DISTRICT 2 – OVERVIEW

INTRODUCTION

The Division of Recreation and Parks (DRP) District 2 is divided into four planning regions based on common natural landscapes and associated natural resources:

Atlantic Coast Region

The parks of the Atlantic Coast planning region are coastal in nature, consisting of barrier islands, estuarine tidal marshes and other natural communities associated with or in proximity to the Atlantic maritime environment.

Gulf Coast Region

Most of the Gulf Coast planning region parks consist of coastal wetlands and maritime forests that are integral to the vast salt marsh-dominated ecosystem of the northeastern Gulf of Mexico. Many of the region's parks also contain freshwater springs.

North Florida Highlands Region

This planning region's parks occur in the interior of District 2, generally along the elevated ridges and karst terrain of north Florida where rolling hills, steephead ravines and sinkholes are prominent in the natural landscape.

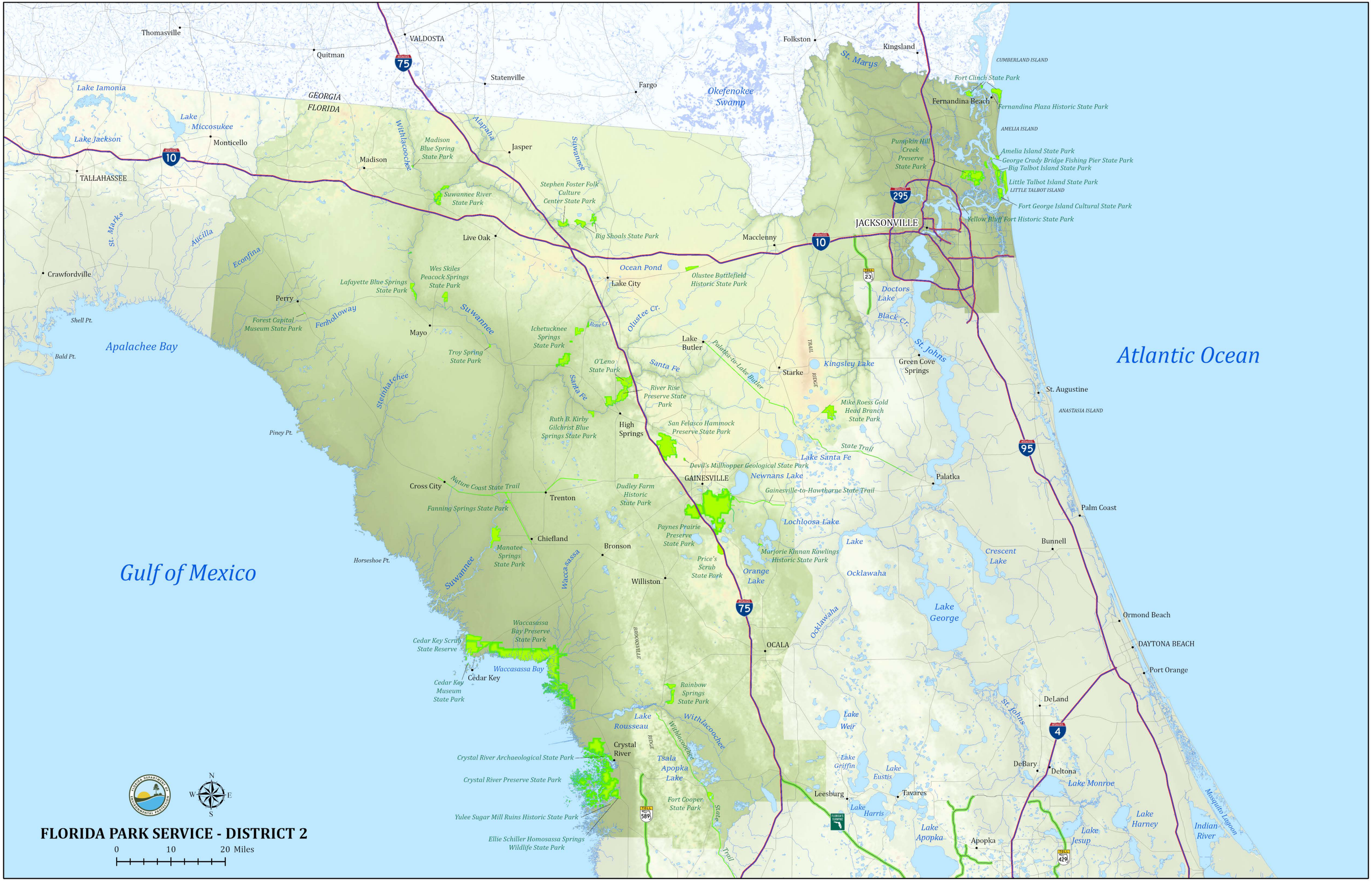
Suwannee River Region

Located along the winding path of the Suwannee River and its tributaries, this planning region's parks include the highest concentration of freshwater springs in the world, as well as an extensive network of aquatic caves and karst windows.

DISTRICT 2 GEOGRAPHY

Encompassing 15 counties in north Florida, District 2 is the only DRP district that extends from the Atlantic Ocean to the Gulf of Mexico. Duval and Nassau counties have barrier islands with dramatic beach dune topography reflecting the high wave energy of the Atlantic Ocean, while the vast estuarine marshes and offshore flats of Taylor, Dixie, Levy and Citrus counties reflect the shallow bathymetry and low wave energy of the eastern Gulf of Mexico. Although somewhat loosely defined, the boundary between Florida's peninsula and panhandle occurs within the district, marking a major geographic division within the state.

The northwestern third of District 2 is sparsely populated, with land use dominated by agriculture and silviculture. Higher population densities occur in the northeastern portion of the district, centered on the greater Jacksonville metropolitan area and along the Interstate 75 corridor in cities such as Lake City, Gainesville, and Ocala.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Okefenokee Swamp
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Fort Clinch State Park
Fernandina Beach
Fernandina Plaza Historic State Park
AMELIA ISLAND
Lake Iamonia
GEORGIA
FLORIDA
Lake Miccosukee
Lake Jackson
Monticello
Withlacoochee
Alapaha
Madison Blue Spring State Park
Jasper
Suwannee
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Pumpkin Hill Creek Preserve State Park
Amelia Island State Park
George Crady Bridge Fishing Pier State Park
Big Talbot Island State Park
Little Talbot Island State Park
LITTLE TALBOT ISLAND
Fort George Island Cultural State Park
Yellow Bluff Fort Historic State Park
TALLAHASSEE
Stephen Foster Folk Culture Center State Park
Suwannee River State Park
JACKSONVILLE
St. Marks
Aucilla
Econfina
Live Oak
Big Shoals State Park
Macclenny
Ocean Pond
Olustee Battlefield Historic State Park
Crawfordville
Wes Skiles Peacock Springs State Park
Lafayette Blue Springs State Park
Lake City
Doctors Lake
Perry
Black Cr.
Shell Pt.
Forest Capital Museum State Park
Fenholloway
Suwannee
Olustee Cr.
Rose Cr.
Ichetucknee Springs State Park
Mayo
Lake Butler
Palatka-to-Lake Butler Trail
St. Johns
Apalachee Bay
Bald Pt.
Troy Spring State Park
Santa Fe
O'Leno State Park
Starke
Kingsley Lake
Green Cove Springs
Steinhatchee
River Rise Preserve State Park
Santa Fe
St. Augustine
ANASTASIA ISLAND
Mike Roess Gold Head Branch State Park
Ruth B. Kirby Gilchrist Blue Springs State Park
High Springs
San Felasco Hammock Preserve State Park
Piney Pt.
State Trail
Lake Santa Fe
Devil's Millhopper Geological State Park
GAINESVILLE
Newnans Lake
Palatka
Cross City
Nature Coast State Trail
Trenton
Dudley Farm Historic State Park
Gainesville-to-Hawthorne State Trail
Fanning Springs State Park
Palm Coast
Lochloosa Lake
Chiefland
Paynes Prairie Preserve State Park
Bronson
Manatee Springs State Park
Marjorie Kinnan Rawlings Historic State Park
Lake
Bunnell
Crescent Lake
Horseshoe Pt.
Price's Scrub State Park
Orange Lake
Ocklawaha
Wacca-sassa
Williston
Lake George
Ormond Beach
Waccasassa Bay Preserve State Park
Cedar Key Scrub State Reserve
OCALA
DAYTONA BEACH
BROOKSVILLE
Waccasassa Bay
Port Orange
Cedar Key
Cedar Key Museum State Park
Rainbow Springs State Park
DeLand
Lake Weir
Lake Rousseau
Withlacoochee
Withlacoochee
RIDGE
Crystal River
Lake Griffin
Crystal River Archaeological State Park
Tsala Apopka Lake
Lake Eustis
DeBary
Deltona
Crystal River Preserve State Park
Leesburg
Tavares
Lake Monroe
Fort Cooper State Park
Lake Harris
Lake Harney
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Lake Apopka
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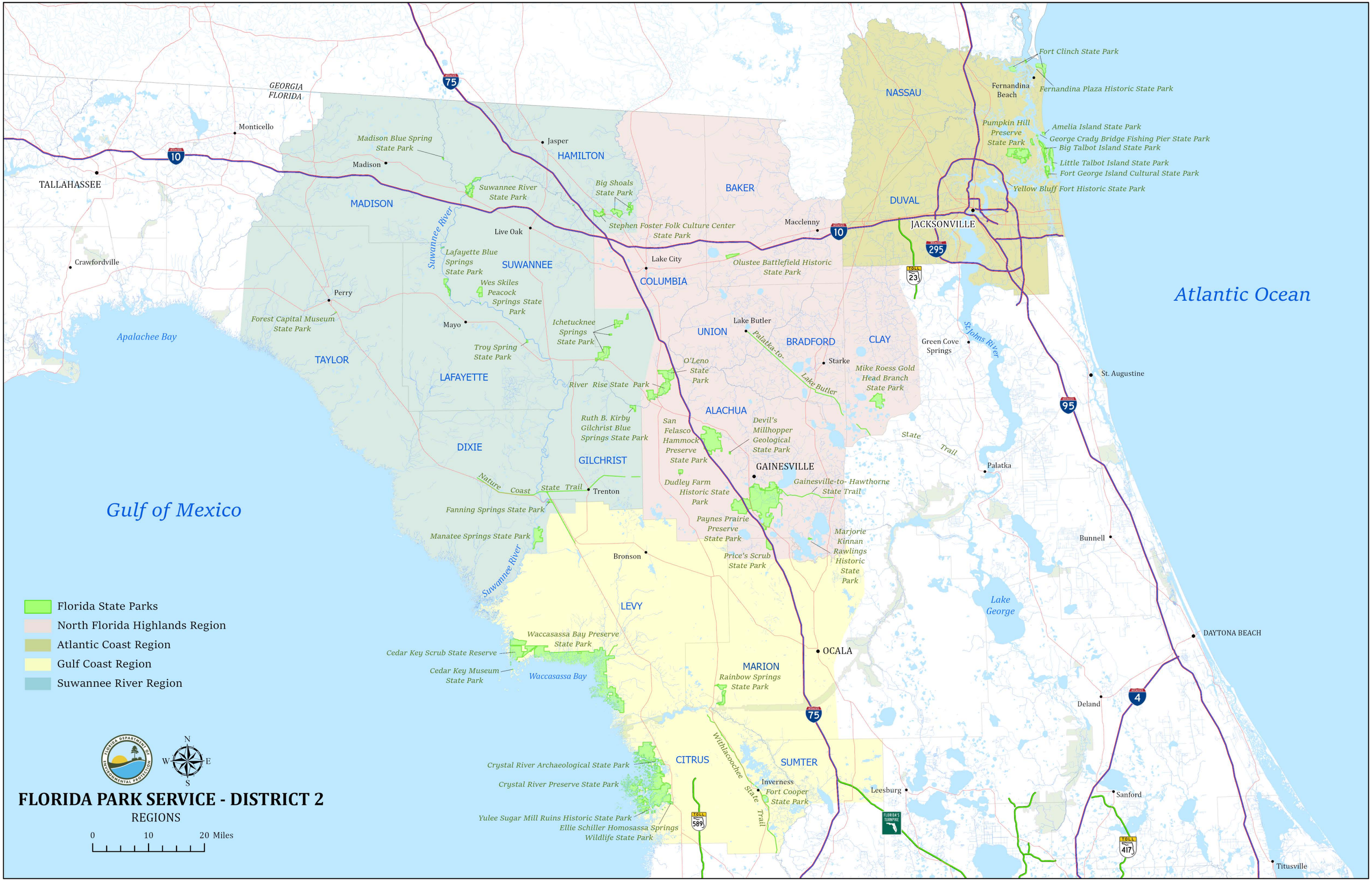
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Live Oak
Big Shoals State Park
Stephen Foster Folk Culture Center State Park
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Lafayette Blue Springs State Park
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Olustee Battlefield Historic State Park
Wes Skiles Peacock Springs State Park
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Mayo
Ichetucknee Springs State Park
Troy Spring State Park
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LAFAYETTE
Lake Butler
UNION
BRADFORD
CLAY
Palatka-to-Lake Butler
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O'Leno State Park
River Rise State Park
Mike Roess Gold Head Branch State Park
Green Cove Springs
St. Johns River
St. Augustine
ALACHUA
Ruth B. Kirby Gilchrist Blue Springs State Park
San Felasco Hammock Preserve State Park
Devil's Millhopper Geological State Park
DIXIE
GILCHRIST
GAINESVILLE
Dudley Farm Historic State Park
Gainesville-to- Hawthorne State Trail
Palatka
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Lake George
Waccasassa Bay Preserve State Park
Cedar Key Scrub State Reserve
Cedar Key Museum State Park
Waccasassa Bay
OCALA
MARION
Rainbow Springs State Park
DAYTONA BEACH
Deland
CITRUS
SUMTER
Withlacoochee State Trail
Crystal River Archaeological State Park
Crystal River Preserve State Park
Inverness
Fort Cooper State Park
Leesburg
Sanford
Yulee Sugar Mill Ruins Historic State Park
Ellie Schiller Homosassa Springs Wildlife State Park
Titusville
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Fernandina Beach
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Little Talbot Island State Park
Fort George Island Cultural State Park
Yellow Bluff Fort Historic State Park
DUVAL
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North Florida Highlands Region
Atlantic Coast Region
Gulf Coast Region
Suwannee River Region
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FLORIDA PARK SERVICE - DISTRICT 2
REGIONS
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DISTRICT 2 GEOLOGY AND GEOMORPHOLOGY

Geology

The geological formations from which Florida's current landforms are derived built up in two main phases. The first was a long geologic period of carbonate deposition when the Florida Platform was covered by shallow seas. During this time, a channel known as the Gulf Trough, or Suwannee Straits, separated the Florida Platform from what is now continental North America (Randazzo and Jones 1997). Strong currents through the trough prevented sediments from the continent from reaching the platform, and deposition of sediments consisting of the carbonate skeletons of marine organisms formed layers of carbonate rock. By the early Miocene historic period, sediments eroding south from the continent had filled the Gulf Trough, allowing sand and clay from the Appalachians to spill onto the Florida Platform and be deposited on top of the carbonate rocks that had formed in the prior eras. The subsequent effects of several forces – coastal (erosion and deposition by coastal currents and wind during cycles of sea level rise and fall), karstic (dissolution of limestone by groundwater) and fluvial (riverine) processes—on the land's surface have shaped the topography, soils, hydrology and vegetation of the present-day landscape (Upchurch et al. 2019).

