Tate's Hell State Forest Hydrologic Restoration Plan

Volume I

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Volume II: Basin Restoration Plans 2010 – 2020

Volume II describes the approach used to development hydrologic restoration plans, provides hydrologic restoration plans for the 29 surface water drainage basins in the vicinity of Tate's Hell State Forest, provides estimated construction costs for the proposed hydrologic improvements, discusses implementation of the Hydrologic Restoration Plan and operations and maintenance of structures, and provides a summary and recommendations for both Volume I and Volume II.

Introduction

History

Tate's Hell State Forest encompasses 202,436 acres of low-lying, poorly drained land located between the Apalachicola and Ochlockonee rivers in Franklin and southern Liberty counties (Figure 1). The present day forest was once a wetland-dominated landscape referred to as Tate's Hell Swamp. Tate's Hell Swamp encompassed at least 12 ecological community types including wet prairies, dwarf cypress swamps, Atlantic White Cedar swamps, and mixed forested wetlands (Florida Natural Areas Inventory 1997, 2000). Pine flatwoods and uplands were found at higher topographic elevations and along the remnant coastal ridges. Coastal habitats included fresh and saltwater marshes and sand pine scrub.

The forest has experienced a long history of silvicultural activities and thousands of acres of historical wetlands have been converted to slash pine plantation. In the late 1800s, timber harvesting was a key component of the economy of Franklin County. By the 1920s, there were seven sawmills in the area (Division of Forestry 2007). Tram lines were used to access blocks of old growth longleaf pine (*Pinus palustris*), cypress (*Taxodium* spp.) and Atlantic white cedar (*Chamaecyparis thyoides*) (Division of Forestry 2007). Through the early 1950s, timber production and cattle grazing were the predominant land uses in and around Tate's Hell. Aerial photos from 1953 depict scattered areas of logging activities and reveal that many of the major forest roads were under construction.

During the 1960s and 1970s, extensive areas of pine flatwoods, wetlands, and other habitats were converted to slash pine (*Pinus elliottii*) plantation. A comparison of 1953, 1969, and 1973 aerial photography for Tate's Hell area suggests that many of the 800 miles of unpaved logging roads were constructed during the 1950s and 1960s. Roadside ditches were excavated to provide road fill material and to drain adjacent wetlands. Many pine stands were bedded, planted at high densities, and fertilized with nitrogen and phosphorus. Prior to state acquisition of the property, fire was typically suppressed. These large-scale habitat alterations significantly impacted historical ecological communities and altered the magnitude, timing, and quality of surface water runoff discharged from Tate's Hell Swamp to Apalachicola Bay, East Bay, St. George Sound and surrounding waters.

The Apalachicola River and Bay system contains one of the most diverse, productive, and economically important estuaries in the United States. The river and bay system has been designated as Outstanding Florida Waters and Apalachicola Bay has been designated as an Aquatic Preserve. East Bay, which receives surface water runoff from Tate's Hell, serves as a major nursery for ecologically and commercially important finfish, shellfish and other aquatic organisms. The Apalachicola River and Bay system is a high priority for the Surface Water Improvement and Management (SWIM) Program, which was established by the state in 1987 to reduce watershed degradation and protect natural resources.

In 1994, the State of Florida began acquiring the Tate's Hell property with the goal of restoring historical ecological communities and surface water drainage patterns to improve the quality of surface water discharged to the Apalachicola Bay system and surrounding waters. The Northwest

Florida Water Management District initiated the land acquisition process with the $3.5 million purchase of the Glawson tract. Due to the ecological importance of the East Bay estuary, the acquisition and restoration of Tate's Hell was identified as a priority under the State of Florida's Conservation and Recreation Lands (CARL) Program.

To date, the land acquired for Tate's Hell State Forest totals 202,436 acres. It is the second largest State Forest and the largest contiguous State Forest in Florida. Tate's Hell is managed as a multi-use area by the Florida Division of Forestry (DOF) with cooperation from the Florida Fish and Wildlife Conservation Commission (FWC). The overall land management goal is to restore, protect, and manage Tate's Hell ecosystems and maintain biological diversity, while integrating public use (DOF 2007). The forest is a designated Wildlife Management Area, with opportunities for hunting, camping, fishing, canoeing, hiking, and off-highway vehicle use.

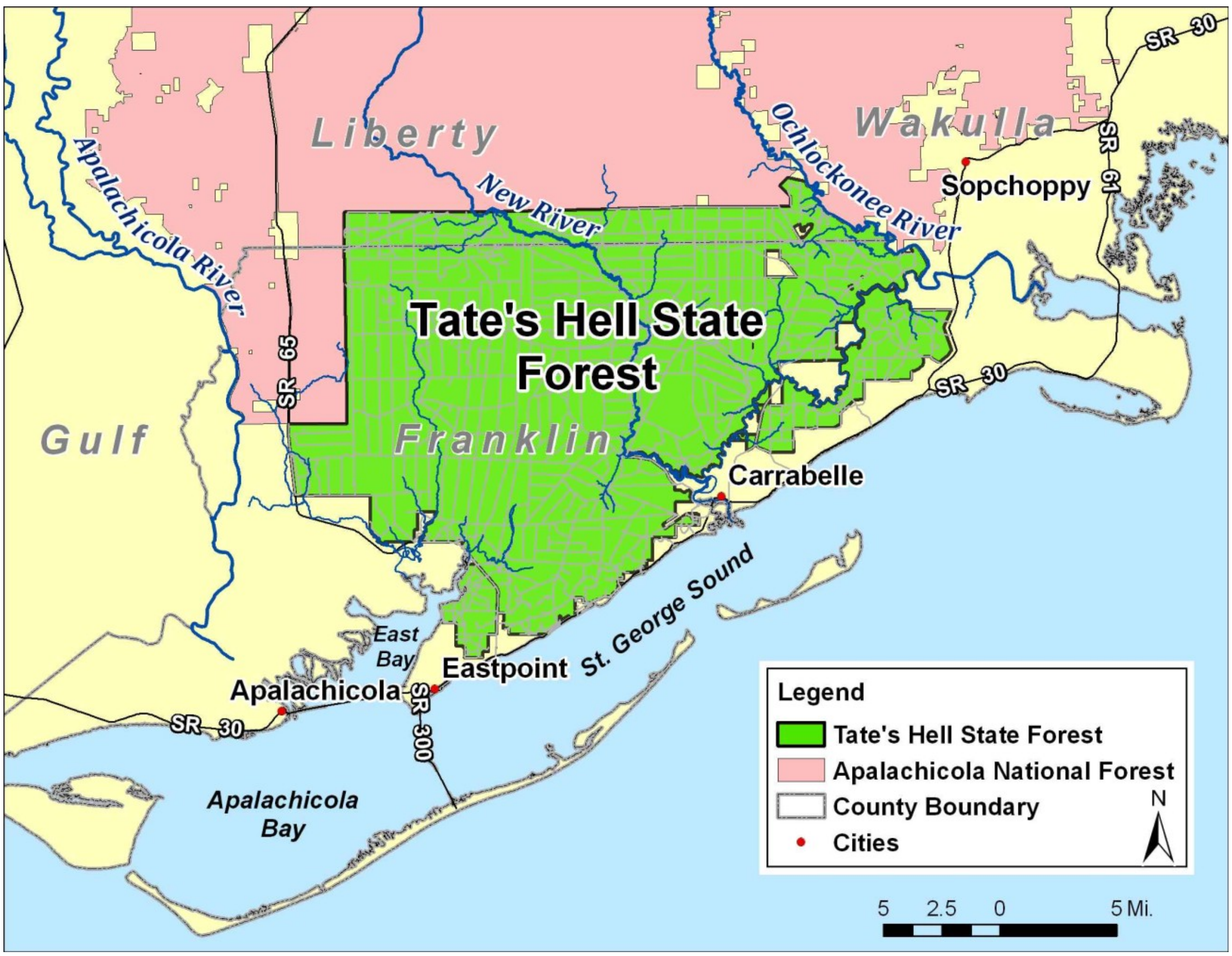

Figure 1. Location of Tate's Hell State Forest

The Division of Forestry continues to manage a large portion of the property for timber production. Pine management activities provide an economic benefit to the state and local community and are aimed at improving forest health. Where soils and topography are suitable, the Division of Forestry has replanted clear-cut areas with long-leaf pine (*Pinus palustris*). The Division of Forestry uses prescribed burns to maintain appropriate fire frequencies, which is critical because many of the native ecosystems are fire-dependent. The Ten-Year Management Plan for Tate's Hell indicates that the Division of Forestry will shift from managing even-aged pine stands towards uneven aged stands with old growth characteristics (DOF 2007). Natural regeneration rather than replanting is the preferred approach to long-term reforestation.

In addition to pine flatwoods, there are many other ecological communities at Tate's Hell that will benefit from forest management and hydrologic restoration activities. These ecosystems include wet savannas, dwarf cypress swamps, forested wetlands, salt and freshwater marshes, and uplands and coastal scrub. Together, these ecosystems harbor at least 25 state-listed endangered, threatened, or species of special concern including the Red-cockaded Woodpecker (*Picoides borealis*), the frosted flatwoods salamander (*Ambystoma cingulatum*), and the Florida black bear (*Ursus americanus floridanus*), and plants such as the spoon-leaved sundew (*Drosera intermedia*), white-top pitcher-plant (*Sarracenia leucophylla*), and yellow fringeless orchid (*Platanthera integra*).

Hydrologic Restoration Goals

The Northwest Florida Water Management District (NWFWMD or District) shares the Division of Forestry's goals of restoring and protecting the ecosystems of Tate's Hell State Forest, with a particular emphasis on hydrologic restoration. The overall goals of hydrologic restoration are to:

(1) Improve the water quality of surface water flows and runoff discharged to East Bay, Apalachicola Bay, and surrounding waters
(2) Restore historical surface water drainage patterns
(3) Enhance wetland hydrology and function
(4) Restore a mix of native ecological communities

During the past ten years, nearly a dozen hydrologic restoration projects have been implemented within Tate's Hell State Forest by the NWFWMD, the DOF, the FWC, and other public and private entities. Existing projects are scattered across the site and target a variety of ecological community types. Past hydrologic restoration activities have included:

- removing forest roads and adjacent ditches
- installing hardened low water road crossings
- installing ditch blocks and flashboard risers
- installing bridges
- modifying culverts
- reducing the density of undesirable shrub or tree species
- replanting native groundcover and tree species
- controlling exotic and invasive plants
- restoring appropriate fire regimes using prescribed burns

Due to the large size of Tate's Hell and the extensive degree of impacts, restoration of historical ecological communities and surface water drainage patterns is anticipated to be a gradual process with cumulative benefits accruing as hydrologic restoration and ecosystem management activities are implemented during the next several decades.

Plan Objectives

To date, wetland restoration has been implemented largely on an *ad hoc* basis. The NWFWMD and the Division of Forestry recognized the need for a comprehensive plan to guide future restoration efforts and in 2007 began discussing goals and priorities, sharing data, and working on the development of a ten-year Hydrologic Restoration Plan.

The objectives of the Hydrologic Restoration Plan are to:

(1) Prioritize areas within Tate's Hell State Forest for hydrologic restoration
(2) Develop hydrologic restoration plans for each surface water drainage basin, including locations for proposed hydrologic improvements and estimates of construction costs
(3) Develop guidelines for environmental monitoring and long-term management of restoration areas
(4) Improve interagency communication and coordination related to hydrologic restoration activities

The Hydrologic Restoration Plan provides a blueprint for future restoration activities. The *Ten-Year Resource Management Plan for the Tates Hell State Forest* (DOF 2007) and the *Vegetation Management Guidelines for the Tates Hell State Forest* (DOF and Florida Natural Areas Inventory 2001) provided the starting point for the development of the Hydrologic Restoration Plan. The Division of Forestry and NWFWMD recognize that the hydrologic restoration at Tate's Hell will be an incremental and adaptive process that will continue over the next several decades. Restoration priorities, basin-specific hydrologic restoration plans, and monitoring and management guidelines are anticipated to be reviewed and revised as site conditions and land management priorities change over time. To enable future plan revisions to be made in an efficient manner, two secondary objectives of the planning process were to: (1) develop a set of GIS files containing information pertinent to restoration activities that can be maintained and periodically updated by the NWFWMD and the Division of Forestry, and (2) improve interagency coordination regarding hydrologic restoration and data collection and maintenance.

