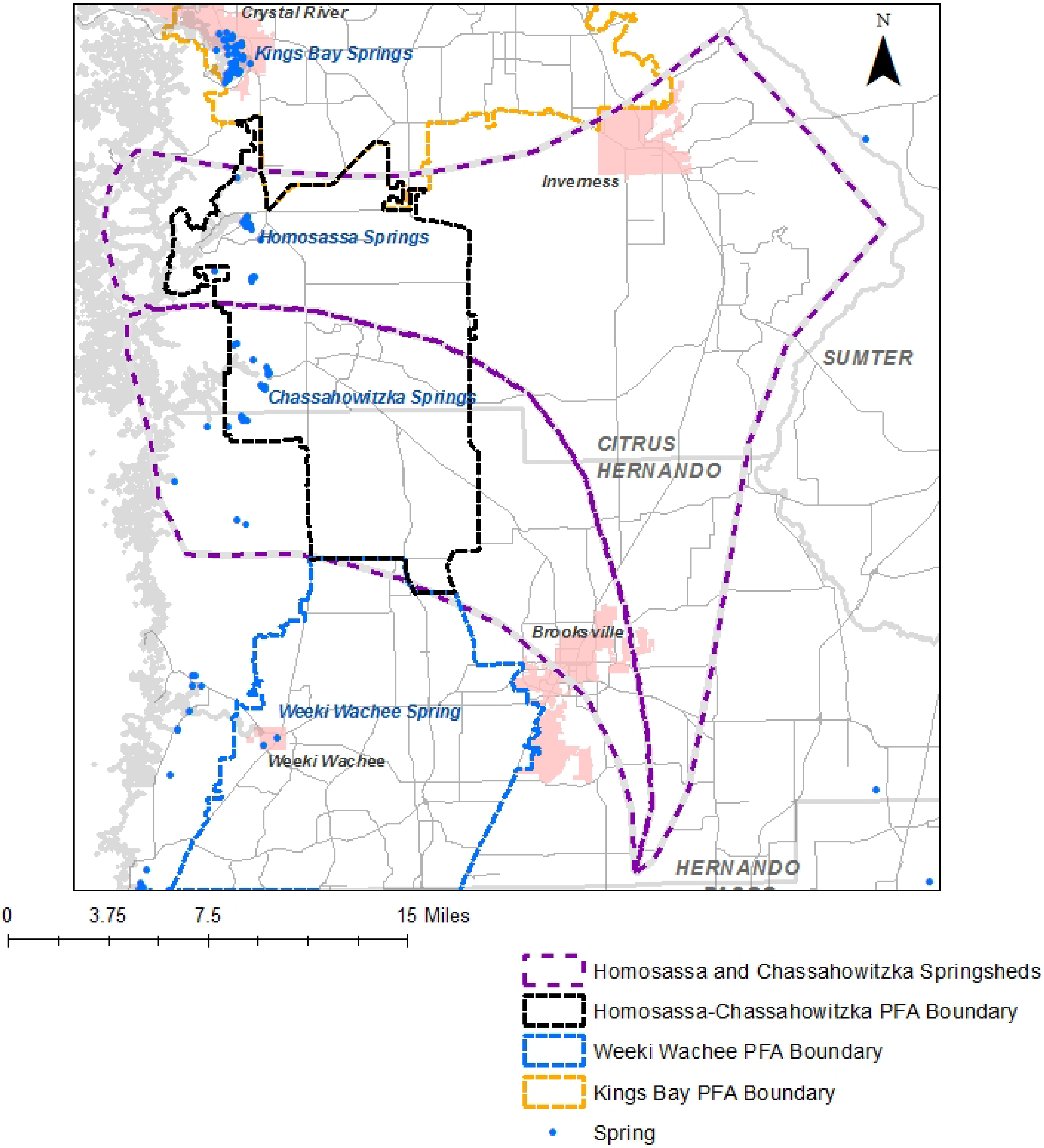

Figure 1. Springsheds for Homosassa and Chassahowitzka Spring Groups and proposed priority focus area

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 uniform 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 or greater as shown on a GIS coverage developed by SWFWMD in 2002 from a USGS numerical model.[1] **Figure 2** shows the area of greatest recharge (≥10 inches per year) based on the USGS methodology. To help further refine the recharge regime for priority setting, another recharge map, which was developed by the Florida Natural Areas Inventory (FNAI) for state land acquisition priority ranking, was also considered. This layer 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 in proximity to public water supply wells.[2] The FNAI recharge coverage is shown in **Figure 3**.

Step 3. Identify regions within the springsheds where the Floridan Aquifer is most vulnerable. There is not a county-scale aquifer vulnerability assessment that covers both Citrus and Hernando Counties, so the statewide Florida Aquifer Vulnerability Assessment (FAVA) model for the Floridan Aquifer was used to map aquifer vulnerability in the springsheds of the Homosassa and Chassahowitzka Spring Groups (**Figure 4**). Higher vulnerability areas exist where the upper Floridan Aquifer is unconfined or semiconfined, and/or where there is a strong vertical gradient and potential for water to move vertically from the surficial aquifer to the underlying Floridan Aquifer. This modeling tool was developed by the Florida Geological Survey to provide a spatial coverage of aquifer vulnerability ranges across an area.[3] In general, areas of greatest aquifer vulnerability occur where aquifer recharge is also greatest. The statewide FAVA model shows that almost the entire area covered by both springsheds falls within the "more vulnerable" category, although it includes only a limited amount of local data for calibration.

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[1] GIS data layer representing the results of a numerical model used to simulate the regional groundwater flow system in peninsular Florida. Obtained by SWFWMD from USGS in 2002.

[2] Florida Natural Areas Inventory, December 2000. Florida Forever Conservation Needs Assessment Summary Report to the Florida Forever Advisory Council.

[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.