The general trend in the age of surficial geology in northern peninsular Florida is that of younger formations at the surface in the northeastern peninsula, with surface formations increasing in age to the south and west toward the Gulf of Mexico (Figure X Surficial Geologic Age). The most widespread surface formation in the region is also among the oldest: the Ocala Limestone, which is of Eocene age. This rock is near or at the surface in a broad area of the southwestern region of District 2 from Columbia, Alachua and Marion counties west to the Gulf of Mexico. North and east of these counties, the largely impermeable siliciclastics, limestones and dolostones of the Miocene Hawthorn formation make up a thick layer near the surface, where they confine the Floridan aquifer and largely prevent the formation of sinkholes and other karstic features. The most recent surficial materials are found on high ridges that have resulted from coastal processes during high sea levels – the Brooksville Ridge, Bell Ridge and Trail Ridge – as well as most of coastal northeastern Florida. These areas are dominated by Pleistocene to Holocene sediments. These newer sediments are present over much of the other regions, but often as a relatively thin layer.

Geomorphology

Geomorphology refers to the physical features of the land surface and their relation to the underlying geologic structures. The boundaries of District 2 overlap with five of the 10 geomorphological districts described in the Atlas of Florida Geology (Figure Y; Florida Geomorphology Atlas). The geomorphological districts and provinces that contain park units within District 2 are described in the table below (Williams et al. 2022). Each District 2 planning region is also referenced for each province. The portion of the Tifton Upland District that falls within District 2 contains no park units and is not discussed further.

There are important geomorphologic terms that are used widely throughout the management plan and therefore will need a brief introduction. Florida is largely made up of karst landscapes, that are underlain by limestone bedrock. Surface and groundwater that is in contact with karstic landscapes can dissolve limestone more easily than most rocks, which leads to an increased number of openings and connections between the surface and the groundwater (i.e., the Floridan aquifer system). Sinkholes, springs and stream-to-sink water bodies are characteristic topographic features within karstic landscapes. A karst escarpment is a geologically sloped landscape from an upland to a lowland.

One of the most widely discussed escarpments in north Florida is the Cody Escarpment. Extending from the Apalachicola River across much of the northern peninsula, the Cody Escarpment was formed during a Pleistocene interglacial period of high sea level when the limestone and overlying sediments at the shoreline were eroded by the sea, resulting in a marked drop in elevation. At this transition, the Hawthorn layer of clay and sand becomes thinner seaward of the Cody Escarpment, and the porous Ocala Limestone nears the land surface.

Swallets (openings into the Floridan aquifer system) are especially common along the Cody Scarp and other smaller escarpments in the region, where streams and rivers flowing over the less permeable Hawthorn Formation reach the porous limestone and flow through karst openings directly into the aquifer.

The width of the Cody Escarpment varies anywhere from 1 to 10 miles. The Cody Escarpment is only one of Florida's many complex geomorphic sloped landscapes, but it is perhaps the most prominent one in DRP District 2. Nearly all streams that cross this escarpment end up entering swallets or sinkholes and mixing with the Floridan aquifer.

The potentiometric surface of groundwater, the height to which the water would rise if it were unconfined, is an indication of the general direction of groundwater flow.

BARRIER ISLAND SEQUENCE DISTRICT

TIFTON UPLAND DISTRICT

OKEFENOKEE BASIN DISTRICT

OCALA KARST DISTRICT

LAKES DISTRICT

LAKES DISTRICT

Hills

Madison

Ocean Pond Plain

Duval

St. Marys Plain

Sea Islands

Atlantic Coastal Complex

Lower St. Johns River Valley

Upland

Atlantic Ocean

Alachua Karst Hills

Branford Karst Plain

Lake City Ridge

Raiford Ridges

Trail Ridge

St. Johns River

San Pedro Bay

Perry Karst Plain

Suwannee River

Bell Ridge

Waccasassa Flats

Alachua Karst Hills

Hawthorne Lakes

Chiefland Karst Plain

Brooksville Ridge

Williston Fairfield Karst Hills

Ocala Karst Hills

Lake George

Gulf of Mexico

Gulf Hammock

Karst Plain

Tsala Apopka Plain

Ocala Karst Hills

Crystal River Karst Plain

Brooksville Ridge

FLORIDA PARK SERVICE - DISTRICT 2

GEOMORPHOLOGY DISTRICTS & PROVINCES

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Florida State Parks

Geomorphological Districts

Geomorphological Provinces

Table 1. Geomorphological Districts and Provinces

OCALA KARST DISTRICT

The Ocala Karst District makes up the largest portion of District 2, encompassing a large swath extending from the Georgia border south along and inland from the Gulf Coast, where it continues beyond the District 2 boundary and terminates at Tampa Bay. The multiple provinces making up this district are diverse but generally characterized by karst features resulting from dissolution of the underlying Ocala Limestone, and, to a lesser extent, the Suwannee Limestone. Numerous sinkholes, sinking streams (a river that disappears underground) and swallets of inland portions of this district make it a key area for recharge of the Floridan aquifer. Where the land surface intersects with the Florida aquifer system potentiometric surface, springs are also abundant, especially near major rivers, escarpments and the coast. In large part, these springs and other karst features of the Ocala Karst District – many of which are protected and showcased in state parks – contribute to Florida's global geological significance.

Although the provinces making up the Ocala Karst District are geologically similar, they are nonetheless varied. Level, poorly-drained karst plains occurring near the coast give way to the Bell and Brooksville ridges, where ancient shoreline processes created spits, sand bars and dune fields that are now being modified by dissolution of the underlying limestone. East of the ridges, the district generally consists of rolling hills punctuated by sinkholes and other karst landforms.

An important geomorphological feature in this region is the Cody Escarpment, which begins at the eastern and northern margins between the Ocala Karst district and adjacent provinces.

PROVINCE	DISTRICT 2 REGION	DESCRIPTION
Perry Karst Plain	Suwannee	This province is a coastal karst plain with many small sinkholes and scattered springs. Over most of the province there is a thin layer of Quaternary undifferentiated sediments overlying the limestone, which consists of Eocene Ocala Limestone in the southern part of the region and Oligocene Suwannee Limestone in the province's northern and central regions. Elevation ranges between 0-75 feet, with most of the region between five and 60 feet. This province is characterized by several sink-to-spring systems where rivers go underground and later emerge.
Chiefland Karst Plain	Suwannee/Gulf Coast	This is a relatively flat coastal karst plain which is crossed by the Suwannee River but is otherwise mostly internally drained. This province has many small sinkhole depressions and areas with ancient dunes, including those that form Cedar Keys and the associated xeric uplands. There are few swallets in this province but many springs – including some major springs – along the Suwannee. Although this province is mostly underlain by Eocene Ocala Limestone, the Eocene Avon Park Limestone is present at the province's southeastern edge. Because the Avon Park Limestone is much less subject to dissolution than the Ocala, this area has an elevated water table and extensive wetlands.
Gulf Hammock	Gulf Coast	This is a poorly-drained coastal karst plain that slopes gently from the foot of the Brooksville Ridge to Waccasassa Bay. Eocene Avon Park dolomitic rock crops out or is near the surface in scattered areas. Elsewhere, the Ocala Limestone is at or near the surface, with Quaternary undifferentiated sediments as a thin mantle over most of the region. Karst features in this province are subtle, and there are few springs and only one known swallet. Instead, shallow, indistinct depressions are scattered throughout. The low elevation and limited relief make this a swampy region, draining to the gulf via the Waccasassa and shorter blackwater streams.

Gulf Hammock (Cont'd)	Gulf Coast	
Crystal River Karst Plains	Gulf Coast	This is a low, mostly level area with elevations generally ranging between sea level and 25 feet. The Eocene Ocala Limestone is near the surface in most of the province, often exposed on islands and along the shoreline. Near and off the coast, little or no sediments cover the Ocala, and many small shallow sinkholes occur, particularly in submerged areas of "drowned karst." Quaternary sediments are increasingly thick toward the eastern edge of the province near the Brooksville Ridge, and larger karst features become more common. Between these two extremes is a low escarpment that gives rise to springs at Crystal River, Homosassa and Chassahowitzka. The Eocene Avon Park Formation is near the surface in some portions of the northern part of this province, limiting the formation of karst features in those areas.
Branford Karst Plain	Suwannee/North Florida Highlands	This is the northernmost inland province of the Ocala Karst District, and the geomorphological province with the most springs in the state. This relatively level karstic landscape includes the middle Suwannee River valley, the Alapaha River valley and parts of the Withlacoochee River valley. It also contains a diverse variety of karst landforms, including many sinkholes, swallets, springs, caves and karst traces. Like the rest of the Ocala Karst District, this province is underlain by Ocala Limestone (with Suwannee Limestone in the northern portion) covered by varying thicknesses of Quaternary undifferentiated sediments. Some low-relief dunes are scattered throughout the region. Elevations range from 10 feet above sea level near the Suwannee and Santa Fe rivers to as high as 150 feet near the escarpment. Most of the province lies within 40-95 feet.
Alachua Karst Hills	North Florida Highlands	This is a hilly province along the Cody Escarpment. Underlying limestone dissolution has resulted in numerous karstic landforms. Most streams crossing the region drain to swallets, and the many sinkholes caused by dissolution of the underlying Ocala Limestone result in a rolling landscape. Karst features in this region tend to be large due to a thicker cover of sediment relative to provinces elsewhere in the district, with sinkhole lakes, elongate linear features (uvalas) and large karstic basin marshes (poljes) resulting from coalescing sinkholes. There are few springs.
Brooksville Ridge	Gulf Coast	Pleistocene coastal processes created this broad north-south ridge that is roughly parallel to the Gulf Coast. The Brooksville Ridge is distinctly higher in elevation than adjacent provinces to the east and west and is divided into two subregions by a low gap through which the Withlacoochee River flows. Tertiary/quaternary sediments overlie much of the region, with dune deposits on the flanks of the ridge. The tertiary/quaternary sediments are atop Hawthorn Formation in some areas. The province has a hilly topography resulting from extensive karst dissolution of the Ocala Limestone. The ridge is mostly internally drained and has numerous sinkhole lakes, some with clay lenses and some connected to the aquifer. Mining of phosphate deposits has been common on the east flank of the ridge.

Waccasassa Flats	Suwannee/Gulf Coast	This province is mostly flat, with scattered low dunes and some higher hills as the province approaches the Bell Ridge and Brooksville Ridge. This is a generally poorly-drained region of flatwoods and wetlands with some sandhills on higher elevations. Eocene Ocala Limestone is overlain by the Hawthorn group, as well as undifferentiated sediments of quaternary age. There are fewer sinkholes in this province than surrounding provinces, and what sinkholes do occur are mostly found near the margins. Likewise, springs are rare, but some occur along the Santa Fe River at the boundary with the Branford Karst Plain.
Williston Karst Plain	North Florida Highlands/Suwannee/Gulf Coast	This region has many sinkholes, caves, swallets, karst windows and springs. As its name suggests, it is generally level, with topography mostly resulting from karst processes, although some dunes occur at the toe of Brooksville Ridge. Eocene Ocala Limestone is the surficial formation, with Miocene undifferentiated Hawthorn and Coosawhatchie Formation of the Hawthorn atop the Ocala on higher hills, and Quaternary undifferentiated and Quaternary beach ridge and dune sediments over the limestone on the plains and smaller hills. Elevations vary from 25 to 160 feet above mean sea level, with most between 60-100 feet. This region is mostly internally drained, although many springs occur along the Santa Fe River at the northern boundary of this province. These generally do not have long spring runs or karst traces that are found north of the river.
Tsala Apopka Plain	Gulf Coast	The Tsala Apopka Plain Province is a moderately flat, inland karst plain lying east of the Brooksville Ridge and crossed from south to north by the Withlacoochee River. Sinkholes, sinkhole lakes and other large karst features occur throughout the province. Eocene Ocala Limestone is the oldest stratum affecting landforms in most of the region and is responsible for the karst features in the landscape. However, there are some places where the Avon Park Formation is near the surface. There is a thin mantle of Quaternary undifferentiated sediments over the limestone throughout the province, and in some areas Miocene undifferentiated Hawthorn Group, Pliocene-Pleistocene reworked Cypresshead sediments or Quaternary beach ridge and dune sediments occur.

OKEFENOKEE BASIN DISTRICT

North and east of the Ocala Karst District, a portion of District 2 along the Georgia border is part of the Okefenokee basin, where thick, impermeable layers of the Hawthorn Formation lie atop the underlying limestone. The surface geology here largely prevents percolation of water and thus limits dissolution and formation of sinkholes and other features more common to the south and west.