Plan Contents

The Hydrologic Restoration Plan for Tate's Hell State Forest is comprised of two volumes. Volume I provides a description of Tate's Hell State Forest, prioritizes areas for hydrologic restoration activities, and provides guidelines for environmental monitoring and management of restoration areas. Volume II presents the hydrologic restoration plans for each surface water drainage basin, provides planning level costs for the proposed hydrologic improvements, and gives recommendations for project implementation and long-term operations and maintenance.

Description of Tate's Hell State Forest

Tate's Hell State Forest encompasses 202,400 acres of poorly drained land in Franklin and southern Liberty counties between the Apalachicola and Ochlockonee rivers (Figure 1). The property extends approximately 17 miles inland from the coast. The present day forest was once a wetland-dominated landscape referred to as Tate's Hell Swamp. During the 1960s through the early 1980s, extensive areas of wetlands and pine flatwoods were converted to dense stands of slash pine plantation. At the same time, more than 800 miles of unpaved roads were constructed. Drainage ditches were excavated along most roads to provide road fill material and drain nearby wetlands. The property was purchased by the State of Florida with the goal of restoring historical ecological communities and surface water drainage patterns in order to improve the quality of surface water runoff discharged from the area to East Bay, Apalachicola Bay, and surrounding waters.

Climate

Tate's Hell State Forest has a humid subtropical climate with long, warm, and wet summers and mild winters. Table 1 summarizes average monthly precipitation recorded at Tate's Hell State Forest during 1995-2010. Inland from the coast, annual precipitation totals about 58 inches of which about 28.5 inches, or 49%, usually occurs during the summer rainy season, from June through September. About 20 inches of rainfall occurs during the winter rainy season, from late December through April. May, October and November are typically the driest months. Annual rainfall is slightly less near the coast and averages approximately 56 inches per year. Monthly average daily temperatures recorded in nearby Apalachicola, FL range from 55^{0}F to 60^{0}F during the winter months of December through February and average about 80^{0}F during the summer. Spring and fall are moderate, with average temperatures generally in the 60s and 70s.

Table 1. Average Monthly Total Rainfall at Tate's Hell State Forest, Station 430, 1995 – 2010

Month	Total Precipitation (in)
January	3.31
February	4.23
March	4.91
April	3.05
May	2.26
June	6.59
July	7.32
August	7.28
September	7.26
October	4.31
November	3.28
December	4.49
Total	58.29

Topography and Soils

The topography of Tate's Hell State Forest is characterized low-lying river corridors, tidal marshes, and a series of remnant coastal ridges. Land surface elevations range from sea level to approximately 50 ft NAVD 88 along some of the remnant sand dune ridges (Figure 2). Most elevations are less than 36 ft NAVD 88.

Although more than 40 unique soil types occur within the forest, four groups account for the majority of the soils (Figure 3). In order of prevalence, these are: (1) Scranton - Rutlege, (2) Plummer–Surrency–Pelham, (3) Meadowbrook–Tooles–Harbeson, and (4) Pamlico-Pickney-Maurepas. All are poorly drained hydric soils.

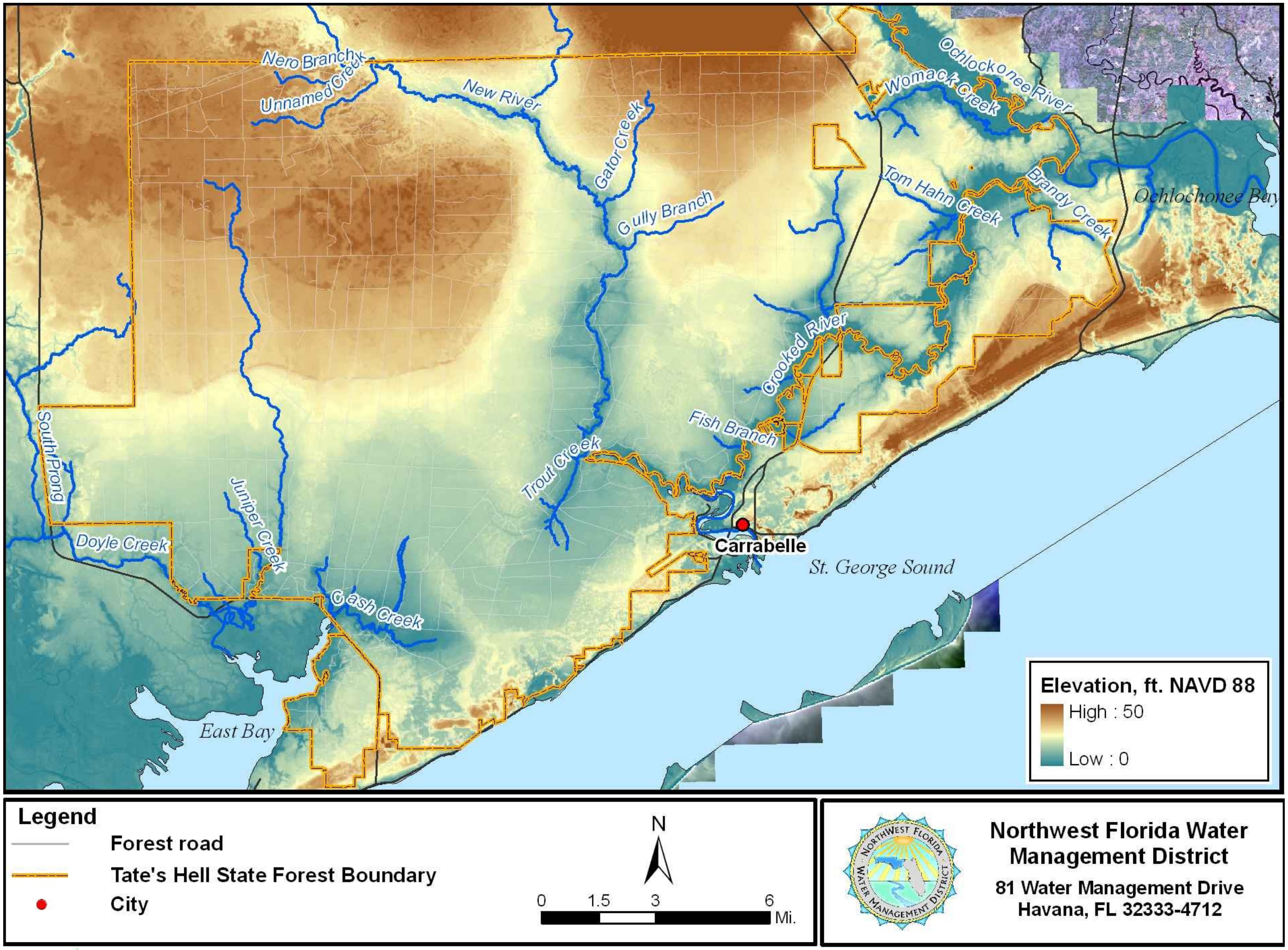

Figure 2. Topography Within Tate's Hell State Forest Derived from LiDAR Elevation Data

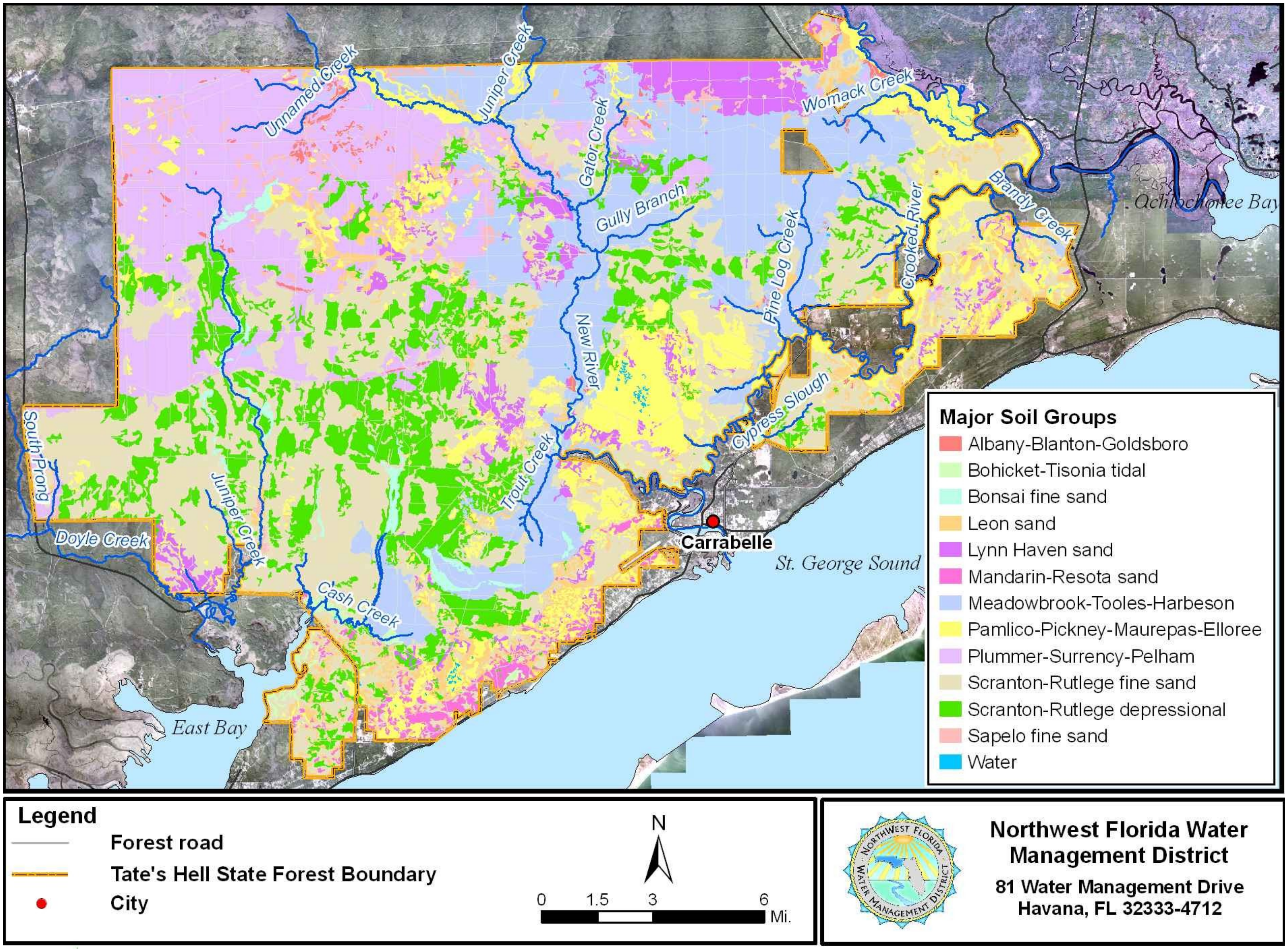

Figure 3. Major Soil Groupings Within Tate's Hell State Forest (SCS 1994)

Hydrogeology

Tate's Hell State Forest is geographically situated within the Apalachicola Embayment region of the Florida panhandle. In order of increasing depth, the hydrogeologic units that comprise the ground water flow system under Tate's Hell State Forest are the Surficial Aquifer, the Intermediate System, and the Floridan Aquifer System.

The Surficial Aquifer consists of undifferentiated sands and clays which are typically unconfined with the exception of areas under semi-confined conditions produced by local sandy clay layers. Ground water from the Surficial Aquifer tends to be less mineralized than water from the underlying systems due to its relatively young age, and therefore has not allowed dissolution from geologic material. In Franklin County, the only known consumptive use of the Surficial Aquifer is on the barrier islands, where wells yielding up to 50 gpm are utilized for landscape irrigation. Discharge from the surficial aquifer contributes to the baseflow of local streams within Tate's Hell State Forest.

The Intermediate System is mainly a confining unit that consists of soft, fossiliferous limestone overlain by a thin layer of sandy clay and clayey sand. The Intermediate System is thickest in the western part of the forest and thins toward the north and the east where it can be less than 50 feet thick. As the Intermediate System thins, leakage across it increases and causes it to function as a semi-confining unit to the Floridan Aquifer below.

The Floridan Aquifer is a sequence of carbonate sediments ranging in thickness from about 1,800 feet in the extreme western portion of the forest to more than 2,800 feet in southern portion and along the coast. Floridan Aquifer transmissivity under Tate's Hell is variable and highest in the eastern part of Franklin County. This higher transmissivity is the result of the southernmost extension of the Woodville Karst Plain into the eastern parts of the forest. Geographically, the Woodville Karst Plain is an area of active recharge, flow, and dissolution into the Floridan Aquifer, and these processes result in higher aquifer transmissivities. Northwest Florida Water Management Test wells in the eastern part of Tate's Hell State Forest yield transmissivities of 20,000 to 40,000 feet squared per day (ft^2/d) in the Floridan Aquifer.