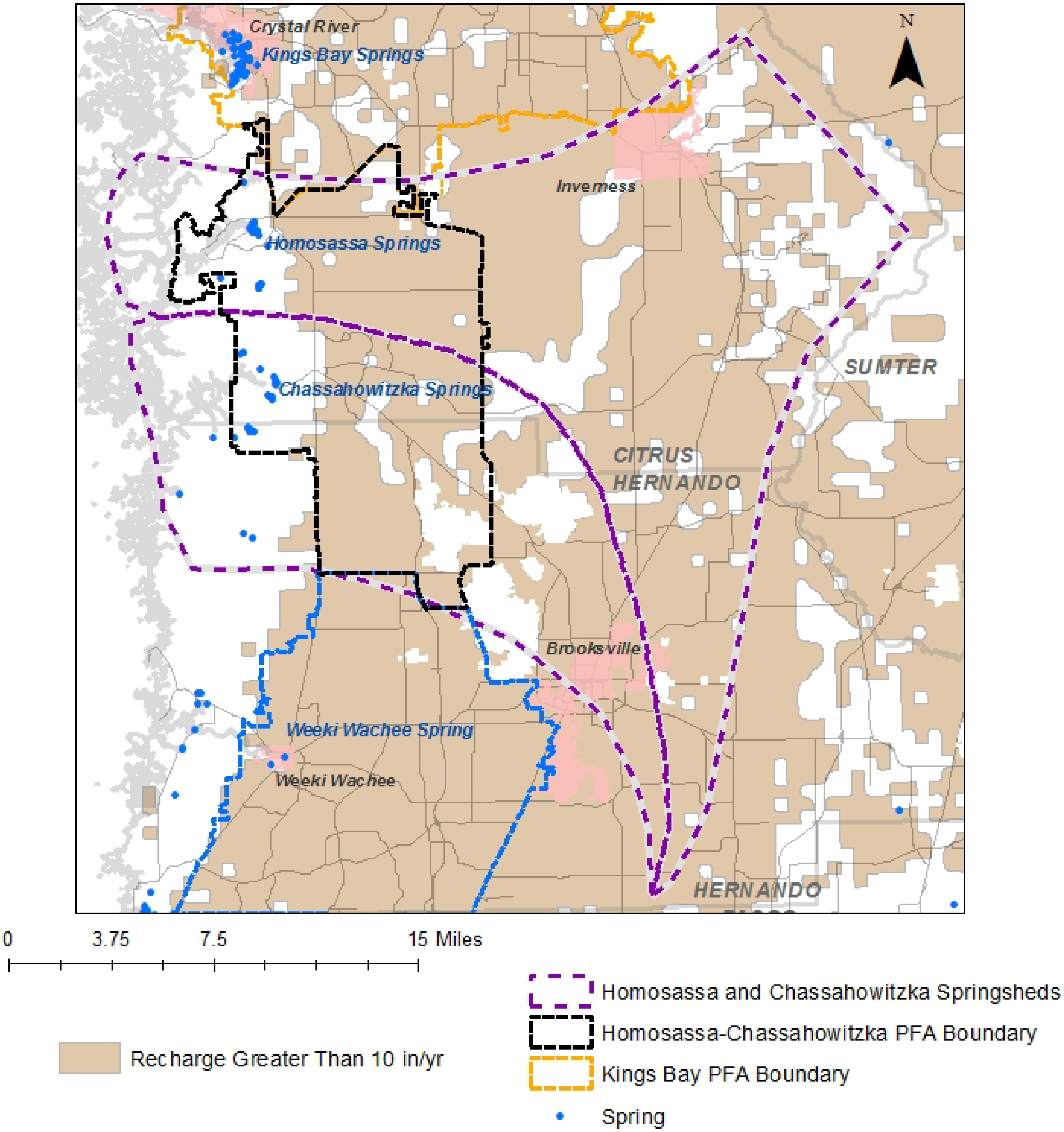

Figure 2. Areas of high recharge to Floridan aquifer (≥10 inches/year) based on USGS model and proposed priority focus area