PROVINCE	DISTRICT 2 REGION	DESCRIPTION
Ocean Pond Plain	North Florida Highlands	This is a mostly level, poorly-drained Plio-Pleistocene marine terrace that includes the southern extent of the Okefenokee Swamp. Much of the province is underlain by the thick siliciclastic sediments and carbonates of the Miocene Hawthorn Formation, generally preventing karst features from forming. Tertiary-Quaternary undifferentiated sediments underlie much of the

Ocean Pond Plain (Cont'd)	North Florida Highlands	eastern part, while to the province's western end, the Hawthorn thins out and Eocene Ocala Limestone and Suwannee Limestone are closer to the surface. Slopes are only common near the Suwannee, the St. Marys and the Alapaha rivers. Elevations range from 60 to 170 feet, with most in the range of 100-150 feet.
Lake City Ridge	North Florida Highlands	This is a mostly level, poorly-drained Plio-Pleistocene marine terrace that includes the southern extent of the Okefenokee Swamp. Much of the province is underlain by the thick siliciclastic sediments and carbonates of the Miocene Hawthorn Formation, generally preventing karst features from forming. Tertiary-Quaternary undifferentiated sediments underlie much of the eastern part, while to the province's western end, the Hawthorn thins out and Eocene Ocala Limestone and Suwannee Limestone are closer to the surface. Slopes are only common near the Suwannee, the St. Marys and the Alapaha rivers. Elevations range from 60 to 170 feet, with most in the range of 100-150 feet.

LAKES DISTRICT

The northern edge of the Lakes District enters District 2 near the district's southern boundary. While this region shares much in common with the adjacent Ocala Karst District, the Lakes District is characterized by larger sinkhole features. A notable example of this is Paynes Prairie, a limestone plain or polje formed by the coalescence of numerous sinkholes.

PROVINCE	DISTRICT 2 REGION	DESCRIPTION
Hawthorne Lakes	North Florida Highlands/Gulf Coast	This northernmost province of the Lakes District includes many small to large sinkhole lakes and wetlands caused by dissolution of the Ocala Limestone, although the surficial geology of this province also includes areas where the Miocene Hawthorn Formation and the Plio-Pleistocene Cypresshead Formation are prominent. Elevations vary significantly, mostly ranging from about 60 to 155 feet, with remnants of ancient coastal ridges at the northern edge of the province exceeding 200 feet. Steephead ravines occur associated with lakes in the northern part of the province.

BARRIER ISLAND SEQUENCE DISTRICT

A relatively small portion of the northeastern corner of District 2 is in the barrier islands sequence district, a geomorphological region which encompasses much of Florida's east coast and extends north to South Carolina. This is a region largely covered by relatively recent undifferentiated and beach dune sediments and is predominantly shaped by coastal and fluvial processes.

PROVINCE	DISTRICT 2 REGION	DESCRIPTION
Sea Islands	Atlantic Coast	This is a region of barrier islands and inland ridges of similar coastal origin interspersed with broad, shallow tidal marshes. The Sea Islands Province is crossed by three tidal-influenced rivers: the St. Marys, Nassau and St. Johns. The surface geology is made up of Quaternary beach ridge and dune and Quaternary undifferentiated sediments, with sediments in tidal marshes and barrier islands of Holocene origin. Elevations range from sea level to slightly above 60 feet, and karst features are absent.

Trail Ridge	Atlantic Coast	The trail ridge originated as an ancient coastal barrier island or sand bar. The highest ridge in northeastern Florida, it consists of Quaternary sediments overlying the Plio-Pleistocene Cypresshead Formation. Because the ridge consists of deep, well-drained sands, this province gives rise to xeric habitats such as sandhill and scrub. Karst features are absent except at the southern end of the ridge where the Ocala Limestone is closer to the surface. In some locations along the flanks of the ridge, groundwater seepage forms well-developed steephead ravines.

Stratigraphy

The limestone beneath Florida is divided into rock formations which are the basic units used in stratigraphy, the branch of geology pertaining to the layers of sedimentary rock that have accumulated over geologic time. The limestone layers that are so prevalent in portions of DRP District 2 belong to distinct formations depending on age, composition, and location. The most recent formation is identified as the Hawthorn Group. This stratigraphic unit includes several geologic formations in north Florida that formed during the late Oligocene to Pliocene age (23-5.3 million years ago) and is characterized by phosphate-rich limestones. Beneath the Hawthorn group is the Suwannee Limestone formation, which formed during the Oligocene age (34-23 million years ago). The Suwannee Limestone consists of either white to cream colored calcium carbonate rock or tan colored dolomitized rock where magnesium has replaced calcium to form magnesium carbonate. Below the Suwannee Limestone is the Ocala Formation, which formed during the Eocene age (56-34 million years ago). The Ocala Limestone consists of nearly pure calcium carbonate limestone with occasional dolostones. It is at or near the surface within much of the Ocala Karst Geomorphological District, and its dissolution accounts for the area's abundant springs, sinkholes, and other karst features. The oldest limestone stratum in District 2 is the Avon Park Formation. Older Cetaceous and Jurassic bedrocks lie beneath the Avon Park Formation but do not reach the surface anywhere in the state.

Environmental Geology

The underlying geology and geomorphology of an area affects the soil hydrology and chemistry and thus plays a strong role in shaping the vegetation. Areas of north Florida with different surficial geology therefore have generally different combinations of natural communities (Figure Z). The sandy sediments making up high sand ridges such as the Trail Ridge are rapidly drained and low in nutrients, giving rise to sandhills and scrub. However, on high elevations where the clays of the Hawthorn layer are found in the soils, nutrient availability is higher and upland mixed woodland, upland pine or upland hardwood forest tend to occur instead. In poorly drained level areas near the gulf coast where limestone is near the surface, hydric hammock is often the typical vegetation, whereas in wet level areas in northeast Florida, the sandy terrace deposits give rise to more acidic spodosols and flatwoods tend to be found.

DISTRICT 2 HYDROLOGY

Major Watersheds, Rivers, and Lakes

Numerous watersheds, rivers and lakes lie entirely or partially within DRP District 2. The most significant rivers are introduced in Table 2 below and are depicted along with watersheds and major lakes in the associated map. Watershed boundaries (i.e., surface water, groundwater including springsheds) can change dramatically over time depending on naturally caused droughts or groundwater consumption.

Table 2. Significant Rivers

St. Marys River	The northeastern portion of District 2 is in the St. Marys River watershed. The St. Marys River originates from the Okefenokee Swamp and follows a circuitous route south, then north, then flows east through a break in the Trail Ridge, reaching the Atlantic Ocean near Fernandina Beach. Along its entire route of approximately 125 miles, it defines the border between Florida and Georgia. In general, the upper St. Marys River has better surface water quality than the lower tidally influenced section. The upper tributaries are much more rural, with numerous forested swamps and open marsh wetlands, while its lower section contains highly saline tidally influenced areas of expansive salt marsh.
Nassau River Nassau River (Cont'd)	The Nassau River flows approximately 55 miles, draining a basin of approximately 430 square miles in Nassau and Duval counties. Three main freshwater tributaries – Thomas Creek, Boggy Creek and Alligator Creek – drain the western upland portion of the watershed. Two other tributaries along with tidal waterways, including the Amelia and Fort George rivers drain the easternmost area of the basin, which is mostly low lying coastal plain and salt marsh. The river discharges to the Atlantic Ocean. The Nassau River-St. Johns River Marshes Aquatic Preserve encompasses one of the most important salt marsh ecosystems in northeast Florida and is the fourth-largest publicly managed estuary in the state (Florida Department of Environmental Protection (DEP) 1986). Also present within this region is the Timucuan Ecological and Historic Preserve, a nearly 50,000-acre conservation area within the city limits of Jacksonville and managed by the National Park Service (National Park Service 1996; Anderson et al., 2005). Other than an unnamed branch in the upper reaches of the Nassau River which is impaired for fecal bacteria (Wainwright 2007), Total Maximum Daily Loads (TMDLs) for pollutants have not been set for the Nassau River.
St. Johns River	The St. Johns River is the longest river in Florida, draining a total of 8,840 square miles as it flows north from its headwaters in Indian River County to where it discharges to the Atlantic Ocean near Jacksonville (Pinto et al., 2022). The average discharge of the St. Johns at its mouth is 8,300 cubic feet per second. The St. Johns River can be divided into five watershed sub-basins including upper, middle, Lake George, Ocklawaha and lower. The Lower St. Johns River drains just over 2,800 square miles, and a majority of this sub-basin is contained within District 2. The St. Johns River has three ecological zones that are based on average salinity, including mesohaline (14.5 parts per thousand), oligohaline (2.9), and freshwater (0.5). The majority of the Lower St. Johns River falls within the two most saline tidally influenced ecological zones, as well as being highly influenced by the significant urban component of the greater Jacksonville region. Over the last few decades, the tidally influenced saline waters have gradually shifted, pushing the freshwater/saline interface further upstream than has been recorded historically. Some portions of southern District 2 that drain to the St. Johns were once internally drained regions that are now part of the St. Johns River watershed due to drainage modifications. Paynes Prairie formerly had no outlet other than the Floridan aquifer. However, modifications in the early 20th

FLORIDA PARK SERVICE - DISTRICT 2

WATERSHEDS, RIVERS, LAKES

0 10 20 Miles

N W E S

Florida State Parks

Watershed Boundaries

Atlantic Ocean

Gulf of Mexico

Apalachee Bay

Okefenokee Swamp

AUCILLA RIVER

WITHLACOOCHEE RIVER NORTH

ALAPAHA RIVER

UPPER SUWANNEE RIVER

LOWER SUWANNEE RIVER

ECONFINA-FENHOLLOWAY

ST. MARYS RIVER

NASSAU RIVER

LOWER ST. JOHNS RIVER

SANTA FE RIVER

OCKLAWAHA RIVER

WACCASASSA RIVER

WITHLACOOCHEE RIVER SOUTH

CRYSTAL RIVER

Aucilla

Econfina

FenHoHoway

Spring Warrior Cr.

Steinhatchee

Withlacoochee

Alapaha

Suwannee

Deep Cr.

Falling Cr.

St. Marys

Ocean Pond

S Prong St. Marys

Clay Hole Cr.

Rose Cr.

Olustee Cr.

Swift Cr.

Palestine L.

Ichetucknee Trace

Ichetucknee

Santa Fe

New L.

Sampson

N Fork Black Cr.

Black Cr.

Kingsley L.

S Fork Black Cr.

Lowry L.

Santa Fe L.

L. Newnans

Lochloosa L.

Ledwith L.

Orange L.

St. Johns

Lake George

Waccasassa

Tenmile Cr.

Waccasassa Bay

L. Rousseau

Withlacoochee

L. Tsala Apopka

L. Panasoffkee

Nassau

St. Johns River (Cont'd)	century diverted a portion of the basin's flow to Orange Lake, part of the Orange Creek basin, which in turn is connected to the Ocklawaha, the largest tributary of the St. Johns. In addition, the eastern edge of District 2 near the south end of the Trail Ridge, although internally drained, is part of the St. Johns basin. Several portions of the Lower St. Johns River in District 2 do not meet water quality standards. A Basin Management Action Plan (BMAP) was developed for the Lower St. Johns River to address elevated nutrients in the freshwater sections of the river and to restore dissolved oxygen by reducing total nitrogen in the brackish portions of the river from Black Creek to the river mouth. This BMAP was adopted in 2008. Additionally, 25 tributaries in the lower river basin were included in two separate BMAPs adopted in 2009 and 2010, mostly to address elevated fecal coliform bacteria.
Suwannee River	The Suwannee River originates in the Okefenokee Swamp and flows on a curving path through Georgia and north Florida, flowing out into the Gulf of Mexico. The Suwannee is for the most part a tannic blackwater system due to its origin in extensive swamps. The river's watershed, which drains almost 10,000 square miles spread across north Florida and southern Georgia, is extensively rural, consisting largely of agricultural, silvicultural and natural lands. Mean daily discharge of the Suwannee is approximately 10,000 cubic feet per second. The Suwannee basin can be divided into upper, middle and lower sections. Surface water dominates the flow in the upper reaches of the river. The upper basin is about 50% in Georgia and also contains the watersheds of the river's major tributaries, the Alapaha, (northern) Withlacoochee and the Santa Fe. In contrast to the surface-water dominated upper Suwannee, the middle Suwannee receives most of its flow from groundwater. During low flow periods, the groundwater from the multitude of springs in the middle Suwannee can make up the majority of the river's flow (Pittman 1997). Major springs along the Suwannee include Lafayette Blue Springs, Falmouth Springs, Peacock Springs and Troy Springs in the middle reaches, and Fanning and Manatee springs nearer the coast. The lower Suwannee is tidally influenced, with tidal action being an important force shaping the natural communities in the floodplain. The Suwannee is notable for being one of a small number of un-dammed, unaltered large rivers in the United States. The lack of artificial regulation of the river's flow means that natural flooding is relatively common and is still an important ecological process for floodplain communities. Flood events also play a role in the interplay between the Suwannee and its tributary rivers and contributing springs by causing occasional back-flooding. While this can be important to the vegetation surrounding the river, back-flooding events can also cause brownouts of springs and caves. In recent decades, these events have occurred more frequently in some areas, which may be a cause for concern. The Suwannee empties to the Big Bend Seagrasses Aquatic Preserve, which along with the St. Martins Marsh Aquatic Preserve is considered Florida's largest protected estuary, containing the largest remaining area of seagrass in Florida. This important estuary is dependent on the input of freshwater and detritus from the river but also receives extensive groundwater inputs from small streams that originate in the near-coast communities such as hydric hammock.
Santa Fe River	The Santa Fe River is one of three main tributaries of the Suwannee River (Berndt et al. 1996). The Santa Fe River basin is a 1,384-square mile watershed that occupies portions of nine Florida counties, from Clay County in the east to Gilchrist and Suwannee counties in the west (Clark et al. 1964). The headwaters of the river lie in eastern Alachua County and western Putnam and Clay counties where it originates as a blackwater stream from Santa Fe Lake. The overall flow of the river is from east to west. The Upper Santa Fe River (above Olustee Creek and thus above O'Leno/River Rise Preserve state parks) receives major surface water inputs from tributaries such as Sampson River, New River, Olustee Creek and Rocky Creek. Below the Olustee Creek tributary, the Santa Fe River begins to cross the wide transitional Cody Scarp. As with most of the major streams that cross this scarp, a sizeable proportion of the river flow disappears underground into swallet openings and re-emerges at various resurgence points after mixing with groundwater in the Floridan aquifer (Martin and Dean 2001; Upchurch 2002). In fact, groundwater inputs dominate the lower Santa Fe system (below Olustee Creek). The base flow of the Santa Fe is derived principally from the Floridan aquifer (Meyer 1962; Meyer et al. 2008). The