Surface Water Hydrology

Stream basins

Figure 4 is a map of the surface water drainage basins in the vicinity of Tate's Hell State Forest. These 29 basins can be grouped into those that discharge to the Ochlockonee River, those that discharge to St. George Sound, and those that discharge to East Bay and the Apalachicola River and Bay system. The area of Tate's Hell State Forest located east of SR 67 is comprised of the Womack Creek basin, part of the Haw Creek basin, and the eastern portion of the Crooked River basin, all of which drain east to the Ochlockonee River. However, when the Ochlockonee River is at flood stage, the Crooked River instead receives water from the Ochlockonee River and flows to the west. Brandy Creek is a small tributary to the Crooked River.

West of SR 67, surface water runoff from the Pine Log Creek basin drains south to the Crooked River. Except for periods when the Ocklockonee River is at flood stage, this reach of the Crooked River generally flows west and merges with the New River to form the Carrabelle River. The divide between easterly and westerly flow in the Crooked River is generally located near or just to the east of the SR 67 bridge. Smaller tributaries to the western reach of the Crooked River include Fish Branch, Sunday Rollaway Creek, and Roberts Creek.

The New River basin is the largest watershed in Tate's Hell State Forest. The entire basin encompasses more than 110,000 acres and extends north of the Tate's Hell property. Tributary basins to the New River include Juniper Creek (northeast of the New River), Gator Creek, Gully Branch, Trout Creek, Nero Branch, and an Unnamed Creek. The New River merges with the Crooked River to form the Carrabelle River and discharges into St. George Sound. Southwest of the Carrabelle River, runoff from some coastal areas of Tate's Hell State Forest discharges directly into St. George Sound.

West of the New River, the High Bluff Creek, Rake Creek, and Sandbank Branch drainage basins discharge into Cash Creek. Cash Creek, in turn, discharges into the East Bayou of East Bay. South of SR 65, portions of the Tate's Hell State Forest drain directly into East Bayou, East Bay, and St. George Sound.

The Whiskey George Creek basin is the largest watershed west of the New River. Whiskey George Creek flows south more than 20 miles and discharges into the West Bayou of East Bay. Tributaries to Whiskey George Creek include Juniper Creek and Doyle Creek. Farther west, surface water from the South Prong, Deep Creek, Graham Creek, and Fort Gadsden Creek basins flows west and eventually discharges to the Apalachicola River.

Local Flow Patterns

Prior to the construction of roads and ditches and the conversion of native habitats to slash pine plantation, surface water runoff filtered through natural wetland habitats prior to discharging to local streams and rivers. For example, surface water runoff from hydric pine flatwoods likely flowed through wet savannas and cypress flats before discharging to the mixed forested wetlands and cypress sloughs located along the stream corridors. In the upper portions of some surface water basins, the historic stream channels were poorly defined. Instead, surface water runoff flowed downstream through a series of one or more large, interconnected basin swamps or cypress sloughs. Historical surface water drainage patterns were critical for maintaining appropriate hydroperiods across a suite of wetland community types. Appropriate wetland hydroperiods support native wetland vegetation and wetland-dependent wildlife such as wading birds and flatwoods salamanders.

The construction of more than 800 miles of forest roads and adjacent ditches has significantly altered local surface water drainage patterns across the present-day Tate's Hell State Forest. During the past few decades, more than 600 culverts also have been installed across the forest roads to alleviate flooding and control the flow of water in roadside ditches. Many slash pine stands

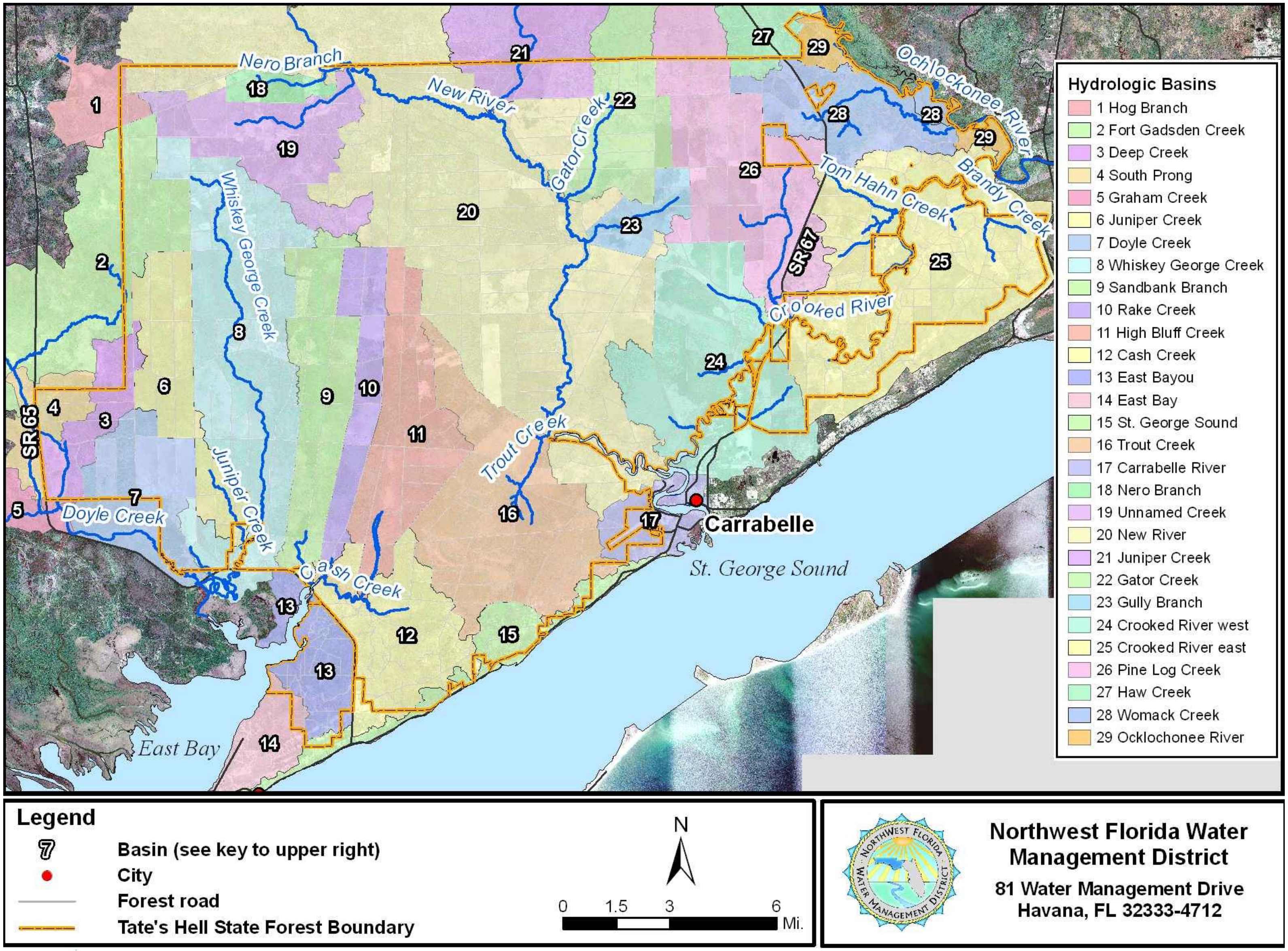

Figure 4. Surface Water Drainage Basins Within Tate's Hell State Forest

were bedded, creating alternating rows of low hills and valleys that disrupted small-scale surface water drainage patterns.

The construction of roads and ditches, together with extensive habitat alterations and the prevalence of poorly drained soils and relatively flat topography, have contributed to the complexity of current surface water drainage patterns. Figure 4 depicts the surface water basins within Tate's Hell State Forest. Many of these basin boundaries are approximate. Basin boundaries were revised using 2007 LiDAR elevation data, 1953 historical aerial photography, and observed flow directions in roadside ditches and culverts. However, flow directions were not available for all culverts and ditches. Furthermore, the available data suggest that the flow direction in some ditches may vary in response to hydrologic conditions. As a result, surface water runoff within the roadside ditches may flow across delineated basin boundaries at some locations. At other locations, forest roads may prevent surface water runoff from adhering to historical flow paths. Basin boundaries will likely change over time as hydrologic improvements (e.g low water crossings, culverts, etc) are implemented to restore historical flow patterns.

Lakes, Ponds, and Wetlands

There are no natural lakes within Tate's Hell State Forest. There are, however, a number of borrow pit ponds scattered across the property, particularly along forest road 22 and SR 67. Ephemeral ponds may be found within remnant wet savannas as well as other wetlands. Some of the deeper cypress sloughs and forested wetlands may contain water year-round. A description of the various wetland types and their distribution within Tate's Hell State Forest is provided in the next section.

Ecological Communities

Staff from the Florida Natural Areas Inventory delineated 14 historical ecological communities (plus open water and cleared areas) within Tate's Hell State Forest based on a review of 1953 aerial photography, soils maps, field data, and other information (FNAI 1997, 2000). Table 2 summarizes the acreage within each group. Figure 5 shows the distribution of historical communities across the landscape. Note that historical ecological communities within Tate's Hell State Forest were delineated during 1997-2000 and reflect the total land area owned by the state at that time.

Table 2. Ecological Groups Within Tate's Hell State Forest

Ecological Community	Acres	
Sand pine scrub	1,848	Dry
Mesic flatwoods	27,469	
Wet / mesic flatwoods (grassy)	8,254	
Wet / mesic flatwoods (shrubby)	13,805	
Wet savanna – pine flatwoods mosaic	49,903	
Wet savanna	19,860	
Wet savanna – swamp mosaic	617	
Wet savanna – cypress flats	11,445	To
Shrub wetland	4,145	
Basin swamp (Atlantic White Cedar)	750	
Basin swamp / shrub / mixed forested wetland	44,605	
Mixed forested wetland	3,749	
Deciduous forested wetland	7,618	
Marsh	2,525	Wet
Open water	9	
Cleared	230	
TOTAL	**196,832**	

In all, wetland habitats comprised more than 45% of the historical land cover within Tate's Hell State Forest. Pine flatwoods accounted for 25 % and pine flatwood – wetland mosaics account for another 25%. A description of the major historical ecological groups, based largely on the previous FNAI studies (FNAI 1997 and 2000) and a brief description of current land cover conditions is given below.

Sand pine scrub

Sand pine scrub occurs on well-drained soils along remnant coastal dune ridges. Sand pine (*Pinus clausa choctawhatchee*) is the dominant native canopy species. Shrubs include myrtle oak (*Quercus myrtifolia*), sand live oak (*Quercus geminata*), saw palmetto (*Serenoa repens*), and Florida rosemary (*Ceratiola ericoides*). There are relatively few groundcover plants but lichens are common. It is thought that patchy fires occurred relatively infrequently (every 50 to 100 years) in this habitat (FNAI 2000). Some areas of historical sand pine scrub have been harvested and replanted in slash pine or sand pine but most areas are relatively undisturbed. The High Bluff Coastal Hiking Trail, located within Tate's Hell State Forest along U.S. Hwy 98, winds through an area of relatively undisturbed sand pine scrub. Areas delineated as historical sand pine scrub also include several narrow strips of shoreline and beach located between U.S. Hwy 98 and St. George Sound.

Mesic flatwoods

Mesic flatwoods occur on moderately-drained sandy soils. Natural mesic flatwoods have an open canopy of longleaf pine, a sparse mid-story, and a dense low groundcover that typically includes wiregrass (*Aristida stricta*), Florida dropseed (*Sporobolus floridanus*) bracken fern (*Pteridium aquilinum*), saw palmetto, and other low shrubs and grasses (FNAI 2000). The recommended fire return interval is every three to four years. In Tate's Hell State Forest, most areas of historical mesic flatwoods were converted to dense stands of slash pine plantation. In recent years, the Division of Forestry has thinned or cleared some of these areas and replanted them with longleaf pine, However, trees have been replanted at relatively high densities (> 200 trees per acre).