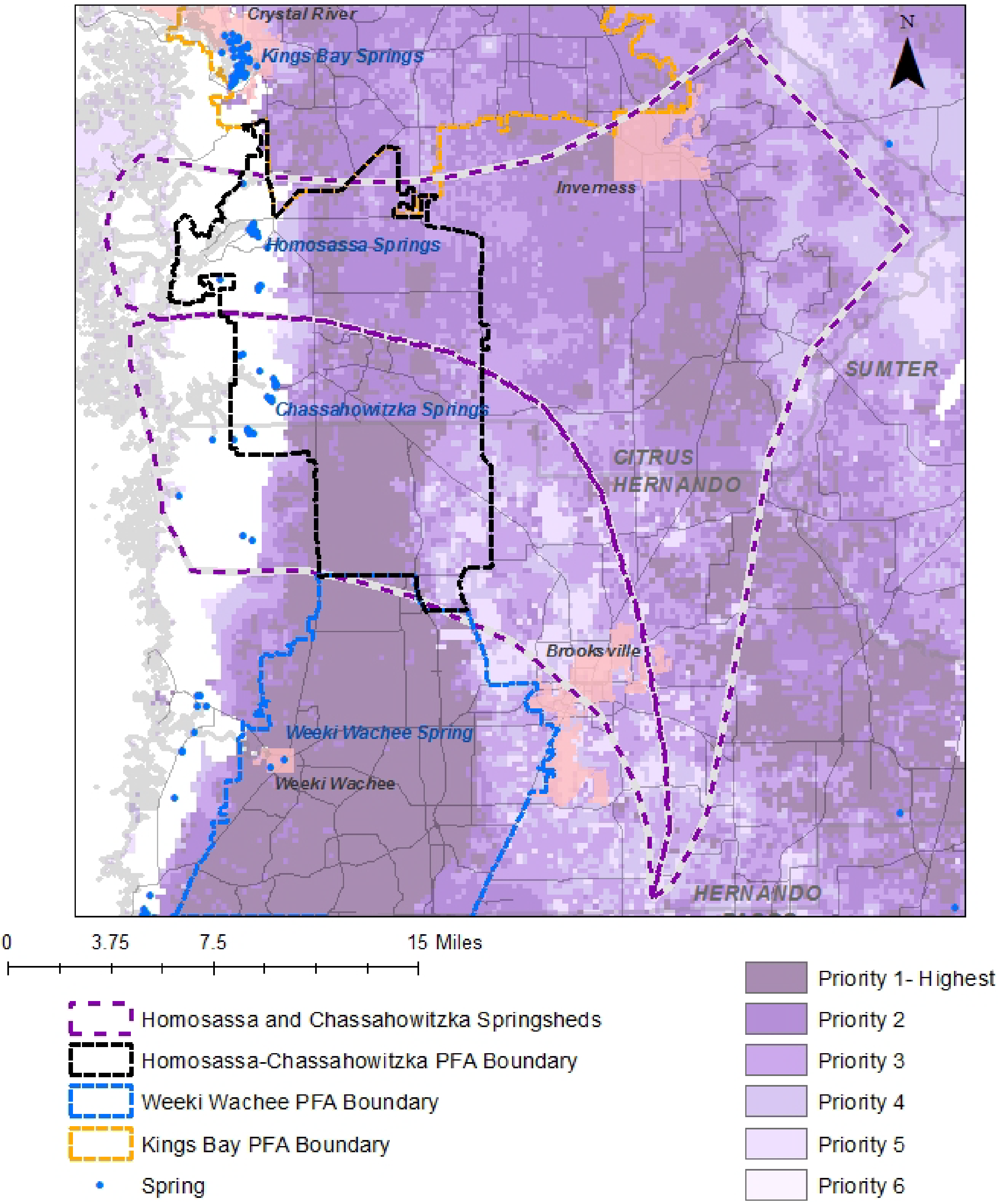

Figure 3 Florida state lands recharge-based prioritization coverage and proposed priority focus area (highest priority areas are areas of highest recharge)

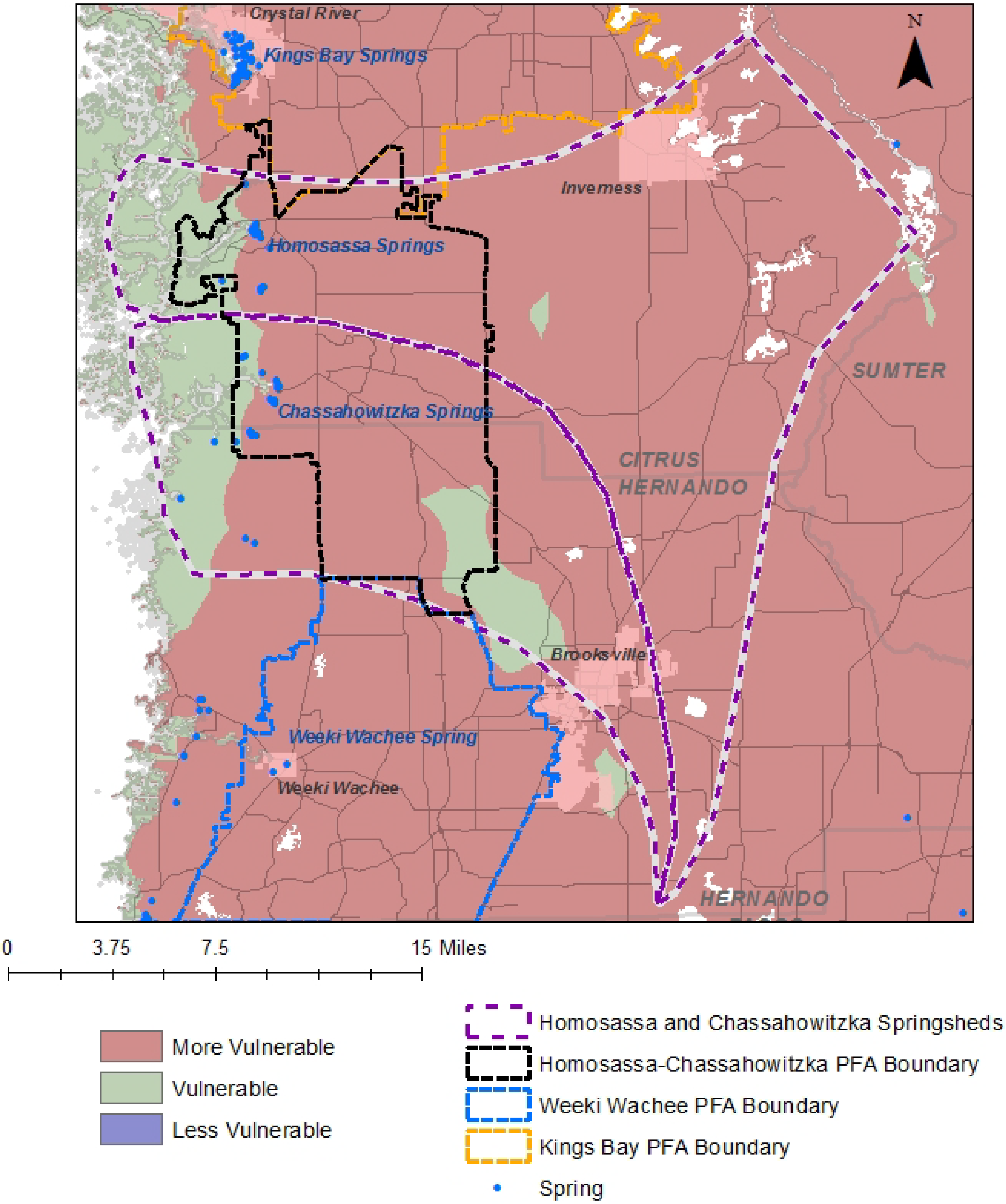

Figure 4. Statewide aquifer vulnerability assessment based on FAVA model and proposed priority focus area

Step 4. Consider nitrogen load. Major spring vents of the Homosassa and Chassahowitzka Spring Groups, which have been monitored on a routine basis by SWFWMD for many years, were listed by the department as impaired by nitrate-nitrogen. In addition, a segment of the Chassahowitzka River was also listed as impaired by nitrate. In 2014, water quality restoration targets known as total maximum daily loads (TMDL) were adopted for nitrate in these springs and the river. The TMDL reports can be found at the following links:

http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp5/Homosassa-nutr-TMDL.pdf

http://www.dep.state.fl.us/water/tmdl/docs/tmdls/final/gp5/Chassahowitzka-nutr-tmdl.pdf

The TMDL reports document mean nitrate concentrations in the Homosassa Springs main vent (Homosassa #1) and the Chassahowitzka Springs main vent (Chassahowitzka Main) of 0.60 and 0.56 milligrams per liter, respectively, with increasing trends noted. The load of nitrogen from spring systems depends on concentration and flow. Based on 2014 average stream flow for the Homosassa and Chassahowitzka Rivers and the mean nitrate concentrations for the main springs contributing to them, estimated loads for Homosassa Springs and Chassahowitzka Springs were approximately 200,000 and 100,000 pounds of nitrogen per year (lb-N/yr), respectively.