Santa Fe River (Cont'd)	first major groundwater input is a historically first magnitude spring located just below the Olustee/Santa Fe confluence, appropriately named Santa Fe Spring (Hornsby and Ceryak 1998). The Santa Fe flows generally westward in a sinuous pattern. Once the river enters the northeast corner Of O'Leno State Park at Interstate 75, it flows entirely through parklands until it reaches a point approximately 1.1 miles below the River Rise. From there downstream to U.S. Highway 27, riverfront property consists of state lands within River Rise Preserve State Park and a mixture of private holdings. After exiting the preserve, the Santa Fe eventually flows into the Suwannee River below the town of Branford. Like almost all other streams that cross the Cody Escarpment, the entire Santa Fe River enters a swallet in O'Leno State Park, where it again emerges over 3 miles south at River Rise Preserve State Park. Major springs along the Santa Fe include Hornsby Spring, Devil's Ear Spring, Gilchrist Blue Poe Spring and Ichetucknee Spring. A significant amount of the lower Santa Fe's flow comes from the Ichetucknee River. The Santa Fe River system is classified as an Outstanding Florida Water. The Santa Fe River BMAP (adopted in 2012 and updated in 2018) specifically aims to address elevated nitrogen in the lower portion of the river and in impaired springs, but the strategies identified in the plan should reduce nitrogen in several other springs along the Santa Fe. Springs managed by DRP that are addressed in this BMAP include the Ichetucknee Spring Group and Gilchrist Blue Springs.
Ichetucknee River	The Ichetucknee River is a spring-run stream that derives its flow from 10 named springs, including two first magnitude springs, and numerous unnamed springs. Drawing from a watershed extending over 200 square miles, including southern Columbia, eastern Suwannee and parts of Baker and Union counties, the Ichetucknee flows 6 miles, emptying to the Santa Fe. A noteworthy feature of the Ichetucknee system is the Ichetucknee Trace, an elongated feature thought to be a relict of a once longer river channel. The trace contains intermittent streams and numerous karst features. During flood events, numerous sinkholes along the trace act as swallets, carrying water rapidly to the spring system. Although the springs and run of the Ichetucknee still have abundant submerged aquatic vegetation, the Ichetucknee Springs Group has been classified as impaired due to elevated nitrogen. TMDLs have been established and the springs and their springshed are part of the Santa Fe River BMAP, updated in 2018. The largest contributors to nitrogen loading in the springs is from agricultural sources (56%), with an estimated 14% coming from septic systems and 13% from turfgrass fertilization (DEP 2018a).
Withlacoochee River (North)	The 115-mile-long Withlacoochee River is a major tributary of the Suwannee. The river originates in Georgia, where in its upper reaches it is mostly fed by surface water. The portion of the Withlacoochee as it approaches the Suwannee receives increasing contributions from groundwater, including first magnitude springs. As in many of the rivers in the Suwannee system, during low flows a larger portion of the river's base flow is derived from groundwater, resulting in temporary shifts in water chemistry. A TMDL has been set for nitrate nitrogen for Madison Blue Spring on the Withlacoochee River. Accordingly, the Withlacoochee in is included in the Suwannee River BMAP (DEP 2018b).
Waccasassa River	The Waccassassa River is a 29-mile long, tidally influenced, highly braided blackwater stream. The river's headwaters are Waccasassa Flats, a karst with a mosaic of depressional wetlands in Gilchrist and Levy counties. Water from these wetlands not flowing directly to the Waccasassa drains via swallets into the upper Floridan aquifer, then flows westward toward Waccasassa Bay. The river is braided over significant portions of its length and lies in a largely rural wooded landscape. Along its path, the river receives flow from Levy Blue Spring, as well as from the Wekiva River. The river's discharge is variable and tidally influenced, with a mean flow of 283 cubic feet per second. The Waccasassa River flows through an area where the Floridan aquifer is mostly unconfined. Groundwater is very important to the flow of the river as well as for the health of Waccasassa Bay. In

Waccasassa River (Cont'd)	addition to the input from the river, Waccasassa Bay also receives substantial input directly from smaller springs and submarine groundwater discharge fractures in the estuary itself. The porous nature of the surface limestones also means the aquifer is prone to contamination from pollutants and from saline water during low groundwater flow. Fecal bacterial counts in the Waccasassa River are documented to be elevated. The river is included in the Coastal Rivers Basin Surface Waters Improvement and Management (SWIM) plan (ESA et al. 2017).
Withlacoochee River (South)	The Withlacoochee River originates in the Green Swamp in Polk and Hillsborough counties and flows from south to north through the Tsala Apopka Chain of Lakes region, a mosaic of lakes and forested wetlands that make up about one-third of the basin. Near Dunnellon, the Withlacoochee is joined by the spring-fed Rainbow River and turns west to pass through a topographic break in the Brooksville Ridge known as the Dunnellon Gap. West of the ridge, the river is impounded to form Lake Rousseau and empties into the Gulf of Mexico near Yankeetown.
Rainbow River	The surface watershed of the Rainbow River covers about 77 square miles and is a hydrologic unit of the larger Withlacoochee River basin. The river is spring fed, deriving most of its flow from a group of at least 24 springs which collectively are the fourth-largest spring group in the state. The Rainbow River is classified as an Outstanding Florida Water. Portions of the Rainbow River are impaired due to elevated nitrate nitrogen, and a TMDL was established in 2013. The Rainbow Springs Group is included with the adjacent Silver Springs Group in a single BMAP. Although water from Silver Springs ultimately flows into the St. Johns River, these two adjacent spring systems share a BMAP in part because their groundwater sources share a "zone of interaction that influences the movement and direction of water flow" (DEP 2018c).
Crystal River	Crystal River is a spring-fed river that originates in Kings Bay and flows about 7 miles to the Gulf of Mexico. The Kings Bay springs complex, one of the largest spring complexes in Florida, is made up of approximately 70 springs within an area of about 600 acres. The flow rate of Crystal River typically ranges from 878 to 1,053 cubic feet per second. The Kings Bay/Crystal River springshed is about 310 square miles, occupying roughly the northern half of Citrus County. Crystal River is classified as an Outstanding Florida Water. Kings Bay was verified to be impaired due to elevated nutrients in 2012 and TMDLs were established in 2014. A BMAP was established for Crystal River/Kings Bay in 2018.
Homosassa River	The Homosassa River is a short, spring-fed river that flows almost 8 miles to the Gulf of Mexico. The river's primary source of freshwater is the Homosassa Springs Group, consisting of about 25 named springs clustered in a 4-square-mile area. The springshed is an area of about 292 square miles, occupying roughly the southern half of Citrus county as well as some of eastern Hernando County. The Homosassa River is classified as an Outstanding Florida Water.

Aquifers

The Floridan aquifer system is an important groundwater aquifer that underlies all of DRP District 2 at varying depths (Miller 1986). This is an extremely productive aquifer that consists of porous limestones from the Eocene era, predominantly the Ocala Limestone. The aquifer is confined in the eastern and northern parts of District 2 by thick, clay-rich deposits of the Hawthorn layer. The Hawthorn Formation in these areas prevents aquifer recharge and confines the aquifer, creating artesian conditions. Extensive recharge of the Floridan aquifer occurs where the aquifer is unconfined in the western part of District 2.

In some areas, there can be impermeable or near-impermeable layers within the aquifer that act as dividers between the upper and lower aquifer. There is typically relatively little mixing of the upper and lower aquifer regardless of whether an intermediate confining layer is present, and the Upper Floridan is generally the water source for springs and drinking water in Florida and is the portion of the aquifer most affected by contamination.

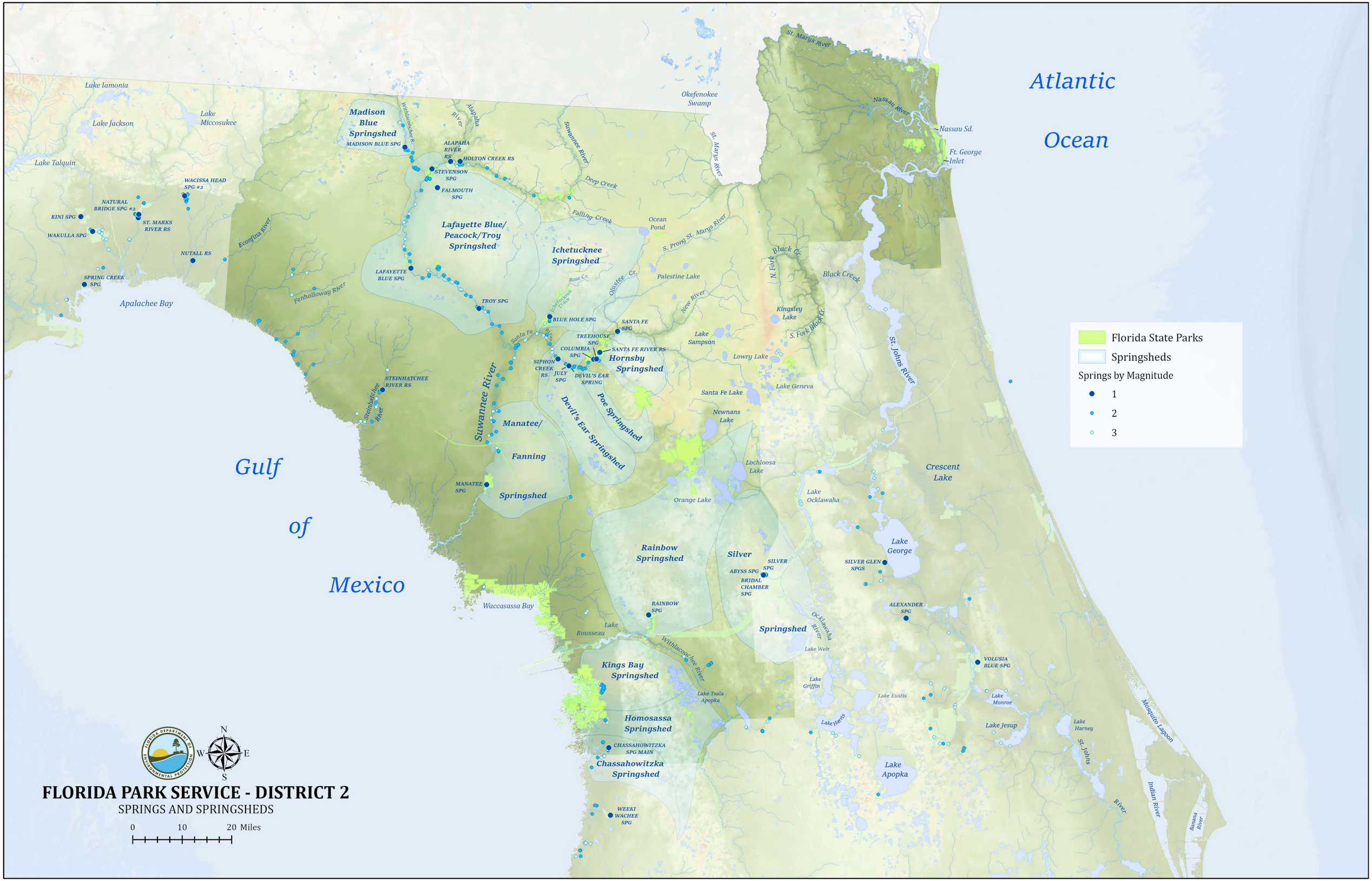
The potentiometric surface of the aquifer, the height to which the water in the aquifer would rise if it was unconfined, is an indication of the general direction of groundwater flow. In District 2, a groundwater divide near the Waccasassa Flats and the Brooksville Ridge separate the large Suwannee groundwater basin from the water flowing to the Waccasassa. The boundary between groundwater flowing east toward the St. Johns River to the east and toward the Suwannee to the west has shifted west over time. This is thought to be due to the lowering of groundwater levels by groundwater pumping in Duval and Nassau counties (Grubbs and Crandall 2007).

In areas where the Floridan aquifer is confined, occasional sand or shelly deposits in the Hawthorn layer can house an intermediate aquifer, which is sometimes locally important for wells. A surficial aquifer can exist wherever porous sands and shell lie atop the Hawthorn layer. This surficial aquifer is fed mainly by local rainfall and is important to the water table of local wetlands and lakes. Seepage from surficial and intermediate aquifers can be important to the formation of steephead ravines in localized situations, most commonly at the margins of the Trail Ridge, and for the baseflow of seepage streams.

At the seaward margin of the Floridan aquifer, a wedge of salt water extends inland, under the less dense fresh groundwater. The elevation of the zone where the two meet has continued to rise as sea levels rise and as freshwater inputs fluctuate due to droughts and groundwater withdrawal (Fernald and Purdum 1998, Copeland et al. 2011).

Springs and Springsheds

There are over 1,000 known springs in Florida, among the largest – if not the largest – concentrations of freshwater springs in the world. Nearly half of these are in the District 2 region, and over 80 are within District 2 parks. There are 19 first magnitude springs and 146 second magnitude springs known in the District 2 region. These springs are most abundant near the Cody Escarpment and along the Suwannee and Santa Fe rivers, where the impermeable Hawthorn layer gives way to porous limestone that allows for exchange between the surface and the Floridan aquifer. A second important concentration of springs lies in the southern part of the district, inland from the Gulf Coast, where groundwater – largely from inflows at another escarpment to the east – flows west and emerges from springs near the coast, including the Kings Bay system and the Homosassa Springs Group.