Wet/mesic flatwoods

Wet / mesic flatwoods were grouped together in areas where hydrological differences could not be inferred from historical photographs (FNAI 2000). Wet flatwoods differ from mesic flatwoods in that they occur on poorly drained soils. Natural wet flatwoods have a widely spaced canopy of slash pine, pond pine (*Pinus serotina*) or longleaf pine and a grassy or shrubby understory. Common shrubs include titi (*Cliftonia monophylla* and *Cyrilla racemiflora*), sweet gallberry (*Ilex coriacea*), bitter gallberry (*Ilex gabra*), and St. John's wort (*Hypericum* spp.). Groundcover species include wiregrass, beakrushes (*Rhynchospora* spp.), panic grasses (*Panicum* spp.), nutrushes (*Sceleria* spp.), and sundews (*Drosera* spp.) Natural fire frequencies vary with position in the landscape but prescribed fires are recommended every two to four years. Most areas of native wet and mesic flatwoods within Tate's Hell have been converted to dense stands of planted pine. Where fire was suppressed historically, titi shrubs have invaded and created a dense mid-story.

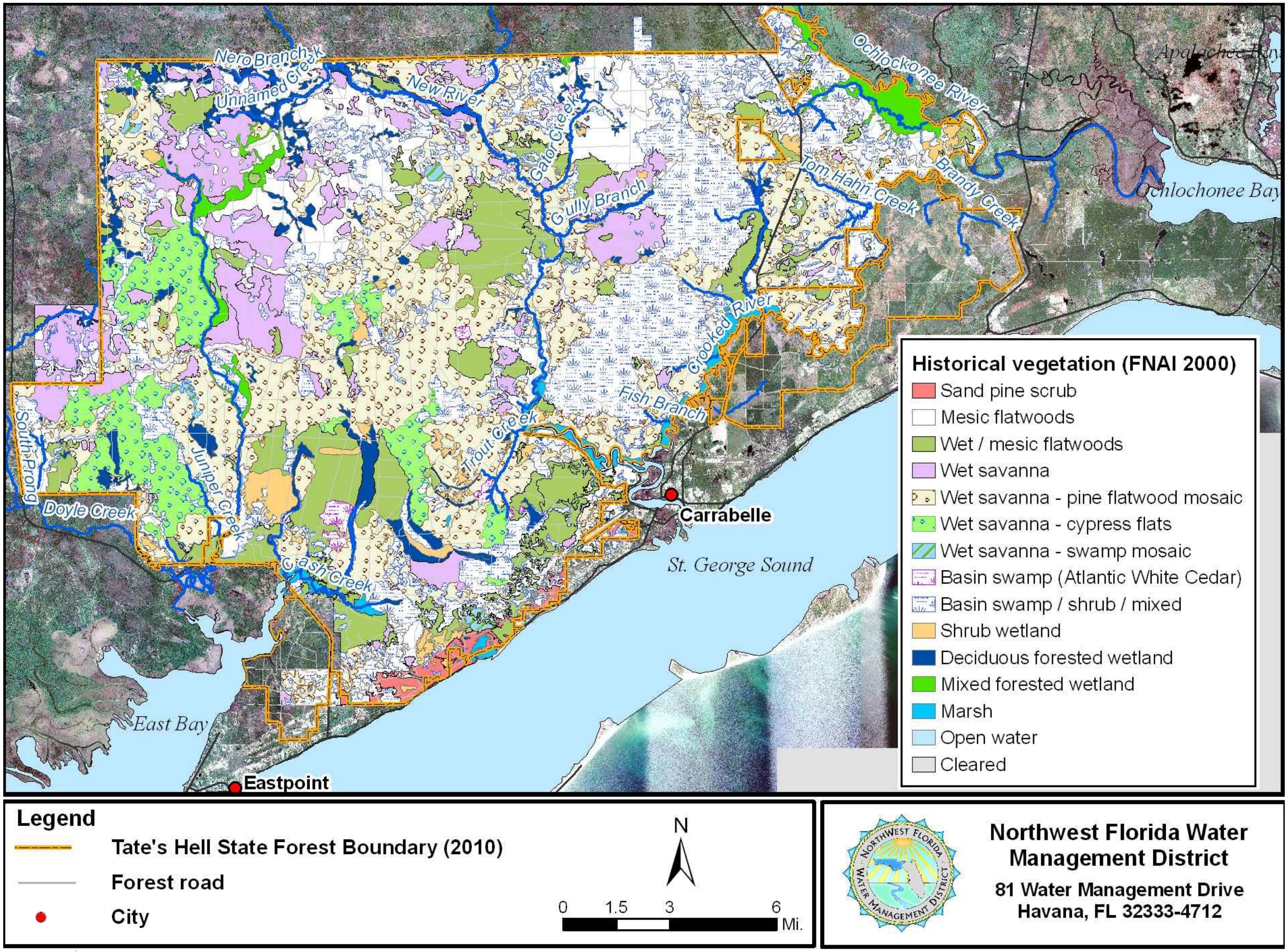

Figure 5. Historical Ecological Community Types Within Tate's Hell State Forest

Wet savannas

Wet savannas (also called wet prairies) occur on poorly drained soils in relatively low topographic areas and represent ecotones between wet flatwoods and deciduous or mixed forested wetlands. Wet savannas are open areas with few trees and are dominated by grasses, sedges, forbs, and low shrubs. These areas are seasonally saturated and may have ponded water for short periods of time. In addition to wiregrass, beakrushes, nutrushes, yellow-eyed grasses (*Xyrus* spp.), and St. John's wort, wet savannas often contain rare or uncommon plants such insectivorous pitcher plants (*Sarracenia* spp.), dew –threads (*Drosera tracyi*), and grass-pink orchids (*Calopogon* spp).

Most historical wet savannas within Tate's Hell State Forest have been converted to slash pine plantation. Ruts from logging equipment may have altered local drainage patterns. Often, hardwoods and titi shrubs have encroached due to past fire suppression. The Division of Forestry has begun restoring historical savannas by thinning planted pines and shrubs and conducting prescribed burns to restore and maintain a fire frequency of every one to four years. The District, Division of Forestry, and other entities have restored wetland hydrology in several large savanna areas by removing logging roads and adjacent ditches, and installing ditch blocks, hardened low water crossings, and flashboard risers to restore historical surface water drainage patterns.

Wet savanna – cypress flats

This community type was proposed by FNAI (2000) specifically for Tate's Hell State Forest to describe savanna habitats with widely-spaced pond cypress (*Taxodium ascendens*) and slash pine combined with a midstory of shrubs and smaller cypress (Figure 6). The wetland communities occur on poorly drained soils. Groundcover vegetation is typical of wet savannas. Wet savanna – cypress flats can be considered to be a transitional habitat between wet savannas and deciduous forested wetlands (e.g. cypress swamp or sloughs). The greater abundance of trees and shrubs, as compared to a wet savanna, is thought to be due to a lower fire frequency and a longer hydroperiod. These areas can become dominated by titi and other shrubs when fire is excluded for long periods of time. The optimal fire frequency is unknown but thought to be approximately every five to ten years (DOF and FNAI 2001).

Figure 6. Wet Savanna - Cypress Flats

Although many wet savanna-cypress flats have been planted in pines, this habitat is unsuitable for long-term timber production and many of these areas are now being restored. In the Doyle Creek basin, the NWFWMD restored a large area of wet savanna - cypress flats by removing more than three miles of forest roads and adjacent ditches and installing several hardened low water road crossings to re-establish surface water drainage patterns.

Basin swamps / shrub wetlands / mixed forested wetlands

This grouping is a mix of wetland types that were combined due to the difficulty in distinguishing forested vegetation types from historical photographs (FNAI 2000). Vegetation groups include mixed pond cypress - titi forests, black gum (*Nyssa biflora*) - bay forests, slash pine – cypress - bay swamps, Atlantic White Cedar swamps, shrub wetlands, and other mixtures of canopy trees and shrubs. Basin swamps, shrub wetlands, and mixed forested wetlands occur on poorly drained soils, in depressional features or areas of low topography, and typically have standing water present for a portion of each year. Fire return intervals range from somewhat frequent (< 10 years) in shrub wetlands to infrequent (20 years or longer) in riverine forested wetlands. Although many of these wetland areas were not converted to pine plantation, past fire suppression has resulted in dense overgrown vegetation in many areas.

Atlantic white cedar swamps are a subset of basin swamps. Historical areas of Atlantic white cedar swamp were mapped primarily in the vicinity of the Trout Creek and High Bluff Creek basins. However, large swamps dominated by Atlantic white cedar can also be found in the Fort Gadsden Creek basin and the Sandbank Branch basin. Although some areas of Atlantic white cedar were converted to slash pine plantation, many of these areas were left relatively intact. Titi, bays, pines, and pond cypress may also be present in these densely forested wetlands.

Shrub wetlands

Shrub wetlands dominated by black titi (*Cliftonia monophylla*), white titi (*Cyrilla racemiflora*) and gallberry are a naturally occurring habitat type in Tate's Hell State Forest. Additionally, wet savannas and wet savanna – cypress flats that are not maintained by periodic fires may transition to shrub wetlands over time (Ewel 1990). As with other wetlands, shrub wetlands and bogs tend to occur on poorly drained saturated soils. Some shrub wetlands have been converted to slash pine plantation but large areas of remnant shrub wetlands exist, particularly east of SR 67. Due to past fire suppression, many of these areas are very overgrown. The estimated fire frequency in shrub wetlands is once every 10 to 20 years (Ewel 1990).

Deciduous forested wetlands

Deciduous forested wetlands include cypress sloughs, dwarf cypress swamps, riverine bald cypress (*Taxodium distichum*) swamps, and smaller forested wetlands having canopies of pond cypress, red maple (*Acer rubrum*), tulip tree, (*Liriodendron tulipifera*) or black gum. Deciduous forested wetlands should have standing water present for several months during each year. Fire occurs relatively infrequently, perhaps every 15 to 20 years (FNAI 2000). Although some deciduous forested wetlands were logged, clear-cut, and replanted during past decades, most of these areas were too wet for timber production. However, in most areas the wetland hydrology has been altered by the construction of nearby roads and drainage ditches.

The dwarf cypress swamps are a unique type of deciduous forested wetland (Figure 7). The trees that comprise these swamps appear similar to the 'hat rack' cypress found in the Florida Everglades. Dwarf cypress trees are thought to have developed their diminutive stature due to slow development in poor soil conditions. Although they typically reach a height of only 15 feet, many of these trees are more than 300 years old (DOF 2007).

Figure 7. Dwarf Cypress Swamp

Marshes

Fresh and brackish water marshes are present along the lower reaches of several rivers and streams including the New River, Carrabelle River, Crooked River, Whiskey George Creek, and Cash Creek. In addition, there are also several isolated freshwater marshes within Tate's Hell State Forest. Vegetation in riverine marshes typically is comprised of monotypic stands of saw grass (*Cladium jamaicense)* and black needle rush (*Juncus roemerianus*) and in more saline areas, vegetation is often composed of a fringe of salt cordgrass (*Spartina alterniflora*) in deeper areas with black needle rush occurring at slightly higher elevations. Isolated freshwater marshes typically contain sedges, grasses, rushes, floating aquatics and herbaceous plants. Marshes generally have water present year-round although water levels may fluctuate with tidal or seasonal rainfall cycles. Fire occasionally occurs in marshes. The fire frequency is typically a function of the adjacent habitat type (FNAI 2010).

Figure 8. Frosted Flatwoods Salamander

Wildlife

The diverse ecological communities of Tate's Hell State Forest serve as habitats for many species of conservation concern including Red-cockaded Woodpeckers, gopher tortoises (*Gopherus polyphemus*), Apalachicola kingsnakes (*Lampropeltis getula meansi*), and Florida black bears. The Red-cockaded Woodpecker (RCW) is a federally-listed endangered species that typically inhabits wet and mesic flatwoods. Tate's Hell State Forest supports more than 30 RCW clusters. The forest provides important habitat for the RCW and is part of the East Gulf Coastal Plain Recovery Unit identified in the U.S. Fish and Wildlife Service Red-cockaded Woodpecker Recovery Plan (USFWS 2003).

Eastern indigo snakes (*Drymarchon corais couperi*) and Bachman's Sparrows (*Aimophila aestivalis*) have also been observed within the forest (FNAI data 2008 and A. Warwick 2010, pers. comm.). Historically, the forest provided habitat for the frosted flatwoods salamander (*Ambystoma cingulatum*) but it is unknown if any individuals remain.

More common animals include White-tailed deer (*Odocoileus virginianus*), Eastern wild turkey (*Meleagris gallopavo silvestris*), raccoons (*Procyon lotor*), coyotes (*Canis latrans*), river otters (*Lutra canadensis*), and other small mammals. The wetlands and roadside ditches support a number of reptile and amphibian species, including the Florida Cottonmouth (*Agkistrodon piscivorus conanti*), the American Alligator (*Alligator mississippiensis*), and lesser known species such as the eel-like two-toed amphiuma (*Amphiuma means*).