The draft nitrogen inventories developed in 2016 by the department for the Homosassa and Chassahowitzka Group springsheds show that during recent years, the estimated loads of nitrogen to the ground water in the springsheds were estimated at 580,000 lb-N/yr and 380,000 lb-N/yr, respectively.[4] According to the inventories for both, more than 90 percent of the nitrogen load to ground water occurred in the high recharge area shown in **Figure 2**. The draft inventory for the Homosassa Springs Group springshed showed that the most significant sources of nitrogen were sports turf fertilizer (which includes golf courses and athletic fields), livestock waste, farm fertilizer, and onsite treatment and disposal systems (septic tanks). The draft inventory for the Chassahowitzka Springs Group springshed showed that farm fertilizer, sports turf fertilizer, atmospheric deposition and septic systems were most significant. The urban areas with potential nitrogen loading from septic tanks and sports turf fertilizer use and the agricultural areas with potential fertilizer and livestock waste loading were considered in delineation of the PFA.

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 these areas, groundwater can move rapidly from points where the water enters the aquifer to the spring vents. In some Outstanding Florida Spring areas, dye traces have been conducted by researchers to measure the travel times and information from these studies can be incorporated into the PFA development. In some other areas, models have been used to estimate travel times and define protection zones and can also be used to help

[4] Eller, K., Katz, B,a nd Lyon, C.. 2016. Nitrogen Source Inventory and Loading Estimates for the Contributing Areas of Homosassa Spring Group and Chassahowitzka Spring Group (in draft). DEP Groundwater Management Section.

define PFAs. In the absence of modeled or demonstrated travel times, best professional judgement of groundwater professionals experienced in the spring area may be considered.

No dye tracing work or modeling has been conducted to evaluate ground water transport in either of these springsheds. Most of these springsheds lie within the Brooksville Ridge physiographic region where the limestone of the Floridan Aquifer is mantled by layers of sand and clay. Recharge in the Brooksville Ridge area is generally high (>10 in/yr), occurring directly through permeable sands or as focused recharge through sinkholes that breach confining layers. In both springsheds, karst topography is present, with limestone close to land surface and numerous karst erosional features. It is likely that karst processes have created solution channels and conduits in the limestone to allow rapid movement of groundwater but specific areas of potentially rapid transport of ground water are not known. It is, however, understood that proximity to the springs must be a consideration in creating the PFA boundary. **Figure 5** shows 5-mile radii surrounding Homosassa and Chassahowitzka Springs. In the absence of groundwater transport of conduit data in these areas, it was assumed that ground water transport from high recharge areas within 5 miles of the springs is most likely rapid.

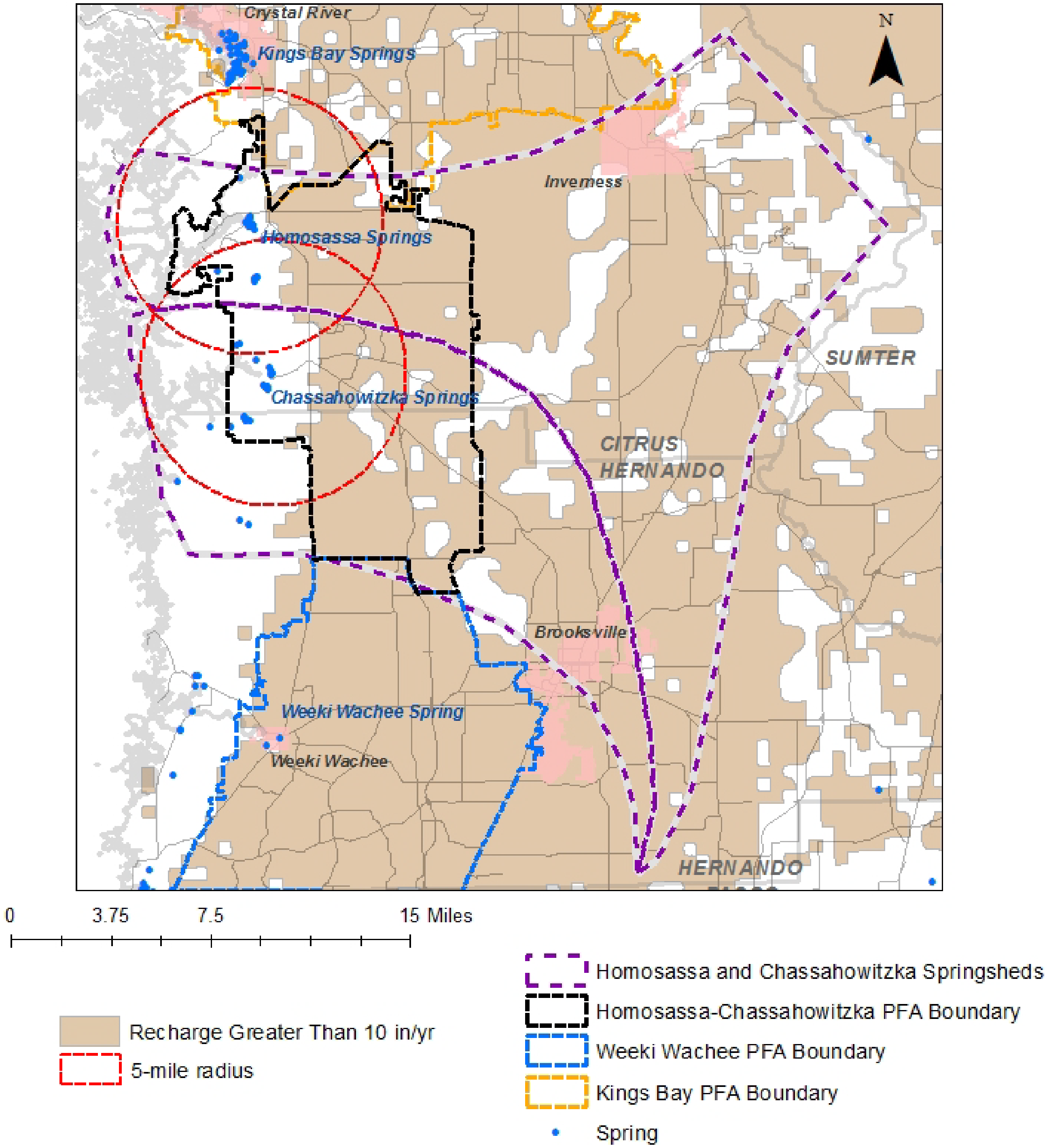

Figure 5. Homosassa and Chassahowitzka Spring Groups, surrounding 5-mile radii, and proposed priority focus area