Atlantic
Ocean
Gulf
of
Mexico
Lake Iamonia
Lake Jackson
Lake Miccosukee
Lake Talquin
Apalachee Bay
Waccasassa Bay
Okefenokee Swamp
St. Marys River
Nassau River
Nassau Sd.
Ft. George Inlet
Madison Blue Springshed
MADISON BLUE SPG
Withlacoochee R.
Alapaha River
ALAPAHA RIVER RS
HOLTON CREEK RS
STEVENSON SPG
FALMOUTH SPG
Suwannee River
Deep Creek
Falling Creek
Lafayette Blue/ Peacock/Troy Springshed
LAFAYETTE BLUE SPG
TROY SPG
Ichetucknee Springshed
Ichetucknee Trace
Rose Cr.
Ollustee Cr.
BLUE HOLE SPG
SANTA FE SPG
TREEHOUSE SPG
COLUMBIA SPG
SANTA FE RIVER RS
Hornsby Springshed
SIPHON CREEK RS
JULY SPG
DEVIL'S EAR SPRING
Santa Fe
Devil's Ear Springshed
Poe Springshed
Manatee/ Fanning Springshed
MANATEE SPG
Ocean Pond
S. Prong St. Mary River
Palestine Lake
New River
N. Fork Black Cr.
Black Creek
Kingsley Lake
S. Fork Black Cr.
Lake Sampson
Lowry Lake
Lake Geneva
Santa Fe Lake
Newnans Lake
St. Johns River
Lochloosa Lake
Orange Lake
Lake Ocklawaha
Crescent Lake
Rainbow Springshed
RAINBOW SPG
Silver Springshed
SILVER SPG
ABYSS SPG
BRIDAL CHAMBER SPG
SILVER GLEN SPGS
Lake George
ALEXANDER SPG
Ocklawaha River
Lake Weir
VOLUSIA BLUE SPG
Lake Griffin
Lake Eustis
Lake Monroe
Lake Jesup
Lake Harris
Lake Harney
Lake Apopka
Mosquito Lagoon
Indian River
Banana River
Lake Rousseau
Withlacoochee River
Kings Bay Springshed
Lake Tsala Apopka
Homosassa Springshed
CHASSAHOWITZKA SPG MAIN
Chassahowitzka Springshed
WEEKI WACHEE SPG
WACISSA HEAD SPG #2
NATURAL BRIDGE SPG #2
KINI SPG
ST. MARKS RIVER RS
WAKULLA SPG
NUTALL RS
SPRING CREEK SPG
Econfina River
Fenholloway River
STEINHATCHEE RIVER RS
Steinhatchee River
Florida State Parks
Springsheds
Springs by Magnitude
1
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FLORIDA PARK SERVICE - DISTRICT 2
SPRINGS AND SPRINGSHEDS
0
10
20 Miles

Springsheds, the basins that contribute groundwater to a particular spring, are challenging to delineate. Through dye trace studies and other methods, understanding of which areas contribute to specific springs is growing but still imperfect. Delineation of springsheds is important for protecting springs from contamination and for ensuring the maintenance of adequate minimum flows at the springs and in the waterways they feed. Dye trace studies have shown that movement from surface conduits to springs can be rapid, in some cases more than a mile per day.

Springsheds can fluctuate over time depending on the effects of drought, rainfall and groundwater pumping. As an example, hydrologists have documented a shift in the potentiometric divide in the Floridan aquifer between groundwater flowing west to the Suwannee and water flowing east toward the St. Johns, likely due to increased groundwater pumping to meet the needs of the growing human population in northeast Florida. Due to uncertainty in springshed boundaries, multiple springs that draw from overlapping or adjoining areas are often grouped together for regulatory and management purposes.

Reverse Flow and Brownouts

If the back pressure from the river exceeds the flow from a spring, the spring can reverse flow and act as a swallet, or estavelle, as tannic river water causes a “brown out” with a dramatic reduction in visibility and light penetration. This typically occurs during high base flow periods and, in some springs, can be tidally related or result from heavy flood events. Brownouts are a natural occurrence, but due to reduced flows in many springs throughout the state, may occur more frequently than historically. These back floods can cause diebacks of submerged aquatic vegetation and troglobitic animals, especially if prolonged.

Submerged Aquatic Vegetation

Documented increases in nutrient concentrations in the Upper Floridan aquifer over time (Cohen 2007) have led to Increased nutrients in springs throughout the state. This, in turn, is a partial explanation for plant community changes in springs and spring-run streams. The diverse assemblages of submerged aquatic vegetation, including vascular plants, that were historically common are now largely macroalgae-dominated systems. There has been widespread reduction in water clarity as well due to chlorophyll from overgrowth of phytoplankton. Many springs in the state have undergone similar changes in recent decades. Even where submerged macrophytes persist, periphyton can smother macrophytes, and large-scale macrophyte die-offs have occurred (Wetland Solutions Inc. 2010).

Saltwater Intrusion

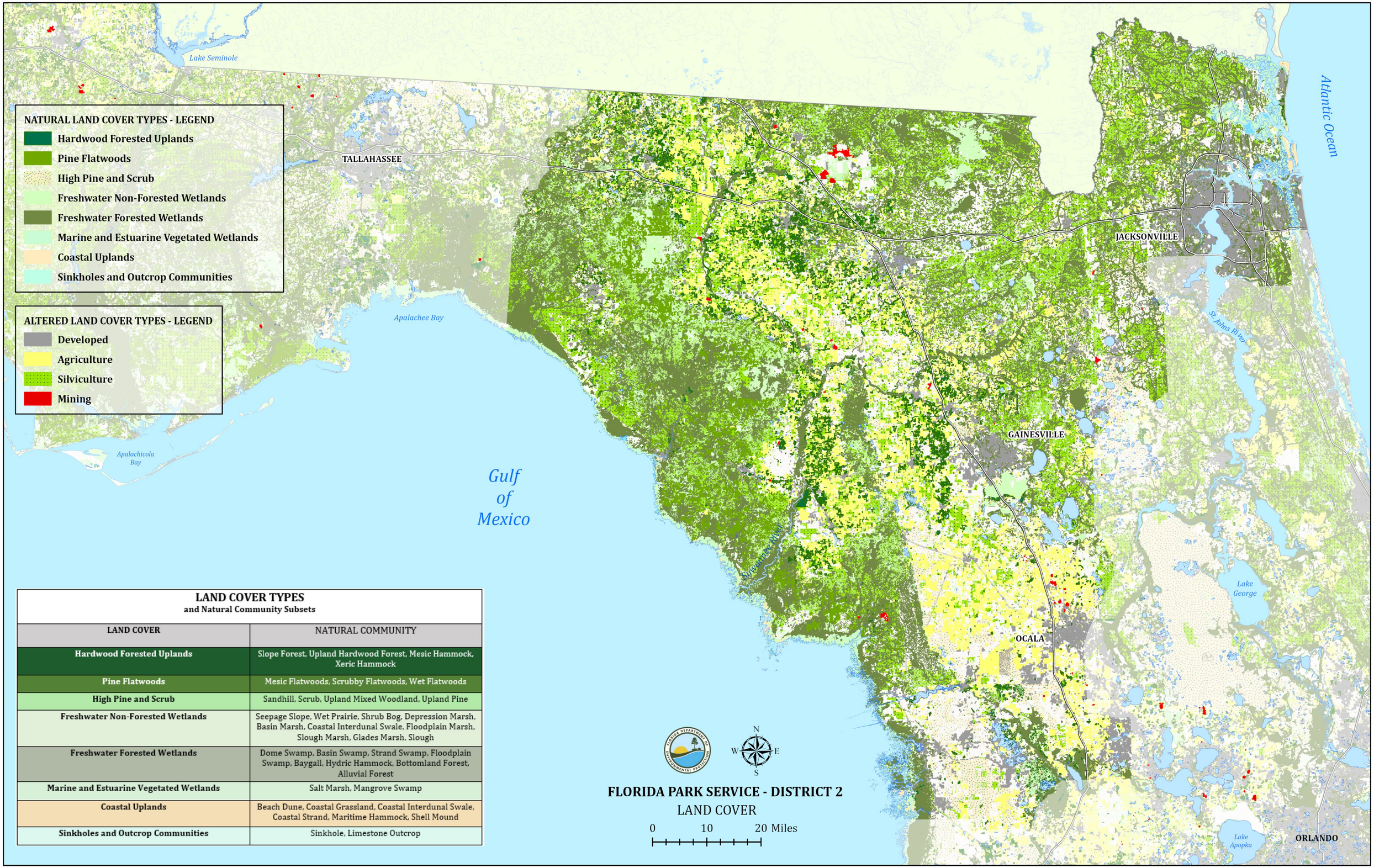
With increases in sea levels, coastal natural communities and groundwater resources are undergoing impacts due to intrusion of seawater. Where the Floridan aquifer meets saltwater at the coast, a wedge of saltwater protrudes into the aquifer, with the interface between the saltwater and the less dense fresh groundwater increasing with depth further inland. As groundwater supplies decrease due to drought and groundwater extraction, this wedge moves inland, and the zone of mixing saltwater and freshwater moves upward. This affects both wetland natural communities and groundwater supplies. Steady shifts in coastal natural communities due to changing sea levels is expected as less salt-tolerant species suffer mortality from ongoing increases in salinity. Coastal springs and drinking water supplies are also affected as the saltwater wedge moves inland and contaminates springsheds and wellfields.

DISTRICT 2 NATURAL COMMUNITIES BY LAND COVER TYPE

The following table includes the Florida Natural Areas Inventory (FNAI) natural communities found collectively within District 2 state parks. These natural communities are categorized under more general landcover types. While many are common across the district, others such as upland pine and mangrove swamp occur sparingly at the northern and southern edges of the district, respectively, marking the current limits of their geographic ranges.

Table 3. Natural Communities in District 2 State Parks

HARDWOOD FORESTED UPLANDS	
Mesic Hammock	Mesic hammock is a closed-canopy evergreen forest generally found in relatively flat areas with sandy soil. Dominant trees are live oak (*Quercus virginiana*), cabbage palm (*Sabal palmetto*), southern magnolia (*Magnolia grandiflora)*, pignut hickory (*Carya glabra*). A shrub layer of saw palmetto (*Serenoa repens*) is typically present. Other common shrub species include American beautyberry (*Callicarpa americana*) and wild olive (*Cartrema americanum*). Herbs are sparse but often include woodsgrass (*Oplismenus setarius*), bracken fern (*Pteridium aquilinum*), partridgeberry (*Mitchella repens*) and/or wood oats (*Chasmanthium laxum*).
Upland Hardwood Forest	Upland hardwood forest is a closed-canopy forest with a diverse array of mostly deciduous trees growing on relatively rich sand/clay or calcareous soils. These forests occur on rolling mesic hills, but also in fire shadows caused by hydrologic or geological features such as on slopes above creeks and sinkholes, and at intergrades between fire-dependent uplands and nearby floodplain communities. The canopy of upland hardwood forest can be very diverse, including such species as southern magnolia, pignut hickory, live oak, laurel oak (*Quercus hemisphaerica*), bluff oak (*Quercus austrina*), basswood (*Tilia americana*), American beech (*Fagus grandifolia*), hackberry (*Celtis occidentalis*), swamp chestnut oak (*Quercus michauxii*), white oak (*Quercus alba*), Florida maple (*Acer floridana*), and spruce pine (*Pinus glabra*), among others. Several species characteristic of upland hardwood forests, including white oak and American beech, reach their southern limit in north Florida. Red bay (*Persea borbonia)* is sometimes common but no longer reaches the canopy due to suppression by laurel wilt disease. Subcanopy species and shrubs can include American holly, devil's walkingstick (*Aralia spinosa*), eastern hophornbeam (*Ostrya virginiana*), horse sugar (*Symplocos tinctoria*), flowering and rough-leafed dogwood (*Cornus florida* and *C. asperifolia*), Hearts-a-bustin (*Euonymous americanus*), winged elm (*Ulmus alata*) and rusty blackhaw (*Viburnum rufidulum*). Herbs and graminoids are varied, commonly including violets (*Viola walteri* and other *Viola* spp.), longleaf woodoats, sedges (*Carex* spp.), sarsaparilla vine (*Smilax pumila*) and ebony spleenwort (*Asplenium platyneuron*). Upland hardwood forests on especially calcareous soils often share species with coastal shell mound communities, such as soapberry (*Sapindus saponaria*), climbing buckthorn (*Sageretia minutiflora*) and Godfrey's privet (*Forestiera godfreyi*). Areas of these forests along slopes above creeks where groundwater seepage may occur have sometimes been called slope forests, but the slope forest community is limited to steep slopes of the panhandle, where it is characterized by endemic and northern relict species not found in the northern peninsula. There is also substantial overlap with mesic hammock, which generally has a more species-depauperate, evergreen canopy and fewer understory components.
Xeric Hammock	Xeric hammock is a closed-canopy forest dominated by sand live oak (*Quercus geminata*) and a shrub layer often consisting of saw palmetto, rusty staggerbush (*Lyonia ferruginea*), sparkleberry (*Vaccinium arboreum*), deerberry (*Vaccinium stamineum*) and wild olive. Herbaceous species are often sparse but can include



LAND COVER TYPES
and Natural Community Subsets

LAND COVER	NATURAL COMMUNITY
Hardwood Forested Uplands	Slope Forest, Upland Hardwood Forest, Mesic Hammock, Xeric Hammock
Pine Flatwoods	Mesic Flatwoods, Scrubby Flatwoods, Wet Flatwoods
High Pine and Scrub	Sandhill, Scrub, Upland Mixed Woodland, Upland Pine
Freshwater Non-Forested Wetlands	Seepage Slope, Wet Prairie, Shrub Bog, Depression Marsh, Basin Marsh, Coastal Interdunal Swale, Floodplain Marsh, Slough Marsh, Glades Marsh, Slough
Freshwater Forested Wetlands	Dome Swamp, Basin Swamp, Strand Swamp, Floodplain Swamp, Baygall, Hydric Hammock, Bottomland Forest, Alluvial Forest
Marine and Estuarine Vegetated Wetlands	Salt Marsh, Mangrove Swamp
Coastal Uplands	Beach Dune, Coastal Grassland, Coastal Interdunal Swale, Coastal Strand, Maritime Hammock, Shell Mound
Sinkholes and Outcrop Communities	Sinkhole, Limestone Outcrop