Together with the Apalachicola National Forest and associated wildlife management areas, Tate's Hell State Forest has been designated an Important Bird Area by the National Audubon Society. The forest supports significant breeding populations of Swallow-tailed Kites and Red-cockaded Woodpeckers (National Audubon Society 2010). Breeding Bird Atlas data suggest that nearly 90 species breed in the vicinity of Tate's Hell State Forest. Many additional bird species use the forest habitats during the spring and fall migratory seasons.

The entire forest has been designated as a Wildlife Management Area and hunted species are regulated by the Florida Fish and Wildlife Conservation Commission.

Recreation

Tate's Hell State Forest offers numerous recreational opportunities including camping, hiking, hunting, kayaking, boating, and fishing. There are approximately 30 primitive campsites located within the forest, many of which are located along the New River or other waterways. A concrete boat launch facility is located at the Cash Creek Day Use Area. Other launch sites for smaller boats, canoes, and kayaks are located throughout the forest. Portions of Tate's Hell State Forest are included in the Florida Circumnavigational Saltwater Paddling Trail.

There are hiking opportunities along the extensive system of forest roads. Additionally, the High Bluff Coastal Trail provides an opportunity to see unique coastal scrub habitat. A few miles to the north, the Ralph G. Kendrick Boardwalk provides an educational kiosk and an observation platform over a dwarf cypress swamp. Tate's Hell State Forest is also one of the sites included in the Great Florida Birding Trail. Off-Highway Vehicle (OHV) Trails have been designated on more than 150 miles of forest roads. The OHV system at Tate's Hell State Forest was the first trail system created under the T. Mark Schmidt Off-Highway Vehicle Safety and Recreation Act of 2002. This act provides the public with additional opportunities to ride off-highway vehicles on public lands.

Archeological Sites

As of 2007, 36 archeological sites had been recorded at Tate's Hell State Forest (DOF 2007). Sites that date back to the early settlement period include old home sites, bridge ruins, and cattle dipping vats. Several aboriginal archeological sites are located along the coast. Shell middens and scattered ceramics have been found throughout the forest. The Division of Forestry coordinates with the Division of Historical Resources regarding the protection and management of all archeological sites.

Land Management

The Division of Forestry manages Tate's Hell State Forest as a multi-use site for the purposes of habitat restoration and protection, wildlife management, public recreation and silvicultural management. As a result, Division of Forestry staff engages in a broad range of land management activities including road maintenance, monitoring of plant and animal populations, and habitat management activities such as tree thinning, prescribed burning, shrub reduction, and invasive species control. The *10-Year Management Plan for the Tate's Hell State Forest* identifies five principal land management goals and describes action-oriented objectives and associated performance measures (DOF 2007). These goals and objectives provide an excellent overview of the land management activities within Tate's Hell State Forest and are described below.

1. **Restore, maintain, and protect all native ecosystems, insuring the long-term viability of populations and species considered rare, threatened, endangered, or of special concern.**

The Division of Forestry's management objectives include increasing the proportion of prescribed burns conducted during the growing season versus the dormant season, updating the fire management plan, developing and implementing a non-native invasive species control plan, maintaining forest boundaries, conducting inventories to identify the presence and distributions of listed plant and animal species, monitoring photo plots of sensitive areas, mapping environmentally sensitive communities, and sustaining and improving monitoring programs for Red-cockaded Woodpeckers, gopher tortoises, and rare plants.

2. **Encourage and enhance multiple-use management, including human use, in a manner that is agreeable with other long-term goals, especially protection of native ecosystems.**

The Division of Forestry's management objectives include updating the Outdoor Recreation Plan, developing and continually updating a Road Management Plan, conducting liaison group meetings twice a year, conducting an activity or media promotion for State Forest Awareness Month, and pursuing additional revenue-generating opportunities through forest product sales, recreation fees, or leases.

3. **Practice sustainable forest management utilizing sound silvicultural techniques.**

Management objectives include conducting forest inventory updates each year, updating and implementing the Silvicultural Management Plan (comprised of the reforestation plan, forest inventory, harvest plan, and prescribed burn plan); completing reforestation of all cut-over areas with appropriate species at densities suitable to the site; conducting timber harvests in a manner that maintains appropriate stand densities, improves forest health, regenerates cutover stands, salvages wood following natural disasters, and minimizes ground disturbance; evaluating the effectiveness of reforestation / restoration projects and developing recommendations for additional activities on sites where warranted; and implementing the prescribed burn plan to reduce fuel loads, promote restoration, and maintain native community structure.

4. **Protect known archeological and historical resources.**

Division of Forestry management objectives including training additional personnel as archaeological monitors, updating the "Environmentally Sensitive Areas" map in the Fire Management Plan, and informing crews of archaeological sites where heavy equipment should be avoided.

5. **Restore, maintain, and protect hydrologic functions related to the quality and quantity of water resources and the health of associated wetland and aquatic natural communities.**

Division of Forestry management objectives include conducting inspections to determine the need for installation or replacement of culverts or hardened low water crossings, rehabilitating fire-lines to reduce channeling of water, developing and implementing hydrologic restoration plans for watersheds that have been damaged by past management activities, and investigating and recruiting sources of funding and cooperative projects with other agencies for hydrologic restoration.

In all, the Division of Forest staff manage 202,400 acres and maintain more than 800 miles of unpaved roads, more than 600 drainage culverts, 150 miles of OHV trails, and approximately 30 campsites, and conduct habitat management and restoration activities (e.g. tree thinning, prescribed burning, replanting, hydrologic restoration) to enhance and maintain the diverse historical ecological communities found within Tate's Hell State Forest.

Prioritization of Areas for Hydrologic Restoration

Overview

To prioritize areas for hydrologic restoration, Tate's Hell State Forest was divided into 19 restoration tracts (Figure 9). The boundaries of these restoration tracts were developed in GIS and are based on a combination of factors including surface water basin boundaries, existing roads, and the forest management units used by the Division of Forestry. Three criteria were used to prioritize these tracts for hydrologic restoration:

- Surface Water Quality Benefits
- Habitats for Species of Conservation Concern
- Feasibility of Restoration.

Criteria were assigned numeric scores ranging from 0 to 24, with 24 being the highest value. Each of the criteria is described below.

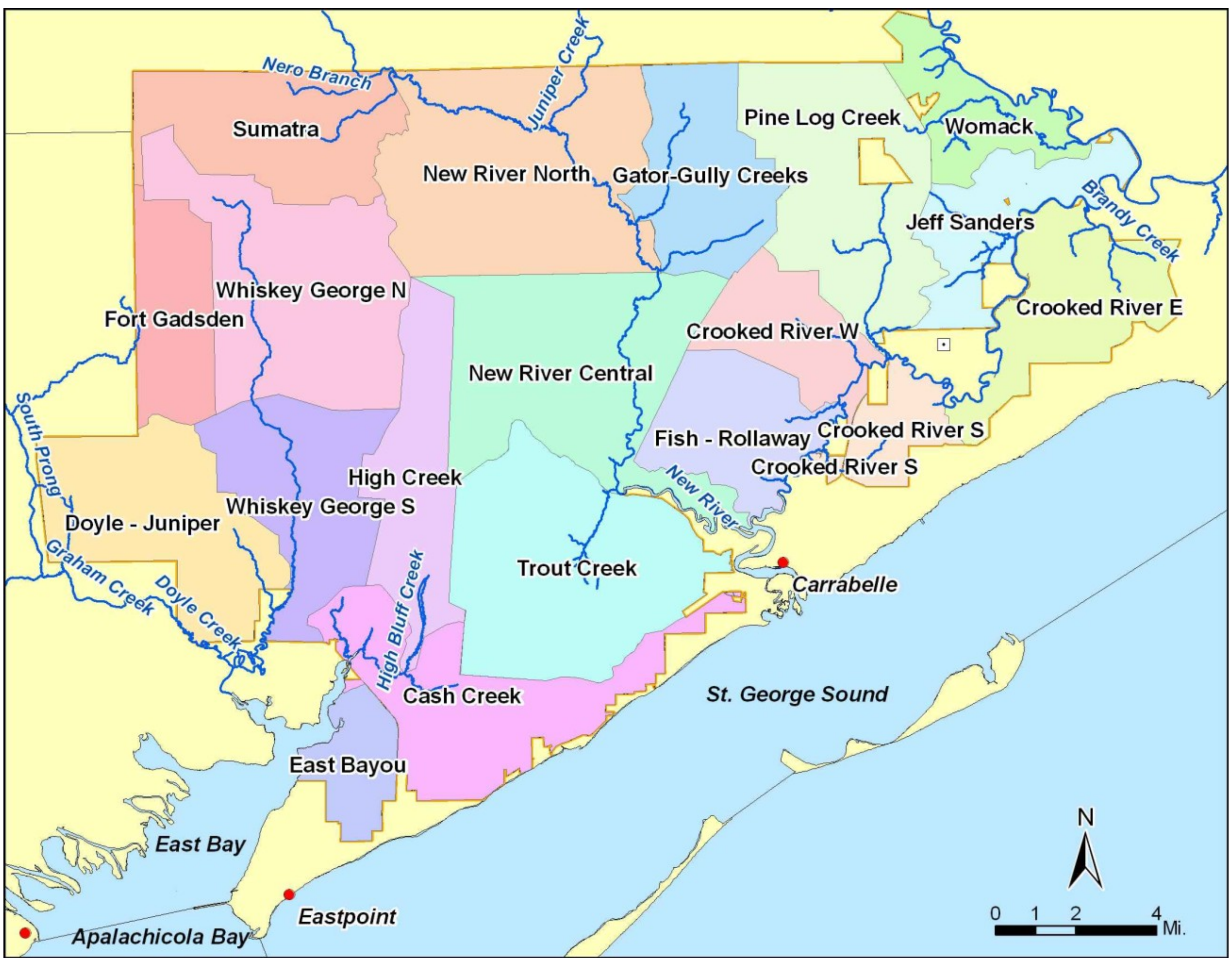

Figure 9. Restoration Tracts

Surface Water Quality Benefits

Restoration tracts were prioritized based on the potential water quality benefits anticipated to result from enhanced wetland treatment and attenuation of surface water runoff following hydrologic restoration activities. Scoring is based on the proximity of surface water discharges from each restoration tract to Apalachicola Bay, East Bay, and surrounding waters. Apalachicola Bay, East Bay, and the tributaries to East Bay are classified as Class II waters having designated uses of shellfish propagation and harvesting. Tributaries to East Bay include Cash Creek, Whiskey George Creek, Doyle Creek, Juniper Creek, Rake Creek, and High Bluff Creek. All other rivers and streams within Tate's Hell State Forest are Class III waters with designated uses of recreation and the propagation and maintenance of healthy fish and wildlife populations.

The restoration tracts were grouped into four scoring tiers (Table 3). Because water quality improvement is the primary goal of hydrologic restoration activities, scores for this criterion were given the greatest weight and range from zero to 24. Because of the nursery functions (i.e., enhanced feeding, shelter and refuge from predation) provided by East Bay and Apalachicola Bay, restoration tracts that discharge surface water runoff to these water bodies were given the highest scores. East Bay, St. Vincent Sound and areas near the mouth of the Apalachicola River support nearly 70% of the fishes and large invertebrates collected throughout the estuary. The highest water quality benefit scores reflect potential water quality improvements to these critical nursery areas.

Tracts that discharge surface waters to the New River, and ultimately to St. George Sound, represent the second tier. Tracts that discharge surface water to the Crooked River, where the Crooked River generally flows west towards the Carrabelle River and St. George Sound, comprise the third tier. The direction of flow in the Crooked River west of the confluence with Pine Log Creek varies in response to upstream discharges and may be either east or west depending on conditions. For this analysis we have assumed that runoff generated in the Pine Log Creek basin flows west after discharging to the Crooked River. Tracts that discharge surface water to the Ochlockonee River basin comprise the fourth tier, including areas where the Crooked River flows to the east.

Table 3. Scoring for Surface Water Quality Benefits

Score	Description	Applicable Restoration Tracts
24	Runoff discharges to East Bay or Apalachicola Bay.	Fort Gadsden, Whiskey George North and South, Doyle-Juniper, High Bluff Creek, Cash Creek, and East Bayou
18	Runoff discharges to the St. George Sound.	Sumatra, New River North and Central, Gator-Gully, and Trout Creek
12	Runoff discharges to the Crooked River and flows west towards the Carrabelle River and St. George Sound.	Pine Log Creek, Crooked River South, Crooked River West, and Fish-Rollaway
6	Runoff discharges to the Ochlockonee River Basin.	Crooked River East, Jeff Sanders, and Womack Creek

Habitats for Species of Conservation Concern

The approach used to prioritize habitats of species of conservation concern for restoration is similar to that used in the Florida Forever program to prioritize lands for acquisition and is based on the occurrences and associated habitats of state or federally listed plant and animal species. The prioritization of habitats for hydrologic restoration focused on species found in wetlands and pine flatwoods habitats.