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.[5] Denitrification is lowest and leaching of nitrogen is highest in areas with soils types 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 Resources Conservation Service soil survey geographic (SSURGO) database for Florida.[6] 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.

[5] 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 Cyclieing in Agroecosystems (2005) 72: 267-278.

[6] 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-

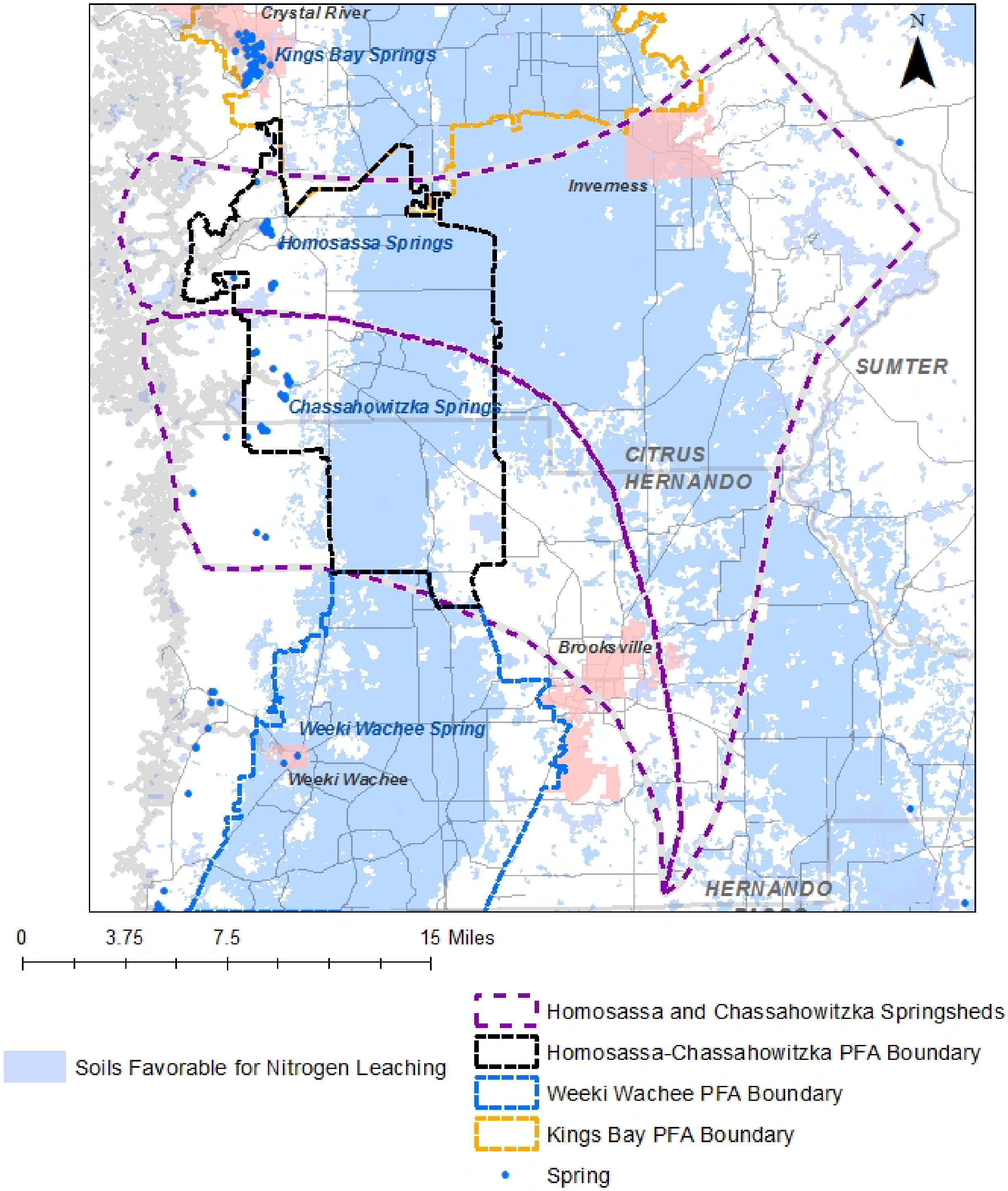

Figure 6. Areas of high nitrogen leaching potential soils based on SSURGO soil drainage class and proposed priority focus area

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 they are under protection. Large land areas along the coast are designated conservation lands as is a large area in central part of the springshed for Homosassa Springs. Boundaries for these areas, including the Crystal River Preserve State Park, the Chassahowitzka National Wildlife Refuge, and the Chassahowitzka Wildlife Management Area along the coast and the Withlacoochee State Forest in the central part of the Homosassa Springs springshed, are used for PFA boundaries. Conservation lands from the FNAI Conservation Lands (FNAI Managed Areas) SDE GIS Feature Class are shown in **Figure 7.**

The western parts of the two springsheds are mostly in urban land uses, with other urban and agricultural land uses occurring further to the east. A large area in the central part of the Chassahowitzka springshed is in the urban generalized classification but consists of open lands used for rock mining. Delineation of the PFA includes consideration of areas with significant potential for nitrogen leaching to groundwater based on the presence of land uses or activities that have been documented in the nitrogen inventory as potentially significant pollutant sources. The draft nitrogen inventories for the Homosassa and Chassahowitzka Springs contributing areas suggest that these potential source areas include areas of intensive urban development and high densities of septic systems and areas of farmland and pasture. Mapped urban and agricultural lands likely to include nitrogen sources are shown in **Figure 8.** Land uses were obtained from the SWFWMD 2009 Land Use GIS coverage.