Xeric Hammock (Cont'd)	sandyfield beaksedge (*Rhynchospora megalocarpa*), witchgrasses (*Dichanthelium* sp.) and composites such as goldenrod (*Solidago* sp.) and *Carphephorus* sp. This community occurs on deep sand substrates, often in the fire shadow resulting from lakes or topographic features. This community differs from most other communities of sandy xeric conditions in that it is not fire-dependent. It is generally a late successional stage of scrub, scrubby flatwoods or sandhill where fire has been excluded, and species characteristic of scrub (e.g., Chapman's oak, *Quercus chapmanii*) or sandhill (e.g., turkey oak, *Quercus laevis*) may be present.
HIGH PINE AND SCRUB	
Sandhill	Sandhill is an open savanna of widely-spaced longleaf pine (*Pinus palustris*) with a dense groundcover of wiregrass (*Aristida stricta*), other grasses, forbs and legumes. The midstory generally consists of one or more deciduous oaks (turkey oak, bluejack oak (*Quercus incana*) or sand post oak (*Quercus margarettae*) or a mixture). Scattered pricklypear (*Opuntia humifusa*) cacti are common in the diverse groundcover that often includes gopher apple (*Geobalanus oblongifolius*), pineywoods dropseed (*Sporobolus junceus*), lopsided Indiangrass (*Sorghastrum secundum*), bluestems (*Andropogon* spp.), oblongleaf twinflower (*Dyschoriste oblongifolia*), dogtongue wild buckwheat (*Eriogonum tomentosum*), narrowleaf silkgrass (*Pityopsis graminifolia*), blazing stars (*Liatris* spp.), coastalplain honeycomb-head (*Balduina angustifolia*), summer farewell (*Dalea pinnata*), milkpeas (*Galactia* spp.), snoutbeans (*Rhynchosia* spp.) and scurf hoary-pea (*Tephrosia chrysophylla*). Sandhills are mostly found on well-drained, nutrient poor sand ridges remaining from ancient shoreline systems. In District 2 they are found extensively along the Trail Ridge and Brooksville Ridge but can occur anywhere suitable soils are found. Healthy examples of these communities have a very diverse groundcover, which typically is more depauperate in areas where fire suppression, agriculture or silviculture have been part of the historic management. Many of the perennial herbaceous species characteristic of sandhills are unlikely to recolonize after soil disturbance, so areas with a history of intensive use typically require restoration. Sandhills require fire approximately every one to three years to prevent proliferation of woody species and reductions of the groundcover due to shading. Fires during the natural lightning season are generally more effective in controlling woody encroachment and are required by some species to flower or produce seeds. This community provides habitat for numerous imperiled species including gopher tortoise, eastern indigo snake, striped newt and southeastern American kestrel.
Scrub	This evergreen shrub-dominated community is found on xeric, nutrient-poor soils of sand ridges and in fire shadows. The shrub layer consists of evergreen oaks (sand live oak, myrtle oak (*Quercus myrtifolia*) and Chapman's oak) often with *Lyonia* spp. and other sclerophyllous shrubs. There is little to no herbaceous cover. Several variants of the scrub community exist. Scrub dominated by oaks is referred to as "oak scrub," whereas the "rosemary scrub" variant, which may occur on the most xeric, nutrient-poor sites, includes the needle-leafed Florida rosemary (*Ceratiola ericoides*). "Sand pine scrub" areas are similar to other scrub types, with the addition of a sparse to dense overstory of sand pine (*Pinus clausa*). Scrub is nearly endemic to Florida but varies somewhat in composition throughout the state. The ancient dune ridges in the central peninsula support extensive scrubs that are considered the oldest communities in the state and harbor many rare endemic species. In contrast, scrub in the northern part of the state, including District 2, is generally younger in origin and lacks the high levels of endemicity found elsewhere. However, north Florida scrub is important habitat for several rare and/or imperiled species, including the Florida scrub-jay and gopher tortoise.

Scrub (Cont'd)	Scrub is highly fire-dependent, but in contrast to other fire-type communities in Florida, it burns less frequently and with higher intensity. Fire return intervals in scrub may range from five years to over 50 years. Oak scrub is thought to have typically burned every five to 20 years, whereas rosemary scrub every 10 to 40 years, and historic inter-fire intervals in sand pine scrub probably exceeded 10 years. Optimal management of scrub for Florida scrub-jays requires that fire (or mechanical treatments) should occur often enough to maintain average shrub heights of 4-5.5 feet.
Upland Mixed Woodland	Upland mixed woodland typically consists of an open to moderately dense canopy of southern red oak, mockernut hickory (*Carya tomentosa*), and longleaf pine with other mixed hardwoods. Scattered shrubs and small trees are present, often including sassafrass (*Sassafras albidum*), hawthorns (*Crataegus* spp.) and flowering dogwood. The herb layer is well developed, but wiregrass is infrequent or absent. Upland mixed woodland shares much in common with upland pine but is characterized by a general lack of wiregrass and turkey oak, and by the codominance of hardwoods in the canopy. Upland mixed woodland is found on mesic-xeric uplands on loamy soils with higher nutrient availability than the sandy soils typical of similar communities. This community is at or near its southern limit in north Florida, and although some more extensive stands exist in the District 2 region, the community is more likely to occupy ecotones between sandhills and lower elevation areas. The upland mixed woodland fire regime is not well understood. A variety of fire return intervals ranging from every two years to once every 10 years have been suggested. It is likely that fire at the more frequent end of this continuum is necessary for the maintenance of community structure and composition. Throughout its range, this community has been impacted by logging, agriculture and fire exclusion. As a result, the historic extent of this community is often difficult to delineate, but it was probably often present at intergrades between sandhill/upland pine and more mesic communities.
Upland Pine	Upland pine is a savanna community with a canopy of widely spaced longleaf pine, generally intermixed with southern red oak (*Quercus falcata*), with a rich herbaceous groundcover layer that includes wiregrass. It is found on uplands with excessively-drained to moderately well-drained sandy or sandy clay soils. Low-growing species such as dwarf huckleberry (*Gaylussacia dumosa*), running oak (*Q. elliottii*), gallberry (*Ilex glabra*) and Darrow's blueberry (*Vaccinium darrowii*) are frequent. Herbaceous cover varies from sparse to abundant depending on the density and shading effects of the shrubs. Wiregrass is often dominant, but a high diversity of grasses and forbs may be present, including creeping little bluestem (*Schizachyrium stoloniferum*), indiangrass (*Sorghastrum* spp.), oblongleaf twinflower, silkgrass (*Pityopsis* spp.), bracken fern, rice button aster (*Symphyotrichum dumosum*) and often a diverse suite of legumes including sensitive pea (*Chamaecrista nictitans*), sensitive briar (*Mimosa quadrivalvis*), sidebeak pencil flower (*Stylosanthes biflora*) and hoary-pea (*Tephrosia* spp.). This community, which reaches its southern limit in the northern peninsula, significantly overlaps in plant species composition with sandhill and upland mixed woodland. Upland pine can be distinguished from sandhill by the presence of southern red oak, and from upland mixed woodland by the dominance of wiregrass. Upland pine occurs in rolling uplands at intergrades between sandhill and more mesic forest types, or as a mosaic with sandhill and upland mixed woodland. The open structure of upland pine is dependent on frequent fire on the order of every one to three years to prevent encroachment of woody species. As with upland mixed woodland, the historic extent of this community is difficult to delineate due to widespread impacts of logging, agriculture and fire exclusion. It likely was somewhat common in areas where upland soils have a significant clay component. Current examples are sometimes dominated by loblolly pine rather than the longleaf that was likely dominant prior to the 19th century.

FRESHWATER FORESTED WETLANDS	
Alluvial Forest	Alluvial forests are found in floodplains, typically along large rivers, and are closed-canopy forests mainly consisting of deciduous species such as water hickory (*Carya aquatica*), overcup oak (*Quercus lyrata)*, diamond-leaved oak (*Quercus laurifolia*), green ash (*Fraxinus pennsylvanica*), American elm (*Ulmus americana*), water locust (*Gleditsia aquatica*) and river birch (*Betula nigra*). The understory is often sparse but can include green hawthorn (*Crataegus viridis*), swamp dogwood (*Cornus foemina*), eastern swampprivet (*Forestiera acuminata*), dwarf palmetto (*Sabal minor*), coastalplain willow (*Salix caroliniana*), black willow (*S. nigra*) and American hornbeam (*Carpinus caroliniana*). Herbaceous groundcover varies, but most often includes false nettle (*Boehmeria cylindrica*), butterweed (*Packera glabella*), netted chain fern (*Woodwardia areolata*), redtop panicum (*Panicum rigidulum*) and big carpetgrass (*Axonopus furcatus*). This floodplain community is typically inundated annually during the growing season, and its dominant plants are highly tolerant of deep flooding that coincides with new spring growth. The soils are alluvial deposits of sand, silt, clay or organic soil influenced by ongoing depositional and erosional processes resulting from flooding. Alluvial forests generally occur parallel to rivers and spring runs, but are often separated from them by more-frequently-inundated floodplain swamp or floodplain marsh communities. This community is not fire-dependent.
Basin Swamp	Basin swamps are typically large wetlands in irregularly shaped basins with a peat substrate. The canopy generally consists of pond cypress and/or swamp tupelo, with other mixed hardwoods such as red maple (*Acer rubrum*), dahoon (*Ilex cassine*), swamp bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), loblolly bay (*Gordonia lasianthus*), swamp laurel oak, sweetgum (*Liquidambar styraciflua*), water oak (*Quercus nigra*), green ash, American hornbeam and American elm. The understory may be shrubby with species such as Virginia willow (*Itea virginica*), swamp dogwood, swamp doghobble (*Leucothoe racemosa*), fetterbush (*Lyonia lucida*), wax myrtle (*Myrica cerifera*), titi (*Cyrilla racemiflora*) and common buttonbush (*Cephalanthus occidentalis*). Herbs are typically sparse but may be locally abundant. Airplants (*Tillandsia* spp.) and resurrection ferns (*Pleopeltis michauxiana*) are common epiphytes on the cypress and oaks. These swamps are seasonally inundated in most years and may have still or flowing water, although they do not receive significant inflow from rivers. Basin swamps can be found in a variety of settings. Some occur as isolated wetlands in flatwoods landscapes, whereas others occur as a mosaic with other forested wetlands or surrounding lakes or marshes. Fire may be occasional or rare depending on the landscape. For example, the edges of basin swamps in flatwoods landscapes may be exposed to frequent fires, whereas basin swamps intermixed with bottomland forests or hydric hammocks rarely, if ever, burn. Basin swamps are very similar to dome swamps in composition, but basin swamps are generally larger, less exposed to fire, and typically have more peat accumulation. Floodplain swamps are also similar in composition, although the hydrology of floodplains favors bald cypress rather than the pond cypress found in basin swamps.
Baygall	Baygalls are forested wetlands that typically occur at the bases of slopes or in depressions where they are fed by groundwater seepage from the surrounding landscape. These peat-filled wetands are often saturated but only occasionally inundated. These swamps normally have a closed canopy of evergreen trees consisting of some combination of loblolly bay, sweetbay, and/or swamp bay, although slash pines (*Pinus elliottii*) may also be common or dominant. The shrub layer, often consisting of titi, fetterbush and large gallberry (*Ilex coriacea*) is often dense. Vines such as laurel

Baygall (Cont'd)	greebriar (*Smilax laurifolia*) are common. Herbs, when present, can consist of species such as lizard's tail (*Saururus cernuus*) and ferns. These swamps are most easily distinguished from other forested wetlands by the dominance of evergreen bay species and by their position in the landscape. The shady, saturated conditions found in baygalls normally prevent fire from entering this community.
Bottomland Forest	Bottomland forest is a deciduous or mixed deciduous-evergreen forest generally found in broad shallow depressions, often above river or creek floodplains or as a fringe around basin swamps. The canopy can consist of a wide variety of tree species including water oak, sweetgum, diamond-leaved oak, sweetbay, red maple, loblolly pine, spruce pine, and live oak. Cypress and tupelo can be present but are not dominant. The understory and shrub layers can contain American hornbeam, dwarf palmetto and wax myrtle. Herbs can be sparse to abundant, and often include witchgrasses and slender woodoats. This community is occasionally inundated but usually not for long periods. Bottomlands are distinguished from mesic hammock by the dominance of mixed mesophytic and hydrophytic trees rather than evergreen oaks and cabbage palm, and from upland hardwood forest by the absence of upland species such as southern magnolia and pignut hickory. They differ from more frequently inundated forested wetlands by the lack of dominance by cypress or swamp tupelo. Fire is rare in bottomland forests.
Dome Swamp	Dome swamps occupy small to large shallow isolated depressions within fire-maintained communities. Typically, the canopy consists of pond cypress and/or swamp tupelo. Other tree species such as red maple or sweetbay may be present but are usually not dominant. Shrubs are sparse to moderate, with fetterbush, dahoon and wax myrtle among the most common species. A variety of herbaceous plants such as Virginia chain fern (*Woodwardia virginica*), sedges (*Carex* spp.), beaksedges, and grasses such as *Coleataenia* spp. can occur. Floating or submerged aquatic species may be found in deeper zones in some dome swamps. Dome swamps are seasonally inundated and typically have still water and no well-defined inflow or outflow. Fires in adjacent communities occasionally burn into the edges of dome swamps or across them, which may contribute to the domed profile, with larger trees in the center and smaller trees at the margins. Dome swamps dominated by swamp tupelo are sometimes known as "gum ponds." These may result from differences in the surrounding fire and hydrologic conditions and often occur in upland pine landscapes. Dome swamps dominated by tupelo can also result from historic logging of cypress or from succession of marsh communities.
Hydric Hammock	Hydric hammocks are mesic to hydric forests found in low flat areas, typically where limestone is near the soil surface or where soils have high shell content. Characteristic canopy trees of this community are diamond-leaved oak, live oak, cabbage palm and red cedar (*Juniperus virginiana*), although other hardwoods are often intermixed. Smaller trees and shrubs can include American hornbeam, Walter's viburnum (*Viburnum obovatum*) and wax myrtle. Vines are common, including climbing hydrangea (*Decumaria barbara*), greenbriers (*Smilax* spp.) and poison ivy (*Toxicodendron radicans*). This community is found in level, poorly-drained areas and in shallow depressions. It may be frequently saturated due to poor drainage or flooded for short periods. Hydric hammock is not considered a fire-dependent community, although it can burn rarely to occasionally depending on the size and landscape context. Cabbage palm is