Twenty-five listed plant and animal species (Table 4) that are associated with wetland and pine flatwood habitats have been documented within Tate's Hell State Forest. Staff from the Florida Areas Natural Inventory previously developed habitat maps for 11 of these 25 species in support of the Florida Forever program (FNAI 2007). The 11 species for which habitat maps were available are shown in Appendix A and include animals such as the flatwoods salamander (*Ambystoma cingulatum*) and Red-cockaded Woodpecker (*Picoides borealis*) and plants such as Godfrey's Butterwort (*Pinguicula ionantha*) and White Birds-in-a-Nest (*Macbridea alba*). New habitat maps were created for the 14 remaining species, all of which were plants. FNAI data on reported occurrences provided the basis for the habitat maps. Note that an element occurrence in the FNAI database may represent a local population (e.g. 100 plants) rather than an individual plant.

To create the maps, a 400-m buffer was applied to each FNAI element occurrence point. This buffer radius is identical to that used for plants in the Florida Forever analysis (FNAI 2007). All polygons of suitable habitat that intersect the buffer were identified and combined to create a single

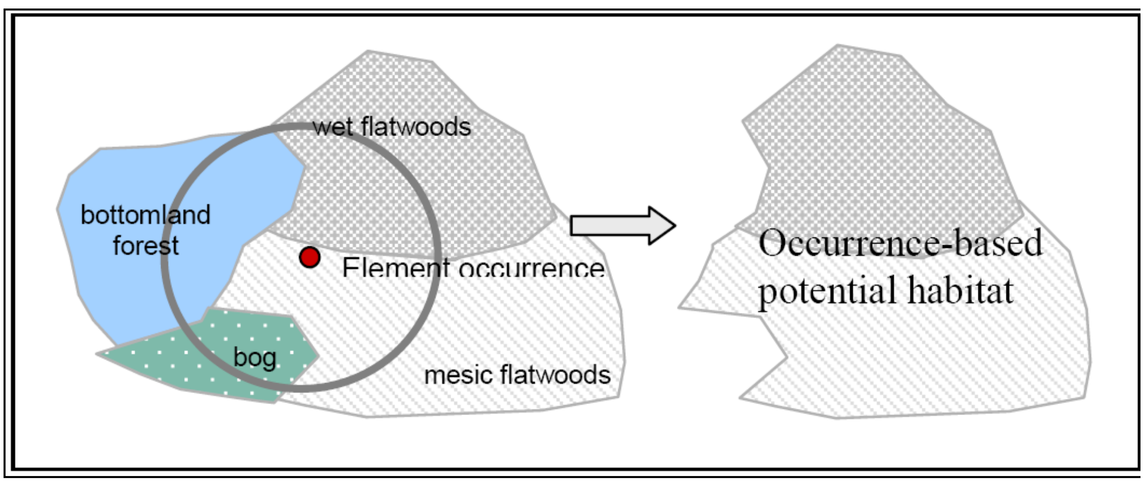

Figure 10. Development of Habitat Maps (FNAI 2007)

habitat polygon. Habitat polygons may extend outward from the buffer. Figure 10 illustrates this process for a hypothetical species found in wet and mesic flatwoods. Suitable habitats for each species were based on information contained in the USF Online Atlas of Florida Vascular Plants, NatureServe species accounts, and information in the FNAI database.

For each of the 25 species, the amount of habitat within each of the 19 restoration tracts was calculated. Each species was assigned a weight ranging from 0 to 12, based the level of conservation concern. The state listing status (endangered, threatened or Species of Special Concern) and the NatureServe sub-national status (S1 = critically imperiled, S2 = imperiled, S3 = vulnerable) were used to assigned species weights (Table 4). For each species, the area of habitat within each restoration tract was multiplied by the species weight. These values were then summed for each restoration tract. Because the restoration tracts vary in size, the summed values were normalized by dividing the sum by the total area of each restoration tract. The resultant values were grouped into classes and assigned scores using natural breaks in the data. The results are provided in Table 5. Note that the GIS boundaries for Tate's Hell State Forest are approximate. As a result, the total area of the restoration tracts slightly exceeds the actual 202,437 acre forest.

Table 4. Weights Assigned to Listed Species Documented at Tate's Hell

Common Name	Assigned Weight	State Status	Nature-Serve Status	Federal Status
Animals				
Eastern indigo snake	6	Threatened	S3	T
Frosted Flatwoods salamander	9	SSC	S2	T
Florida black bear	9	Threatened	S2	-
Red-cockaded Woodpecker	9	SSC	S2	E
Plants				
Apalachicola dragon-head	6	Threatened	S3	-
Carolina grass-of-Parnassus	9	Endangered	S2	-
Chapman's crownbeard	6	Threatened	S3	-
Curtis' loosestrife	12	Endangered	S1	-
Florida bear-grass	6	Threatened	S3	-
Florida skullcap	9	Endangered	S2	T
Godfrey's butterwort	9	Endangered	S2	T
Hummingbird flower	9	Endangered	S2	-
Large-leaved grass-of-parnassus	9	Endangered	S2	-
Panhandle spiderlily	9	Endangered	S2	-
Pine-woods bluestem	6	Threatened	S3	-
Small-flowered meadowbeauty	9	Endangered	S2	-
Southern milkweed	9	Threatened	S2	-
Spoon-leaved sundew	6	Threatened	S3	-
Thick-leaved water-willow	9	Endangered	S3	-
West's flax	9	Endangered	S2	-
White birds-in-a-nest	9	Endangered	S2	T
White-flowered wild petunia	9	Endangered	S2	-
White-top Pitcherplant	9	Endangered	S3	-
Wiregrass gentian	9	Endangered	S3	-
Yellow fringeless orchid	9	Endangered	S3	-

Source: NatureServe 2010. Federal status: T = threatened; E = Endangered

Table 5. Habitat Restoration Priority Scores

Tract	Normalized Sum	Assigned Score
Sumatra	17.2	12
Pine Log Creek	16.6	11
Crooked River South	15.0	10
Crooked River West	14.2	9
Crooked River East	13.1	8
New River North	12.3	7
Cash Creek	11.8	6
New River Central	11.6	6
Gator-Gully Creeks	11.2	6
Fish – Rollaway	10.8	6
Doyle – Juniper	10.5	6
Fort Gadsden	9.7	5
Jeff Sanders	9.6	5
Whiskey George North	9.4	5
East Bayou	9.2	5
High Bluff Creek	8.8	4
Trout Creek	8.1	3
Whiskey George South	7.7	2
Womack	5.0	1

Feasibility of Restoration

The scoring for the feasibility of restoration is based broadly on the degree of similarity between historical and current vegetation conditions. In general, areas where the current and historical conditions are similar are likely to have fewer hydrologic impacts and be more easily restored than areas where differences between historical and current conditions are large. Prior to assigning scores for the feasibility of restoration, it was first necessary to establish the current vegetation conditions within Tate's Hell State Forest. To accomplish this, unique habitat polygons were delineated using GIS. Each polygon was then assigned attributes that reflect the current and historical vegetation conditions. For each habitat polygon, the likelihood of long-term timber management was determined and categorized as either perpetual, short-term, or none based on the recommendations in the *Vegetation Management Guidelines* (DOF and FNAI 2001). The details of these analyses are provided in Appendix B.

Although there is a wide range of conditions across Tate's Hell State Forest due to the high degree of site disturbance as well as natural variability, the ecological communities were grouped into general vegetation categories for the purpose of assigning restoration feasibility scores. The vegetation categories, their associated attributes, and the assigned restoration feasibility scores are given in Table 6. Individual habitat polygon scores were used to compute area-weighted average scores for each restoration tract. The results are given in Table 7.

Table 6. Scoring Approach for the Feasibility of Restoration

Current Vegetation	Attributes and Scoring Rationale	Score
Wetlands with a natural tree canopy	Former wetlands retaining a natural wetland canopy. These areas are not planted in pines. These areas may achieve desired habitat conditions following hydrologic restoration.	12
Low density planted pines (Wet / mesic flatwoods or wet savanna – pine flatwood mosaic)	Former wetlands that have been planted in pines but are proposed to be hydrologically restored and will not be managed perpetually for timber production. The pine density is less than 200 TPA and the BA is less than 60 ft^2/ac. These areas may require both hydrologic improvements and natural recruitment of wetland trees.	10
Cleared forested wetlands	Clear-cut wetlands whose historical ecological community is unsuitable for timber production. These areas will likely require both hydrologic improvements and planting or natural recruitment of wetland trees.	8
Medium density planted pines (Wet / mesic flatwoods)	Former wetlands that have been planted in pines, are proposed to be hydrologically restored, and will not be managed perpetually for timber production. The BA is between 61 and 80 $ft^2/acre$ or the tree density is between 200 and 300 TPA. These areas will likely require hydrologic improvements and one or more harvests (thinning) of pines.	8
High density planted pines (Wet / mesic flatwoods)	Former wetlands that have been planted in pines, are proposed to be hydrologically restored, and will not be managed perpetually for timber production. Tree density is greater than 300 TPA or the basal area is greater than 80 $ft^2/acre$ or the density and basal area are unknown. These areas will likely require both hydrologic improvements and two or more harvests (thinning) of pines.	6
Isolated wetlands surrounded by pine flatwoods	Wetlands smaller than 10 acres where the current or historical ecological community is wetter than a pine flatwoods ecosystem. Because the surrounding pine flatwoods areas will be managed for timber production, the feasibility of hydrologic restoration is low.	6
Former wetlands with a titi canopy	The dominant forest cover is titi. These areas will be difficult and costly to restore due to the proliferation of this invasive native shrub. Historical shrub wetlands, wet savanna – cypress flats, and basin swamp/ shrub / mixed forested wetlands are excluded from this scoring category because these communities may have a natural titi component.	4
Pine flatwoods proposed for long-term timber production and other uplands	This category includes pine flatwoods that will be managed perpetually for timber production, along with roads, sand pine scrub, open water, and upland areas where hydrologic restoration is not needed.	0

BA = basal area TPA = trees per acre

Table 7. Feasibility Scores by Tract

Tract	Total Acreage	Total Score	Area-weighted Average Score
Cash Creek	12,731	63,505	4.99
Crooked River East	9,463	42,518	4.49
Crooked River South	3,546	8,354	2.36
Crooked River West	6,187	49,510	8.00
Doyle – Juniper	12,809	92,246	7.20
East Bayou	3,863	15,118	3.91
Fish – Rollaway	7,859	68,791	8.75
Fort Gadsden	6,604	60,184	9.11
Gator-Gully Creeks	9,209	44,191	4.80
High Bluff Creek	8,758	32,299	3.69
Jeff Sanders	6,834	33,810	4.95
New River Central	17,865	51,995	2.91
New River North	20,193	85,728	4.25
Pine Log Creek	14,604	75,369	5.16
Sumatra	10,857	76,153	7.01
Trout Creek	17,925	93,408	5.21
Whiskey George North	16,938	113,781	6.72
Whiskey George South	10,522	43,350	4.12
Womack	5,818	46,156	7.93

Results

Table 8 summarizes the individual criteria scores and the total scores for each of the 19 restoration tracts. The total maximum score is 48. Based on the total scores, restoration tracts were assigned an overall priority for hydrologic restoration. The priority groups are high, medium, and low. The results are mapped on Figure 11. The top-ranked tract is the Fort Gadsden tract. Other high priority areas include the Doyle-Juniper, Sumatra, Whiskey George North, Cash Creek, East Bayou, and High Creek areas.

This prioritization of areas for hydrologic restoration is based on current conditions and available data. Much of the information on current vegetation conditions (forest cover, trees per acre, etc.) is based on inventories conducted in 2000 and 2001. As a result, it is recommended that the prioritization of areas for restoration be updated periodically as site conditions change and as new data becomes available.