Septic tanks are shown in **Figure 9**. Septic tank locations are based on a GIS coverage of parcels associated with septic tanks in the Florida Department of Health's Florida Water Management Inventory Project (http://www.floridahealth.gov/environmental-health/onsite-sewage/research/flwmi/index.html).

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. 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 within the PFAs, the boundaries must be clearly defined and associated with features easily recognizable on a map. For that reason, the actual boundaries of PFAs used for planning and restoration are made to conform to easily recognizable natural features, roads, managed conservation area boundaries and political boundaries.

The proposed PFA boundary for Homosassa and Chassahowitzka Springs is also in common with boundaries for adjacent PFAs to the north and south, the Kings Bay Springs PFA boundary to the north and the Weeki Wachee Spring PFA boundary to the south.

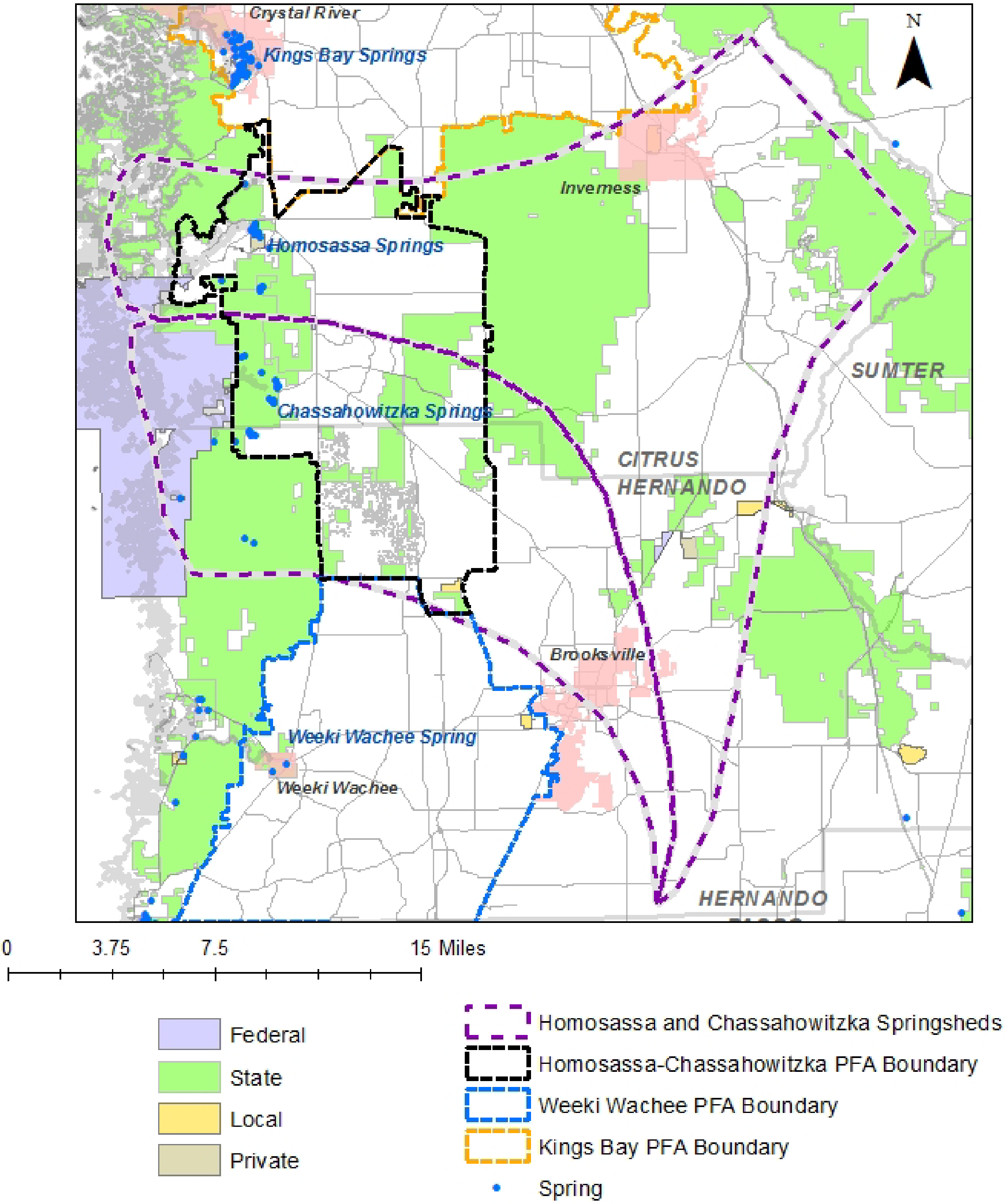

Figure 7. Conservation lands and proposed priority focus area

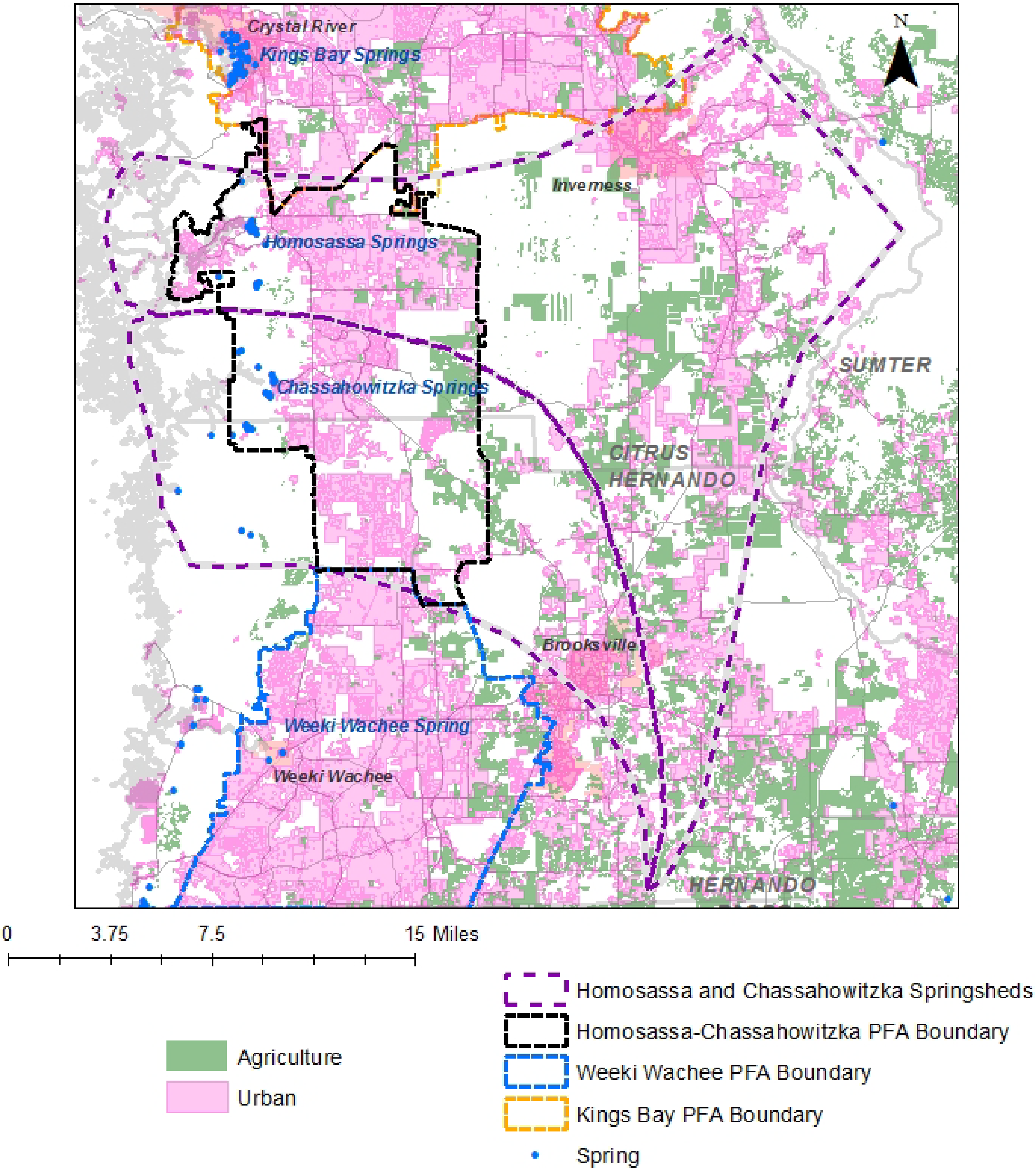

Figure 8. Urban and agricultural lands potentially associated with nitrogen sources and proposed priority focus area

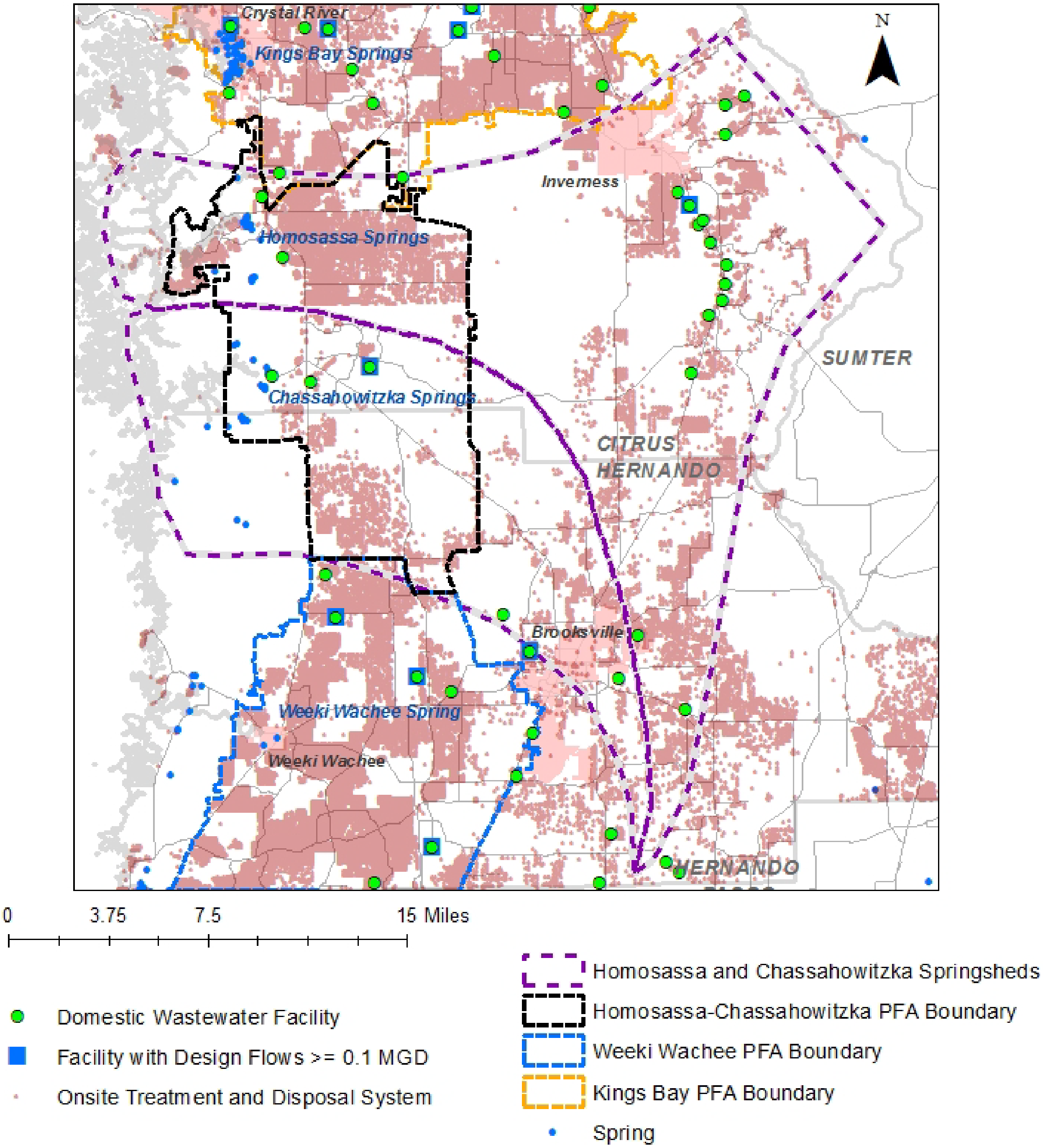

Figure 9. Onsite treatment and disposal systems, domestic wastewater treatment facilities and proposed priority focus area