Hydric Hammock (Cont'd)	highly tolerant of fire, but red cedar is susceptible to burning and generally not found in recently burned hammocks. Some hydric hammock in this region consists of the coastal hydric hammock variant. Due to salinity, these hammocks have a somewhat less diverse canopy consisting of cabbage palm, red cedar and live oak, and are often found adjacent to salt marsh. Hydric hammock can be difficult to distinguish from other similar communities, but cabbage palm and red cedar are good indicators.
Floodplain Swamp	Floodplain swamps are hydric forests that are usually inundated and typically have a canopy of bald cypress and/or tupelo, with other wetland trees often mixed in the canopy. They occur along rivers, creeks and spring runs, where they are found at the edges of waterways as well as in backwaters and low areas behind levees. Midstory and groundcover are often sparse. Carolina ash (*Fraxinus caroliniana*), water elm (*Planera aquatica*), buttonbush, dahoon holly in the midstory, and string lily, lizard's tail, savannah panicum (*Phanopyrum gymnocarpon*), royal fern and others in the groundcover are among the species that can be found. Fire is generally rare in this community. The freshwater tidal swamp variant of this community can be found near river mouths along the Gulf Coast. These differ from the more widespread floodplain swamps due to pulsed flooding from tidal action. These freshwater tidal swamps mostly or entirely lack cypress and instead have an open to closed canopy of swamp tupelo, pumpkin ash and sweetbay. Leather fern and sawgrass can be common.
COASTAL UPLANDS	
Beach Dune	Beach dune communities consist of the earliest suite of species that colonize and stabilize the upper beach and foredune. These are open, herbaceous communities with no woody canopy. Dominant species include sea oats, railroad vine, bitter panicum (*Panicum amarum*), and/or mixed salt-spray tolerant grasses and herbs. Species in this community need to be tolerant of burial or able to recolonize quickly, as sand is continually deposited by wind action. Beach dunes grade into marine unconsolidated substrate on the seaward side, and into coastal strand, coastal grassland or interdunal swale on the landward side. This community is an important nesting habitat for a number of imperiled birds, including snowy plover (*Charadrius nivosus*), American oystercatcher (*Haematopus palliatus*), black skimmer (*Rynchops niger*) and least tern (*Sternula antillarum*) and also is used for nesting by sea turtles. Fire is not common in this community, as the adjacent beach provides no opportunity for ignitions on the seaward side and the often patchy vegetation can limit the spread of any fires that do occur.
Coastal Grassland	This herbaceous community occupies the transitional zone between beach dunes and more inland communities dominated by woody plants. Coastal grasslands are dominated by salt-tolerant grasses and herbs. Typical species include sea oats, bitter panicum, camphorweed, saltmeadow cordgrass (*Spartina patens*) and erect pricklypear. The coastal grasslands in northeast Florida may have more herbs than grasses, including beach pennywort (*Hydrocotyle bonariensis*), seabeach evening primrose (*Oenothera humifusa*), camphorweed and cockspur pricklypear (*Opuntia drummondii*). These grasslands are often intermixed with interdunal swale and beach dune communities.
Coastal Interdunal Swale	Coastal interdunal swales are grassy or shrubby communities that develop in elongated depressions between successive dune ridges along the coast. They are different from beach dune and coastal grassland communities in that they consist of species that can

Coastal Interdunal Swale (Cont'd)	tolerate at least occasional inundation. Most notably, they lack sea oats. While typical species include sawgrass, hairawn muhly (*Muhlenbergia capillaris*), broomsedge, seashore paspalum (*Paspalum vaginatum*), sand cordgrass (*Spartina bakeri*) and saltmarsh cordgrass (*Spartina alterniflora*), these communities are quite variable based on hydrology, depth, age of the swale and exposure to salinity. Wetter swales may be dominated by sawgrass (*Cladium jamaicense*), cattail (*Typha* spp.) or needle rush (*Juncus roemerianus*), while others may have a mix of hydrophytic herbs. Shrubby swales are likely to have a low canopy of wax myrtle and/or coastal plain willow. In swales nearest to the coast where saltwater influences are most significant, more salt-tolerant species such as seashore paspalum and marsh fimbry (*Fimbristylis spadicea*) may be prominent.
Coastal Strand	Coastal strand is a short-statured, salt-pruned shrub community occurring on the xeric sand soils of stabilized coastal dunes. Tt generally develops just inland from sea oats-dominated beach dune communities. In north Florida, this community consists of saw palmetto and scattered dwarfed cabbage palm on the seaward edge, which are gradually joined inland by taller shrubs, including tough bully (*Sideroxylon tenax*), yaupon (*Ilex vomitoria*), Hercules' club (*Zanthoxylum clava-herculis*) and stunted red bay, red cedar, and live oak. Soils of coastal strands are generally shelly sands that are somewhat alkaline. This community is dynamic, particularly in barrier island systems due to the erosional and depositional processes of island building. In addition to originating from woody succession of coastal grasslands or beach dune, it can also arise as salt spray impacts maritime hammocks. Fire is not common in coastal strand, and coastal strand is generally not considered a fire-dependent community. However, the natural fire frequency in this community is not well understood. Fire may have historically interacted with salt spray to maintain large areas of coastal strand vegetation.
Maritime Hammock	Closed-canopy evergreen forests on stabilized coastal dunes are known as maritime hammock. These communities are xeric to mesic, with excessively drained soils, but litter layer and closed canopy maintain higher relative humidity. The marine influence limits the canopy to more salt-tolerant species, generally consisting of live oak, cabbage palm, red bay and red cedar, although other species such as laurel oak and southern magnolia may be present. These communities are typically found in areas of rolling topography, although they can also occur in more level areas. Along the northeast Florida coast, maritime hammocks are generally found on shelly sands. Mesic hammocks are very similar communities but occur inland from the more recently stabilized dunes that support maritime hammocks. Maritime hammocks do not generally burn.
Shell Mound	This community occurs on ancient shell deposits left by Native Americans. In the northern peninsula, they are found on both the Atlantic and gulf coasts. Shell mound communities are normally closed canopy forests of mixed hardwoods, including live oak, southern red cedar, yaupon holly and palms. The calcareous substrate results in somewhat unique flora, which may include such species as soapberry, climbing buckthorn and Godfrey's privet. Shell mounds in District 2 mark the northern range limit of some more tropical species (low peperomia, *Peperomia humilis* and wild coffee, *Psychotria nervosa*). Fire and flooding are not typical occurrences in shell mound communities

PINE FLATWOODS	
Mesic Flatwoods	Mesic flatwoods are open savannas of widely spaced pines, generally lacking a midstory but with a rich layer of low shrubs and herbs. The canopy can consist of longleaf pine or slash pine, with slash being more common in coastal flatwoods and where the water table is higher. Common shrubs include saw palmetto, gallberry, shiny blueberry (*Vaccinium myrsinites*), dwarf live oak (*Quercus minima*) and huckleberries (G*aylussacia* spp.). Herbaceous species include wiregrass, other bunchgrasses such as lopsided indiangrass, and wildflowers such as vanillaleaf (*Carphephorus odoratissimus*). These communities require extremely frequent fire (every two to four years). Natural fires historically occurred predominantly during the late spring and early summer. Without frequent fire, encroachment of hardwoods and overgrowth of shrubs reduces biodiversity and increases wildfire risk. Many flatwoods now dominated by slash pine were once longleaf pine flatwoods. The dominance of slash pine in north Florida has probably increased due to forestry activities and changes in fire regime.
Scrubby Flatwoods	Scrubby flatwoods occur on slight rises above mesic flatwoods or at intergrades between flatwoods and more xeric communities. These open flatwoods have a canopy of widely spaced pines over a shrub layer of saw palmetto and scrub oaks (myrtle oak, sand live oak, and Chapman's oak) with wiregrass and other herbaceous species in gaps between the shrubs. The vegetation is a mix of mesic flatwoods and scrub species. This community typically grows in relatively flat areas with sandy soils. This is a fire-dependent community, with intervals between fires somewhat longer than other flatwoods types (approximately every five to 15 years).
Wet Flatwoods	Wet flatwoods occur on sandy soils in level, poorly-drained areas where the inundation occurs annually as a result of poor drainage and a high water table. A semi-closed to open canopy of slash pine or longleaf pine is typical, with pond pine *(Pinus serotina)* becoming dominant in some seepage areas. The midstory, if present, is an open mix of large gallberry, fetterbush and sweetbay. The shrub layer may be dense or it may be sparse and open with a lush and diverse groundcover including graminoids such as wiregrass, toothache grass (*Ctenium aromaticum*) and beaksedges, and other herbaceous plants including hooded pitcher plant (*Sarracenia minor*), milkworts (*Polygala* spp.), meadowbeauties (*Rhexia* spp.) and rosegentians (*Sabatia* spp.). Fire is required for maintenance of wet flatwoods. Grassy wet flatwoods should be burned approximately every two to four years, while shrubbier variants may only burn on every five to 10 years. Near the Gulf Coast, where limestone influences surface soil chemistry, wet flatwoods may be the "sweet flatwoods" variant, with a canopy of mixed cabbage palm and pines. In these flatwoods, hairawn muhly and sawgrass may be common.
FRESHWATER NON-FORESTED WETLANDS	
Basin Marsh	Basin marshes are herbaceous wetlands occurring in large depressions with peat or sand substrate, in fluctuating lake basins or at lake margins, or as marshy inclusions in communities that are not fire-dependent. These marshes are variable in their composition but generally have grassy zones that can contain giant cutgrass (*Zizaniopsis miliacea*), maidencane (*Panicum hemitomon*), sawgrass, and/or baker's cordgrass, whereas deeper areas within the marsh can be populated with pickerelweed (*Pontederia cordata*), white water lily (*Nymphaea odorata*), American lotus (*Nelumbo lutea*), bulltongue arrowhead (*Sagittaria lancifolia* subsp. *lancifolia*) and spatterdock (*Nuphar advena*). Beggarticks (*Bidens* spp.) can be common. Woody plants such as coastalplain willow, buttonbush and willow-herb

Basin Marsh (Cont'd)	(*Decodon verticillatus)* often occur in sporadic patches, sometimes on floating islands of organic material, but may also become the dominant vegetation in mucky, unburned marshes. Basin marshes are important as foraging habitat for wading birds, and, where suitable shrubs are available, as rookery sites as well. They also provide important habitat for rare species such as Florida sandhill crane and round-tailed muskrat. Fire is occasional to frequent in these communities, and where hydrological alterations have taken place, fire may be especially important to prevent conversion of the marsh to a forested wetland.
Depression Marsh	Depression marshes are generally small, isolated, often rounded depressions in sand substrate with peat accumulating toward the center, surrounded by fire-maintained communities. These herbaceous wetlands are often made up of concentric zones of vegetation that may include sand cordgrass, maidencane, sawgrass, pickerelweed and St. John's worts (*Hypericum* spp.). Shrubs such as buttonbush and coastalplain willow are normally only occasional, formed in small central thickets or scattered around the edge. Depression marshes are seasonally inundated and experience frequent or occasional fires. Drought and/or fire suppression can result in colonization by woody species such as pines, tupelo, red maple invasive Chinese tallow (*Triadica sebifera*), and/or willows. Depression marshes are most commonly found in pineland landscapes, but, in coastal settings, some elongated freshwater wetlands that occur between older dunes probably most resemble this community.
Floodplain Marsh	Floodplain marshes are seasonally inundated herbaceous communities occurring on generally sandy alluvial deposits in floodplains or along channels of creeks, rivers and spring runs. This community generally lacks trees but can have occasional to abundant shrubs such as coastalplain willow and buttonbush. Herbaceous species can consist of giant cutgrass, sawgrass, maidencane, sand cordgrass and/or pickerelweed. Depending on landscape, these habitats may burn as much as every three years. The freshwater tidal marsh variant of this community occurs along some creeks near the gulf coast where tidal pulses of freshwater occur, as well as occasional saltwater influences during low flow periods, extreme tides and storms. These marshes often consist of a mix of freshwater and saltwater species and are generally dominated by sawgrass.
MARINE AND ESTUARINE VEGETATED WETLANDS	
Mangrove Swamp	Mangrove swamp is a low-statured estuarine forested wetland that is inundated with saltwater on a daily basis. This community is dominated by red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*) and buttonwood (*Conocarpus erectus*). Mangrove forests sometimes grade into salt marsh but more typically occur as isolated islands. These communities are important nursery grounds for a wide variety of ecologically, commercially and recreationally important fish species and also serve as rookery sites for numerous wading and seabird species. Although black mangrove extends slightly further north, mangrove forests reach their northern limit in northern peninsular Florida.
Salt Marsh	Salt marsh is an herbaceous wetland inundated with saltwater by daily tides. This community usually has distinct zonation of densely-growing graminoids depending on tidal range, often with saltmarsh cordgrass in the areas most frequently inundated, and

Salt Marsh (Cont'd)	needle rush dominating areas above the mean high water mark. Other species include saltgrass (*Distichlis spicat*a), saltwort (*Batis maritima)*, perennial glasswort (*Salicornia bigelovii)* and seaside oxeye (*Borrichia frutescens*). Areas of less densely vegetated salt flat may be interspersed with the marsh. These are slightly higher areas that flood only during extreme high tides or storms and become desiccated and saline. These areas have more sparse vegetation than the surrounding marsh and are often dominated by succulent marsh species such as saltwort and annual glasswort and short-statured grasses such as seashore paspalum, shoregrass and saltgrass. Salt marsh may grade into freshwater tidal marsh on its upland side, or into hammock or flatwoods. Salt marsh is not considered a fire-dependent community, but it may burn rarely to occasionally from prescribed fires spreading from adjacent communities or originating in the marsh from lightning strikes.

DISTRICT 2 IMPERILED SPECIES

Every natural community type in north Florida – and some altered land cover types as well – can provide habitat for imperiled species, although these species are not evenly spread across the landscape. Some parks, such as Mike Roess Gold Head Branch State Park or parks along the Suwannee River, lie in areas that are particularly important due to the number or rarity of imperiled species present. Other parks harbor fewer rare plants and animals due to their complement of natural communities and corresponding habitats. Even parks with few imperiled species play a crucial role in biodiversity conservation at the district and state level. The distribution of three different groups of imperiled species – species of coastal habitats (salt marsh, beach dune, and shell mound), species that are found in springs, spring runs and aquatic caves, and species that use fire-dependent pinelands – can be analyzed as an example. While coastal species are unsurprisingly clustered near the Atlantic and gulf coasts, spring and cave species are most common near the Suwannee and Santa Fe rivers, and fire-dependent pineland species are scattered throughout the region. The relative lack of overlap in the distribution of these groups of rare species emphasizes the importance of the entire suite of parks across District 2 for protecting biodiversity.

A few species in District 2 parks are unique or nearly unique to the region. *Panorpa floridana*, the Florida scorpionfly, is an unusual insect known from only a few specimens from four sites in Alachua and Clay counties, two of which are in state parks (Somma et al 2013). *Sideroxylon alachuense*, the Alachua buckthorn, is a shrub or small tree that occurs in calcareous hardwood forests at four sites in Florida and one in Georgia. The population at Paynes Prairie Preserve State Park is the largest known in the world. Variable-leafed crownbeard (*Verbesina heterophylla*) is a pineland wildflower found only in northeast Florida and a small area of southeast Georgia. Only one state park (Gold Head Branch) is known to harbor this rare plant. Several invertebrates found in spring runs or aquatic caves in the district are known from only one or a handful of sites.