Table 8. Prioritization Results

Restoration Tract	Area (acres)	Water Quality Benefits (0 to 24)	Species of Conservation Concern (0 to 12)	Restoration Feasibility (0 to 12)	Total Score (0 to 48)	Rank	Priority
Fort Gadsden	6,622	24	5	9.11	38.11	1	High
Doyle - Juniper	12,855	24	6	7.20	37.20	2	High
Sumatra	11,082	24	12	7.01	37.01	3	High
Whiskey George North	17,077	24	5	6.72	35.72	4	High
Cash Creek	12,823	24	6	4.99	34.99	5	High
East Bayou	3,870	24	5	3.91	32.91	6	High
High Creek	9,004	24	4	3.69	31.69	7	High
Whiskey George South	10,591	24	2	4.12	30.12	8	High
New River North	20,647	18	7	4.25	29.25	9	Medium
Crooked River West	6,213	12	9	8.00	29.00	10	Medium
Gator-Gully Creeks	9,265	18	6	4.80	28.80	11	Medium
Pine Log Creek	14,807	12	11	5.16	28.16	12	Medium
New River Central	18,411	18	6	2.91	26.91	13	Medium
Fish - Rollaway	7,902	12	6	8.75	26.75	14	Medium
Trout Creek	18,288	18	3	5.21	26.21	15	Medium
Crooked River South	3,553	12	10	2.36	24.36	16	Low
Crooked River East	9,468	6	8	4.49	18.49	17	Low
Jeff Sanders	6,904	6	5	4.95	15.95	18	Low
Womack	5,863	6	1	7.93	14.93	19	Low
Total	205,245						

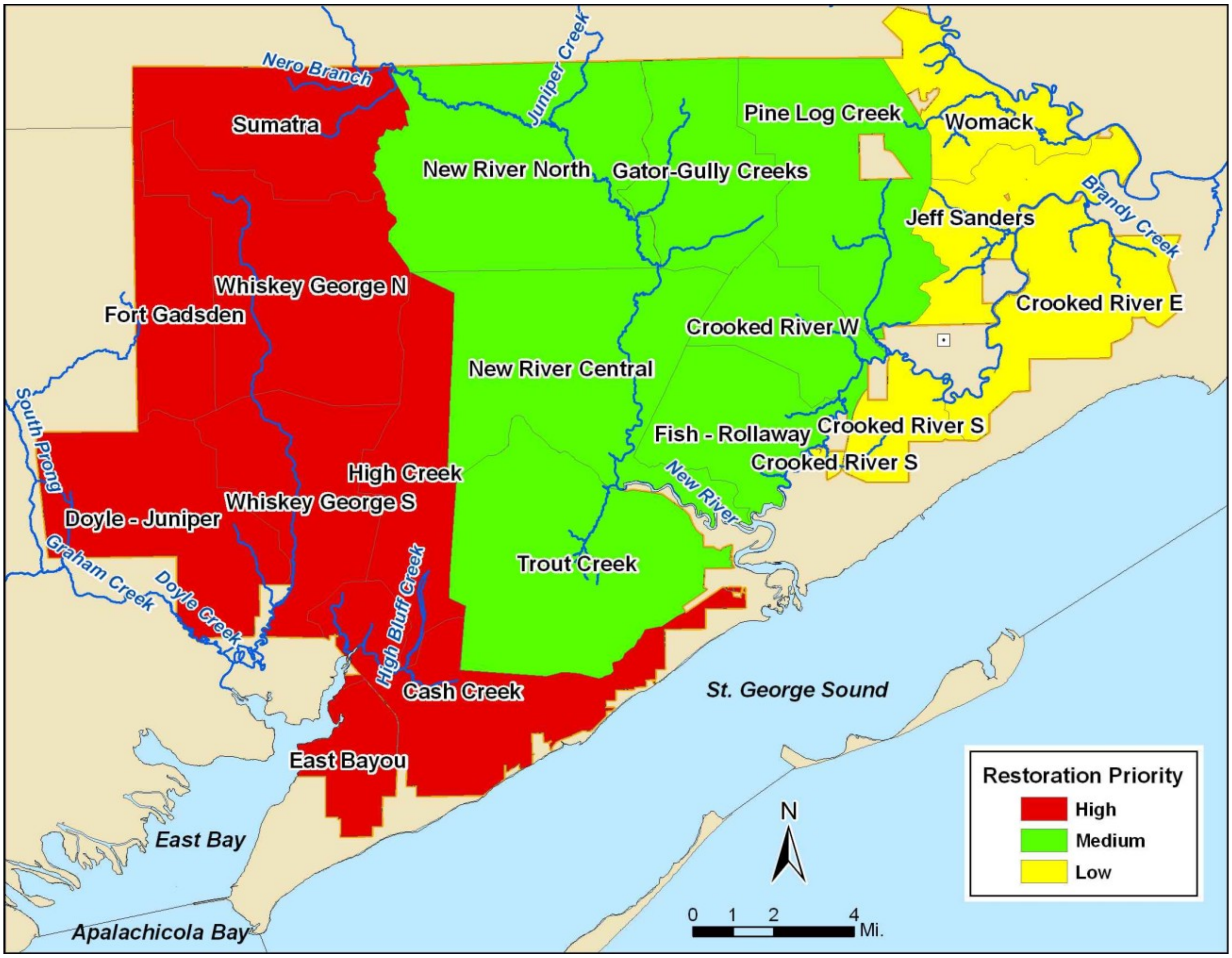

Figure 11. Landscape Scale Prioritization Results

Environmental Monitoring Guidelines

Due to the extensive area of Tate's Hell State Forest, the large number of proposed restoration projects, and limited financial resources and field personnel, it is unlikely that extensive environmental monitoring will be conducted for all restoration projects. However, monitoring should be performed at a subset of representative projects to quantify the success of restoration efforts. Information gained through environmental monitoring activities can lead to enhancements in habitat management and the design and operation of hydrologic structures and ultimately can improve future restoration activities.

Environmental monitoring activities have varied among the restoration projects previously implemented at Tate's Hell due to differences in project goals, site features, permitting requirements, agency resources, and other factors. For future environmental monitoring, it is recommended that a consistent approach be used to facilitate comparisons among restored areas and to enable the cumulative effects of restoration activities to be more easily evaluated.

The methodology contained in the District's Umbrella, Watershed-based Regional Mitigation Plan (UWRMP) (found at http://www.nwfwmdwetlands.com/index.php) provides the basis for the environmental monitoring guidelines outline below (NWFWMD 2009). The UWRMP includes a joint agreement between the District and the U.S. Army Corps of Engineers (Corps) that provides a framework for the mitigation of unavoidable wetland impacts caused by Florida Department of Transportation projects. The Tate's Hell property is identified as a location for FDOT wetland mitigation within the UWRMP. The use of the UWRMP environmental monitoring approach will ensure consistency among wetland restoration projects both within Tate's Hell State Forest and throughout the NWFWMD. Some additional recommendations specific to Tate's Hell State Forest are provided to enhance our understanding of hydrologic and ecologic processes and to facilitate long-term adaptive management of restoration areas.

Restoration Goals

Restoration goals, target ecosystems, and success criteria should be specified for each area where environmental monitoring will be performed. Restoration goals typically include descriptions of target ecosystems and desired habitat conditions to be achieved following hydrologic restoration and habitat management activities. In most cases, the target ecosystem will be the historical ecological community as delineated by the FNAI (FNAI 1997 and 2000). Other ecological communities may be selected as target communities in some cases, particularly when it is not feasible to return to pre-1960 conditions.

Current conditions may constrain the degree of restoration that can be attained in some areas. The more than 800 miles of unpaved roads and adjacent ditches have created large-scale hydrologic and ecologic impacts across Tate's Hell. It will not be feasible to remove most of these roads because they are needed by the Division of Forestry to provide access for public recreation and land management activities. Additionally, past land clearing and logging activities have removed many old growth trees, impacting forest regeneration processes and altering tree species community composition. Where fertilization and bedding of pine stands has occurred, soil conditions and microtopography also have been altered. These changes have influenced the natural trajectories of wetland development and may not be reversible in some restoration areas.

A good example of wetlands for which restoration opportunities may be constrained are former deciduous forested wetlands (e.g. cypress wetlands) that have been cleared, drained, and replanted in pines. In areas where it is not feasible to restore the historical ecological community, a target community with a slightly shorter hydroperiod or slightly different vegetation composition could be proposed. For example, perhaps it would be feasible to restore the deciduous forested wetland to a wet savanna – cypress flats community. Project managers should carefully review current site conditions and constraints prior to establishing restoration goals and success criteria for individual project areas.

Success Criteria

Success criteria should consist of a set of quantitative and qualitative measures for evaluating restoration success. At a minimum, success criteria should include a list of desired vegetation and hydrologic attributes appropriate for the target ecosystems. Success criteria could also include project milestones such as the completion of specific hydrologic restoration and land management activities. Example activities might include the installation of hydrologic improvements; the completion of shrub reduction, pine thinning, groundcover or canopy revegetation; or the completion of prescribed burns. Recommended success criteria for hydrologic restoration projects are shown in Table 9. These are based on criteria contained in the UWRMP, with criteria added to address hydrology and wildlife within Tate's Hell State Forest.

Functional Assessments

Functional assessments of wetland condition are required for hydrologic restoration projects implemented for compensatory mitigation under Section 404 of the Clean Water Act. Because hydrologic restoration activities at Tate's Hell are anticipated to be funded by a variety of mechanisms, including but not limited to compensatory mitigation, functional assessments are not addressed in this document. When functional assessments are needed, such assessments will be performed by the appropriate entities during the permitting process. However, to promote consistency in environmental monitoring and to provide data that may ultimately be useful for evaluating the cumulative success of hydrologic restoration activities across Tate's Hell State Forest, the District recommends that functional assessments be performed using the Unified Mitigation Assessment Method (UMAM), as recommended in the UWRMP (NWFWMD 2009).

Table 9. Recommended Success Criteria for Hydrologic Restoration Projects

Vegetation
• Desired species showing evidence of increasing frequency or abundance (list specific herbaceous, shrub, and tree species)
• Minimum percent cover for specific cover classes (open water, bare ground, shrub layer, etc.)
• Minimum percent cover for key plant species (e.g. *Taxodium* spp., P*inus* spp. , *Aristida*, etc.)
• Maximum percent cover for invasive exotic species (1%) and nuisance native species (5%) (exceptions made for titi in some areas)
• Increase in plant species diversity
• Species richness appropriate for target community
• Minimum survival rates for planted vegetation (typically between 75% and 100%)
• Type and total coverage of tree, shrub, and herbaceous species appropriate for target community
• Appropriate tree densities or basal areas for selected species
• Evidence of recruitment, regeneration, or reproduction (flowering, fruiting, and seed production)
Hydrology
• Measured wetland hydroperiod is appropriate for the target community
• Evidence of re-establishment of historical surface water drainage patterns
• Wetland vegetation is indicative of appropriate hydroperiod conditions
• Improvements in wetland water levels or hydroperiods are indicated by long-term monitoring data
Wildlife
• Evidence of wildlife usage by appropriate species, including invertebrates, fish, herpetofauna, birds, and mammals
• Evidence of successful reproduction of wildlife species
Management Actions
• Timely completion of hydrologic restoration activities
• Prescribed burning completed at appropriate fire return intervals
• Timely completion of tree thinning, replanting, shrub reduction or exotic species control
• Successful and timely operation of flashboard risers

Monitoring Protocols for Hydrology, Vegetation, and Wildlife

The monitoring protocols described below are based on those in the UWRMP (NWFWMD 2009). Additional recommendations are provided for monitoring wetland hydrology and wildlife usage of restoration areas. It is recommended that monitoring be conducted for a minimum of five to ten years following initial hydrologic restoration activities to ensure that success criteria are achieved and are sustained over time.

Hydrology

Hydrologic conditions affect physical, biological, and chemical processes in wetlands including nutrient cycling, sedimentation, primary productivity, and plant and animal species composition. As a result, hydrology may be the single most important factor that determines the establishment and maintenance of wetland processes and vegetation (Mitsch and Gosselink 2000). Hydrology can be quantified by monitoring wetland hydroperiods. The hydroperiod refers to the seasonal pattern of water level depth, duration, and area. Hydroperiods are typically reported as the number of days or months within a year that standing water is present in a wetland. When hydroperiod data are combined with wetland bathymetry data, the area and frequency of inundation can also be estimated. Elsewhere in Florida, hydroperiods for cypress wetlands are estimated to range from six to ten months (USFWS 1999), whereas hydroperiods for wet savannas may be three months or less (Duever 1997). Data regarding wetland hydroperiods, water table fluctuations near wetlands and wetland-water table interactions are lacking in northwest Florida.