PFA Boundary for Homosassa and Chassahowitzka 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 western part of the springsheds for Homosassa and Chassahowitzka Springs. This area includes high groundwater recharge/vulnerability conditions and soil conditions that tend to leach nitrogen. No information on actual or modeled travel time exists for the two spring groups, so travel time could not be used to help determine the size or area of the PFA. However, the PFA boundary was drawn to include land areas close to the springs with high recharge and soil conditions that would permit the greatest leaching of nitrogen because of the potential for adverse impacts from near-field sources. The PFA also includes interconnected areas of urban development, high densities of septic tanks, several larger wastewater treatment facilities, and agricultural lands which can all contribute to nitrogen enrichment in the aquifer and springs. Septic tanks, sports turf fertilizer, agricultural fertilizer, and livestock waste were identified in the draft nitrogen source inventories for both spring groups as the major sources of nitrogen loading to ground water. Lastly, the PFA was drawn to include important land areas that contain the springs to protect them from more direct impacts.

Conservation land boundaries, natural features, county lines and major roadways in the area were also considered in the development of a readily identifiable boundary. The proposed PFA is bounded to the west by the Crystal River Preserve State Park, the Chassahowitzka National Wildlife Refuge, and the Chassahowitzka Wildlife Management Area (WMA) along the coast and to the east by the Withlacoochee State Forest and Department of Transportation (DOT) roads. The northern boundary abuts the Kings Bay Springs PFA boundary and the southern boundary abuts the Weeki Wachee Spring PFA boundary. The proposed PFA includes unincorporated portions of Citrus and Hernando Counties, the Homosassa Springs State Park, and part of the Chassahowitzka WMA that includes the springs group. The proposesd PFA also includes all or part of several unincorporated developed areas shown in **Figure 10** that include Homosassa, Sugarmill Woods, Homosassa Springs, and Lecanto.

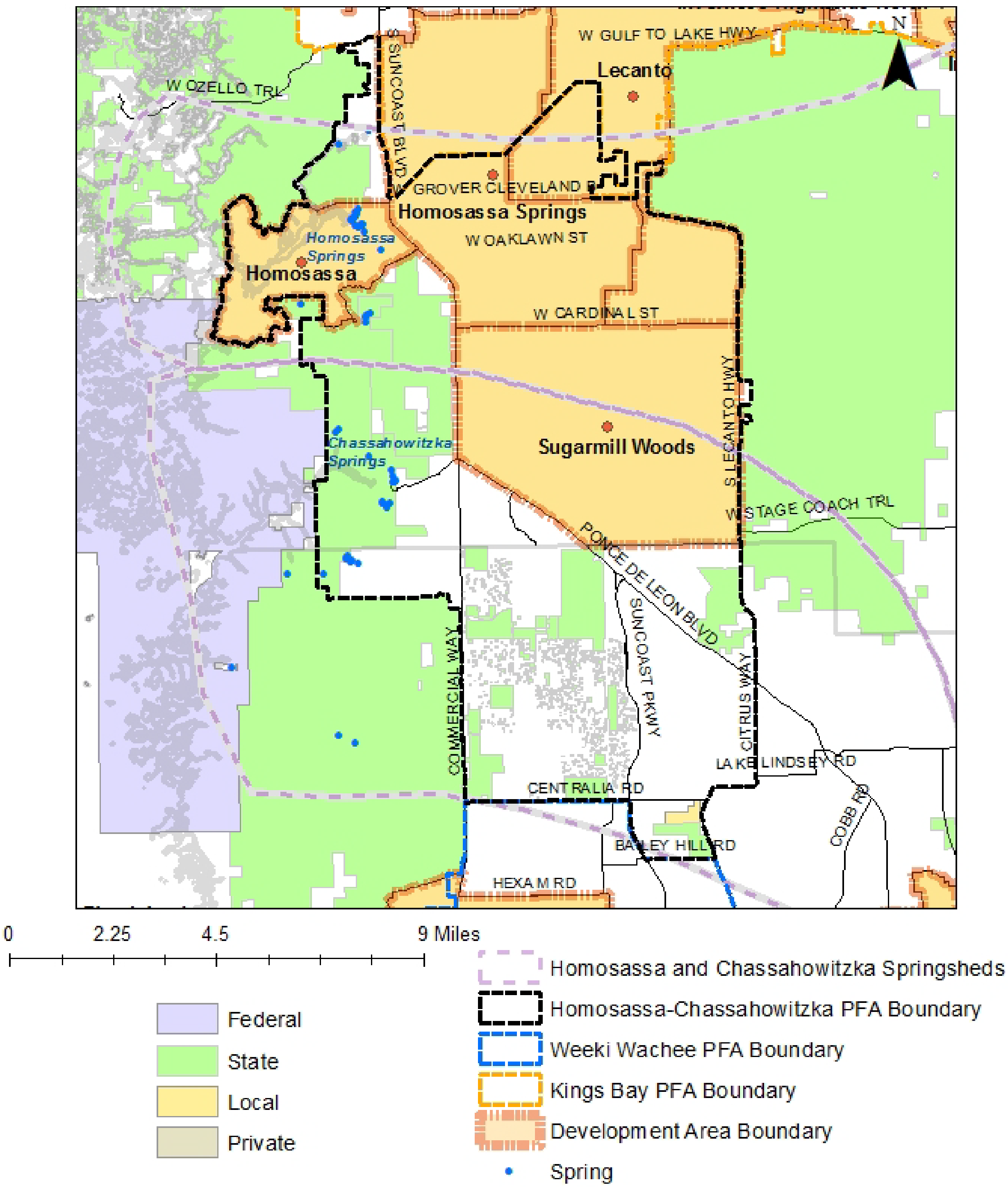

Figure 10. Proposed PFA boundary for Homosassa and Chassahowitzka Spring Groups