The red-cockaded woodpecker (*Dryobates borealis*) was once common and widespread in north Florida and throughout the southeast. Today, within the boundaries of District 2, this federally listed species is only found at a handful of sites. The reason for the decline of this woodpecker and a myriad of other once-common species lies in the loss of fire-dependent longleaf pine (*Pinus palustris*) habitats in Florida and throughout the southeast.

The composition and structure of these flatwoods, sandhills and upland pine communities depends on frequent, low-intensity fires – as often as every one to three years – that historically burned large areas due to lightning. A huge suite of grasses, wildflowers and other plants thrive in the open sunny conditions and are very resilient to fire. The rich groundcover provides food for gopher tortoises and other herbivores, creates shelter for nesting for Bachman's sparrow (*Peucaea aestivalis*) and northern bobwhite (*Colinus virginianus*) and forms the base of a food web that supports the red-cockaded woodpecker and a variety of other wildlife such as the Florida pine snake (*Pituophis melanoleucus mugitus*), brown-headed nuthatch (*Sitta pusilla*) and southeastern American kestrel (*Falco sparverius paulus*). These unique communities, among the most species-diverse in North America, once covered vast areas of the southeastern coastal plain.

Unfortunately, the majority of native pinelands in Florida and the southeast have been lost in the last two centuries. By some estimates, longleaf pine ecosystems occupy only 2-3% of their former range. While the plants found in these communities are very resilient to fire, they do not tolerate soil disturbance, so even temporary conversion to other land uses eliminates the herbaceous groundcover. Once these sites are abandoned, the characteristic pineland groundcover species are poor colonists and rarely if ever re-establish. Likewise, longleaf pine, with the largest seeds of any southern pine, has a limited ability to recolonize when large areas are clearcut. Without the pine needles and grasses needed to carry fire, disturbed sites usually undergo succession to low-diversity successional forests.

The longleaf communities that do remain often suffer from the lack of fire. A statewide assessment of Florida's longleaf pine ecosystems in 2019 found that more than half of the sites were in poor to fair condition. When fires are excluded, the pinelands are invaded and transformed by a small number of common, fast-growing woody plants. These opportunistic species shade out the low-growing pineland plants and the layer of grasses and pine needles that carries low-intensity fire is replaced by densely packed hardwood leaves that prevent fires from spreading. Without fire, opportunistic plants such as laurel oak and water oak continue to proliferate, leading to the demise of the habitat. Loss of the dense cover of bunchgrasses and herbs eliminates shelter and food needed by countless species, and the proliferation of a woody understory renders the habitat unusable for the many species that rely on open structure for movement and foraging. Thus, with the exclusion of fire, pinelands are transformed from a diverse and complex community with hundreds of unique species of plants and animals to a low-diversity habitat suitable for only a few common species.

The recurrent wildfires that gave rise to these habitats are neither desirable nor possible in the modern landscape. In state parks and other natural areas, careful use of prescribed fire is necessary to keep these communities suitable for the species that depend on them. When fire has been excluded for too long, or when the characteristic plants have been eliminated by past disturbances, prescribed fires are no longer possible and other restoration tools such as thinning, mowing or herbicides are used to remove the species that have invaded. Longleaf pine, wiregrass and other species must be planted to ensure that the natural process of fire can once more be used to maintain suitable habitat for the red-cockaded woodpecker and many other imperiled species that rely on these habitats that are so much a part of "the real Florida."

Gopher tortoises (*Gopherus polyphemus*) are among the best-known species of Florida's sandhills and other xeric communities. Tortoises are considered a keystone species because of the outsized importance of their burrows for other species. Tortoise burrows, which often extend over 20 feet below ground, are more than just a refuge for the tortoise. Tortoise burrows provide a cool, sheltered microclimate from the Florida sun and allow many other species a place to shelter from heat, predators and fires. Species such as the gopher frog (*Lithobates capito*), Florida mouse (*Podomys floridanus*) and

eastern indigo snake (*Drymarchon couperi*) regularly use tortoise burrows for shelter, and several species of invertebrates have evolved to rely exclusively on gopher tortoise burrows. In all, over 350 species have been documented using gopher tortoise burrows.

Florida is well known for its beaches, but the importance of coastal state parks extends well beyond their recreational value for people. A narrow ribbon of unique natural communities extends along the coast, where, because suitable conditions extend only a short distance from the ocean, these habitats were much less abundant than many inland communities, even without the impacts of coastal development. These unique habitats are important for rare and common species alike. Several species of shorebirds and seabirds nest, feed and roost on barrier islands, beaches and beach dunes. Many are imperiled due to loss of these habitats to coastal development. Five species of sea turtles, all federally threatened, nest on Florida's beaches. Unique subspecies of marsh wren, seaside sparrow and mink, along with other rare animals, are found only in coastal salt marshes. Dozens of species of migrating songbirds rely on maritime hammock as stopover sites, where they eat wild fruits and insects to refill their energy stores for long journeys between North America and the tropics. Beach dunes, critical for protecting inland areas from the ravages of hurricanes and tropical storms, can have some of the highest densities of gopher tortoises in any habitat. Shell mound communities occurring on indigenous coastal shell middens provide carbonate-rich soil conditions that support imperiled species not found in other habitats. One of these, terrestrial peperomia (*Peperomia humilis*), reaches its northern limit in the parks of District 2.

DISTRICT 2 INVASIVE SPECIES

Invasive Plants

Approximately 1,557 species of non-native plants have been documented in Florida. These are species that originated in other parts of the world and were brought to Florida, intentionally or otherwise, by human activity. The majority of these are not known to spread aggressively in natural areas, but 166 non-native plant taxa are listed as invasive by the Florida Invasive Species Council (FISC 2019). These are species that not only colonize natural areas, but that are documented to have negative impacts. Approximately half of the invasive plants on the FISC list – 83 species – have been documented in the counties that are covered by District 2.

Counties in District 2 range from having 10 to 63 documented invasive plants. This variation may be influenced by many factors, including the size of the county, its diversity of habitats, the human population, and the amount of habitat fragmentation and alteration within the county. Some of the apparent differences from county to county are likely due to differences in scientific attention. Fewer biologists and fewer managed areas in some counties may simply result in invasive species being overlooked.

As of 2022, 62 FISC-listed species have been found in District 2 parks. Across the region, the distribution of the various invasive plants varies. Several species such as silktree mimosa (*Albizia julibrissin*), camphortree (*Cinnamomum camphora*), Japanese climbing fern (*Lygodium japonicum*), Chinaberry (*Melia azedarach*) and Chinese tallow (*Triadica sebifera*) are widespread, occurring in half or more of District 2 parks, whereas 18 invasive plants have been found in only one park.

For invasive species that are less widespread across the park system, several factors may explain their distributions. Climate likely plays a role for some species. District 2 is at or near the northern edge of the range of several invasive plants, most notably Brazilian pepper (*Schinus terebinthifolius*). The moderating effects of the ocean on winter temperatures allows species to extend their ranges farther north along

the coasts than inland. Brazilian pepper is a serious problem in coastal parks in the district, but it is not yet well established inland at similar latitudes. Habitat specificity also plays some role. *Ardisia crenata*, for example, is shade-tolerant and typically occurs in hardwood forests. In District 2 it is most often found in interior parts of the district where richer soils favor hardwood forest communities. Some species simply are still expanding in the region. Skunkvine (*Paederia foetida*) is an example of a species that has rapidly expanded in recent years, now occupying several parks in District 2 where FNAI surveys from 2005-06 did not record it. New invasive species such as elegant Dutchman's pipe (*Aristolochia* elegans) are expanding as people continue to move plants to new areas and regional temperatures rise.

Some non-native plants are not FISC-listed but should nonetheless be of concern to park managers in north Florida. Unlisted invasive non-natives include hardy orange (*Citrus trifoliata*), sweet tanglehead grass (*Heteropogon melanocarpus*) and centipede grass (*Eremchloa ophiuroides*). Some of these species may merit listing in the future. Others may be a localized nuisance when they persist at formerly disturbed sites or colonize restoration areas but may not be capable of invading intact natural areas. Regardless of whether these species are officially considered "invasive," they may still need to be controlled to achieve some natural resource management objectives.

One of the chief reasons invasive plants proliferate is their lack of natural controls such as herbivores and pathogens that limit their population growth in their natural range. Efforts are ongoing to identify natural enemies for several of Florida's invasive plants to control these species without affecting native species. An early success of biological control in Florida was the 1965 release of a beetle to control alligatorweed (*Alternanthera philoxeroides*), an invasive aquatic plant. The alligatorweed beetle was successful. While alligatorweed is still present in Florida, it is no longer the widespread problem it once was. Since then, potential biological controls have been studied for many invasive plants, including air potato (*Dioscorea bulbifera*), hydrilla (*Hydrilla verticillata*) and Chinese tallow (*Triadica sebifera*), and some have been authorized for release and are established in north Florida.

After years of careful study, the air potato leaf beetle (*Lilioceris cheni*) was permitted for release starting in 2012. Both adults and larvae eat the leaves of air potato, and early research showed that the species established successfully and was capable of significantly reducing leaf cover of air potato and allowing native plants to begin to recover. The beetle has been released in all counties of Florida, and from Georgia to Texas as well. Now that populations are established throughout the state, the mass rearing program of *L. cheni* is ending and focus will now be on rearing a complimentary species (*L. egena*) that eats bulbils and was authorized for release in 2022. In addition to the air potato beetles, biocontrol agents for invasive plants including tropical soda apple, Brazilian pepper and Chinese tallow have been released, and additional prospective biocontrol agents are being studied. Researchers are continuing to search for biological controls to help with other invasive plants in Florida.

Invasive Animals

Of the dozens of non-native animals established in Florida, wild hogs are certainly among the most problematic. Hogs rooting in soil for food causes widespread damage to vegetation and hydrology and can affect water quality. Hogs of every age and sex root for food on a regular basis, and it has been estimated that a single hog can root up almost two square meters per minute (Anderson et al 2007). The aggregate impacts of this behavior on natural communities can therefore be extensive (Zengel and Connor 2008; Chavarria et al. 2007). Unfortunately, the negative impacts of wild hogs in natural areas are not limited to rooting. Hogs are also regular predators on eggs, and both adult and juvenile animals carry diseases and disrupt hydrology by creating wallows.

Another widespread invasive animal is the domestic cat. Cats are highly efficient predators against which many native wildlife species have few defenses. The establishment of feral cat colonies, and even the presence of outdoor pets in or near parks, can reduce the parks' abilities to be sanctuaries for Florida's native wildlife.

Another example of non-native willdlife that is currently expanding in north Florida is the Cuban treefrog (*Osteopilus septentrionalis*), which can eat the adults of native treefrogs and whose larvae compete with native tadpoles. The presence of Cuban treefrogs has been shown to correlate negatively with native treefrogs. Another expanding invasive animal is the Argentine black-and-white tegu (*Salvator merianae*), a large, omnivorous lizard that could impact a variety of wildlife species and has been increasingly sighted in District 2 in recent years.

The history of invasive species in Florida in recent decades includes one more notable case study: the introduction of a beetle that brought a pathogen that is deadly to bay trees. The redbay ambrosia beetle (*Xyleborus glabratus*), native to Asia, was first found in Georgia in 2002 and appeared in northeast Florida in 2005. The female beetle bores through the bark of living trees in the Lauraceae family and constructs galleries in the sapwood. The females lay eggs in the galleries and inoculate the tree with a fungus that grows through the tree and serves as food for adult and larval beetles. Unfortunately, the fungus plugs the xylem of the tree, and the infected tree wilts and dies within a few weeks. As a consequence of the introduction of this species, mature red bay and swamp bay trees have been eliminated from hardwood forests, hammocks and swamps in north Florida, with unknown effects on other species that depend on their leaves or fruits for food. It is suspected that the red bay ambrosia beetle was introduced through wooden packing material. The spread of this species was likely accelerated through the movement of wood from infested trees.

DISTRICT 2 CULTURAL RESOURCES

Native American presence in north Florida by the time of European contact was dominated by the Timucuan people, a largely agrarian society of loosely affiliated villages that extended from the Atlantic Ocean to the Aucilla River. The various middens and artifacts left by the Timucuan and their predecessors offer clues to understanding the region’s indigenous people. Several important sites of contact between the native people and the colonizing Spanish occur in the District 2 region and add to this knowledge. These include Mission San Martin de Timucua, Mission San Juan de Guacara and Rancho de la Chua.

Spanish explorers arrived on the north Florida coast by about 1513. By the early 1600s, the Spanish had established missions in the interior of north Florida within or adjacent to existing native villages, with the intent of converting native peoples to Catholicism and enlisting the natives as laborers. In the mid-1500s, European powers fought for control of Florida. The brutal clash between French and Spanish colonists, and later attempts by the English to invade Spanish territory, played out against the backdrop of north Florida and are integral to the area’s history.

In 1763, the British gained and later lost control of Florida. During the 1700s, large plantations dependent on enslaved African people were established in northeast Florida. One such plantation was located on Fort George Island.

Spain's eventual transfer of Florida to the United States in 1819 ushered in an era of conflict with the amalgamation of southeastern tribes known as the Seminole, who refused orders to abandon the reservation that had been established for them in the new U.S. territory. Decisive battles between Seminole warriors and the U.S. Army occurred in the portion of north Florida now encompassed by District 2.

Following the Seminole Wars, north Florida experienced an agricultural boom that included both small homesteads and plantation agriculture. Remnants of this era are preserved within District 2 and are an important part of north Florida's human story.

The 20th century saw the development of tourism, which was often centered around springs and other attractive water features. Several former north Florida roadside attractions are now state parks that preserve the history of this era. This same time period witnessed the birth of the Florida Park Service with the creation of the first nine state parks by the Civilian Conservation Corps and the Works Progress Administration. Home to three of these original units, District 2 plays a major role in preserving this legacy.

DISTRICT 2 MAJOR INTERPRETIVE ELEMENTS

- Natural communities and their importance in preserving natural domain and ecological function.
- How processes such as fire and hydrological regimes shape and sustain Florida's natural landscapes.
- Imperiled species that call District 2 parks home.
- Geology, with emphasis on karst features of critical environmental importance such as springs and sinkholes.
- North Florida's rich history, from its indigenous people to the key figures and events that tell the region's human story.