To evaluate the success of hydrologic restoration efforts, wetland water levels and hydroperiods should be monitored at a subset of restored sites. Preferably, sites would include not only restored wetlands but also reference wetlands without hydrologic impacts. For example, water levels could be measured at restored wet savannas within Tate's Hell State Forest and at reference wet savannas located in the Apalachicola National Forest. Proximal reference sites not only provide a basis for the evaluation of restoration success but can also function as control sites that can help to distinguish between water level changes due to natural rainfall variability and hydrologic restoration activities.

Figure 12. Wetland Staff Gage

To monitor wetland water levels, staff gages should be installed near the deepest portion of each wetland and wetland water levels should be measured at twice each month. Because fluctuations in wetland water levels due to rainfall are large, data should be collected for multiple years so that long-term average conditions can be assessed. Increasing the frequency of water level measurements to weekly or daily would greatly improve the accuracy of hydroperiod estimates.

Little is known regarding the seasonal dynamics of wetland-water table interactions in northwest Florida. Wetlands may provide a source of water or act as discharge areas for the underlying surficial aquifer. Many wetlands elsewhere in Florida seasonally alternate between recharge and discharge conditions. Seasonal dynamics vary among wetland types and hydrogeologic settings. To improve our understanding of wetland-water table interactions in Northwest Florida, a shallow surficial aquifer monitoring well or piezometer could also be installed at the wetland edge and surficial aquifer water levels could be monitored at the same frequency as wetland stage.

Streamflow or stream stage data may also be useful for evaluating the success of hydrologic restoration efforts, particularly in areas where hardened low water crossings, bridges, or culverts are installed to restore historical streamflow patterns.

Vegetation

It is recommended that a baseline vegetation assessment be performed in the vicinity of the proposed hydrologic improvements prior to initiating construction activities or habitat improvements. Following the completion of all restoration activities, vegetation should be monitored annually for the first five years and then at least once every five years thereafter. Baseline vegetation monitoring and annual monitoring for the first five years are anticipated to be conducted by the entity implementing the restoration project. Long-term monitoring activities are anticipated to be performed as part of cooperative, periodic site-wide assessments conducted by the Division of Forestry and the NWFWMD.

To minimize observer bias associated with differences in plant phenologies, vegetation assessments at a particular site should be performed at the same time each year. If the post-restoration target ecological communities are wet savannas, wet savanna-pine flatwoods, and wet savanna-cypress flats, the vegetation assessments should be performed during the spring growing season (e.g May) when pitcher plants (*Sarracenia* spp.) and other wet prairie species are in flower. For other wetland types including forested wetlands, basin swamps, shrub wetlands, and freshwater marshes, the vegetation assessments should be performed during the fall growing season (e.g September).

To quantify land cover types and plant species composition, transects should be established using the field protocols specified in the UWRMP (NWFWMD 2009). If more than one target community type is proposed, a stratified sampling approach is recommended where at least one transect is established for each community type. Ideally, the starting point of each transect should be randomly selected. Transects should be marked using iron rebar and the GPS coordinates should be recorded.

The belt transect technique is recommended for annual monitoring of the forest canopy during the first five years following hydrologic restoration activities (NWFWMD 2009). Within each belt transect, tree species, stem densities and heights should be recorded along with evidence of seed production or natural recruitment. For long-term monitoring of the tree canopy, continued monitoring of the established belt transects, use of forest inventory data, or aerial photo interpretation of canopy conditions could be used. If aerial photo interpretation is used, ground-truthing is highly recommended.

Pedestrian surveys of vegetation should be conducted during the annual monitoring event using the UWRMP protocol. Information recorded regarding the dominant plant species, the health and reproductive status of vegetation, and the presence or spread of nuisance or exotic species can provide additional insight regarding the success of restoration efforts (NWFWMD 2009). A pedestrian survey should be performed for each target community type.

Wildlife

With the exception of the Red-cockaded Woodpecker and perhaps the gopher tortoise, the abundance and spatial distribution of most animal species at Tate's Hell are not well understood. Unfortunately, quantitative wildlife surveys are labor intensive and cost-prohibitive for most hydrologic restoration projects. However, incidental observations of wildlife and wildlife sign could and should be recorded during annual vegetation assessments. Incidental wildlife observations can provide an indication that desired habitat conditions are being achieved. If funding becomes available for additional wildlife monitoring, the Division of Forestry, the NWFWMD, and the FWC should work cooperatively to develop and implement monitoring programs for additional species of conservation concern.

Habitat Management

Habitat management activities associated with hydrologic restoration projects should generally follow the Vegetation Management Guidelines established for Tate's Hell State Forest (DOF and FNAI 2001), which are incorporated by reference into the *Ten-year Management Plan* (Division of Forestry 2007). The guidelines include recommended fire frequencies and hydroperiods for each ecological community type as well as recommendations for silvicultural management activities. The guidelines also specify which areas are suitable and unsuitable for long-term timber production. A brief summary of the guidelines for prescribed burning and silvicultural management are provided below. The need for additional habitat management activities such as shrub reduction, invasive species control, and replanting of native tree or groundcover species should be evaluated on a case by case basis.

Prescribed Burning

Because most of the historical plant communities within Tate's Hell State Forest are fire-adapted, the continued use of prescribed fire by the Division of Forestry to maintain vegetation conditions and promote regeneration is perhaps the most important habitat management technique. Table 10 summarizes the recommended burn frequencies for the historical ecological communities in order from most frequent to least frequent. Lightning season burns (April through June) are most effective at reducing hardwood competition in pine flatwoods habitats (DOF and FNAI 2001). Lightning season burns are also required for seed production and regeneration of many ground cover plants. Sites with heavy fuel loads may require tree thinning or a series of dormant season

Table 10. Burn Intervals for Ecological Communities at Tate's Hell State Forest

Ecological Community	Burn Frequency (years)
Wet savannas and wet savanna-swamp mosaics	1 - 4
Wet/mesic flatwoods (grassy)	2 - 4
Wet savanna -pine flatwoods mosaic	2 - 4
Wet/mesic flatwoods (shrubby)	3 - 5
Wet savanna - cypress flats	5 - 10
Shrub wetlands	10-20
Deciduous forested wetlands	15 - 20
Basin swamp / shrub / mixed forested wetlands	Variable (25 Avg.)
Sand pine scrub	20-80
Basin swamp - Atlantic white cedar	50 - 100
Mixed forested wetlands and marshes	Varies with adjacent habitats

Source: FNAI 2000 and DOF 2007

burns prior to implementing lightning season burns. Once an area reaches desired habitat conditions, varying the seasons and frequency of burns (within listed guidelines) will enhance plant diversity (DOF and FNAI 2001).

Silvicultural Management

Silvicultural management includes tree thinning and harvesting, reforestation of harvested or clear-cut areas, and conversion from even-aged to uneven-aged stands. Silvicultural management activities conducted at hydrologic restoration sites should be based on the historical or target

Table 11. Suitability of Historical Ecological Communities for Timber Production

Ecological Community	Suitable for Timber Production?	Silvicultural Recommendations
Sand pine scrub	No	• Maintain native scrub habitat
Wet/mesic flatwoods (grassy)	Yes	• Convert to uneven-aged management • Maintain a mixture of slash and longleaf pine • Maintain basal area of 30 to 60 ft^2/ac • Retain existing longleaf pines as seed source
Wet/mesic flatwoods (shrubby)	Yes	• Convert to uneven-aged management • Maintain basal area of 55 to 75 ft^2/ac • Retain existing longleaf pines as seed source
Wet savanna	No	• Thin pines to densities of zero to 15 trees per acre • Conduct frequent prescribed burns • No reforestation of pines
Wet savanna-swamp mosaic	No	• Thin pines to densities of zero to 15 trees per acre • Thin during dry periods or use specialized equipment • No reforestation of pines
Wet savanna - pine flatwoods mosaic	Flatwoods only	See Wet Savannas and Wet / Mesic Flatwoods
Wet savanna - cypress flats	No	• Thin planted pines to 5 to 20 trees per acre • Thin during dry periods or use specialized equipment • Retain remnant cypress and flat-topped pines
Shrub wetlands	No	• No thinning or replanting
Basin swamp / shrub wetlands / mixed forested wetlands	No	Drier areas only: • Thin slash pines and retain longleaf • Convert to uneven-aged management
Basin swamp - Atlantic white cedar	No	• Harvests of pines may be acceptable if damage to ecosystem scan be minimized • Further research is needed
Deciduous forested wetlands, mixed forested wetlands, and marshes	No	• No thinning, harvesting, or planting of pines

ecological community type and be consistent with the *Vegetation Management Guidelines* (DOF and FNAI 2001) and the *10-Year Management Plan* (DOF 2007). Table 11 indicates the suitability of each community type for long-term timber production and lists some of the long-term management recommendations developed by the DOF and FNAI. The suitability of areas for timber production may change as natural surface water drainage patterns are restored and site conditions change over time.

Areas containing clusters of the endangered Red-Cockaded Woodpecker merit special consideration. These habitats should be managed consistent with the state's Red-cockaded Woodpecker Management Plan (FWC 2003) and the U.S. Fish and Wildlife Service Recovery Plan (USFWS 2003). Appropriate forest structure for RCWs includes large pines, low densities of small and medium pines, a sparse hardwood mid-story, and an abundant and diverse herbaceous groundcover (USFWS 2003). Areas containing RCW clusters should be burned every one to three years during the growing season to maintain an open forest structure and prevent mid-story encroachment (FWC 2003). Shrub or mid-story reduction may be needed to provide optimal foraging habitat. Cavity trees, dead and dying snags and older pines should not be harvested. Human disturbances should be minimized and no activities should be conducted within 200 feet of any cavity tree during the April – July nesting season (FWC 2003).

Exotic and Invasive Species (including titi)

During construction activities, specifications for erosion control should clearly specify that Bahia grass (*Paspalum notatum*), which is considered an invasive plant, not be used for seeding and mulching. Subsequent to construction, the control of exotic and invasive species should be performed by the entity responsible for the hydrologic restoration project in cooperation with the Division of Forestry. In some cases, the Division of Forestry may assume responsibility for the management of exotic and invasive species. Typically, restoration goals will specify that invasive exotic species be maintained at less than 1% cover. This may require the use of herbicides (subject to Division of Forestry approval), prescribed burning, manual vegetation removal, or some combination of these actions.

Although shrub wetlands were a part of the natural historical landscape within Tate's Hell State Forest, titi shrubs have invaded many other historical ecological communities as a result of past fire suppression. Some areas where titi has invaded have essentially become large monocultures with little groundcover and few other canopy species. Titi shrub reduction will be needed in many areas to restore appropriate vegetation conditions. The reduction of titi shrubs can be accomplished with mechanical removal followed by a series of prescribed burns. In some cases, replanting of native wetland vegetation may be needed.

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Appendices

Appendix A. List of species for which habitat maps were developed by the FNAI and the NWFWMD

Table A.1 Species for which habitat maps were developed by the FNAI

Common Name	Scientific Name
Curtis's Loosestrife	*Lythrum curtissii*
Eastern Indigo Snake	*Drymarchon couperi*
Flatwoods Salamander	*Ambystoma cingulatum*
Florida Black Bear	*Ursus americanus floridanus*
Florida Skullcap	*Scutellaria floridana*
Godfrey's Butterwort	*Pinguicula ionantha*
Panhandle Spiderlily	*Hymenocallis henryae*
Red-cockaded Woodpecker	*Picoides boreaslis*
West's Flax	*Linum westii*
White Birds-in-a-nest	*Macbridea alba*
White-flowered Wild Petunia	*Ruellia noctiflora*

Table A.2 Species for which habitats maps were developed by the NWFWMD

Common Name	Scientific Name
Apalachicola Dragon-head	*Physostegia godfreyi*
Carolina Grass-of-Parnassus	*Parnassia caroliniana*
Chapman's Crownbeard	*Verbesina chapmanii*
Florida Beargrass	*Nolina atopocarpa*
Hummingbird flower	*Macranthera flammea*
Large-leaved Grass-of-Parnassus	*Parnassia grandifolia*
Pine-woods Bluestem	*Andropogon arctatus*
Small-flowered Meadowbeauty	*Rhexia parviflora*
Southern Milkweed	*Asclepias viridula*
Spoon-leaved Sundew	*Drosera intermedia*
Thick-leaved Water-willow	*Justicia crassifolia*
White-top Pitcherplant	*Sarracenia leucophylla*
Wiregrass Gentian	*Gentiana pennelliana*
Yellow Fringeless Orchid	*Platanthera integra*

Appendix B. Supporting GIS Analyses

Delineation of Habitat Polygons

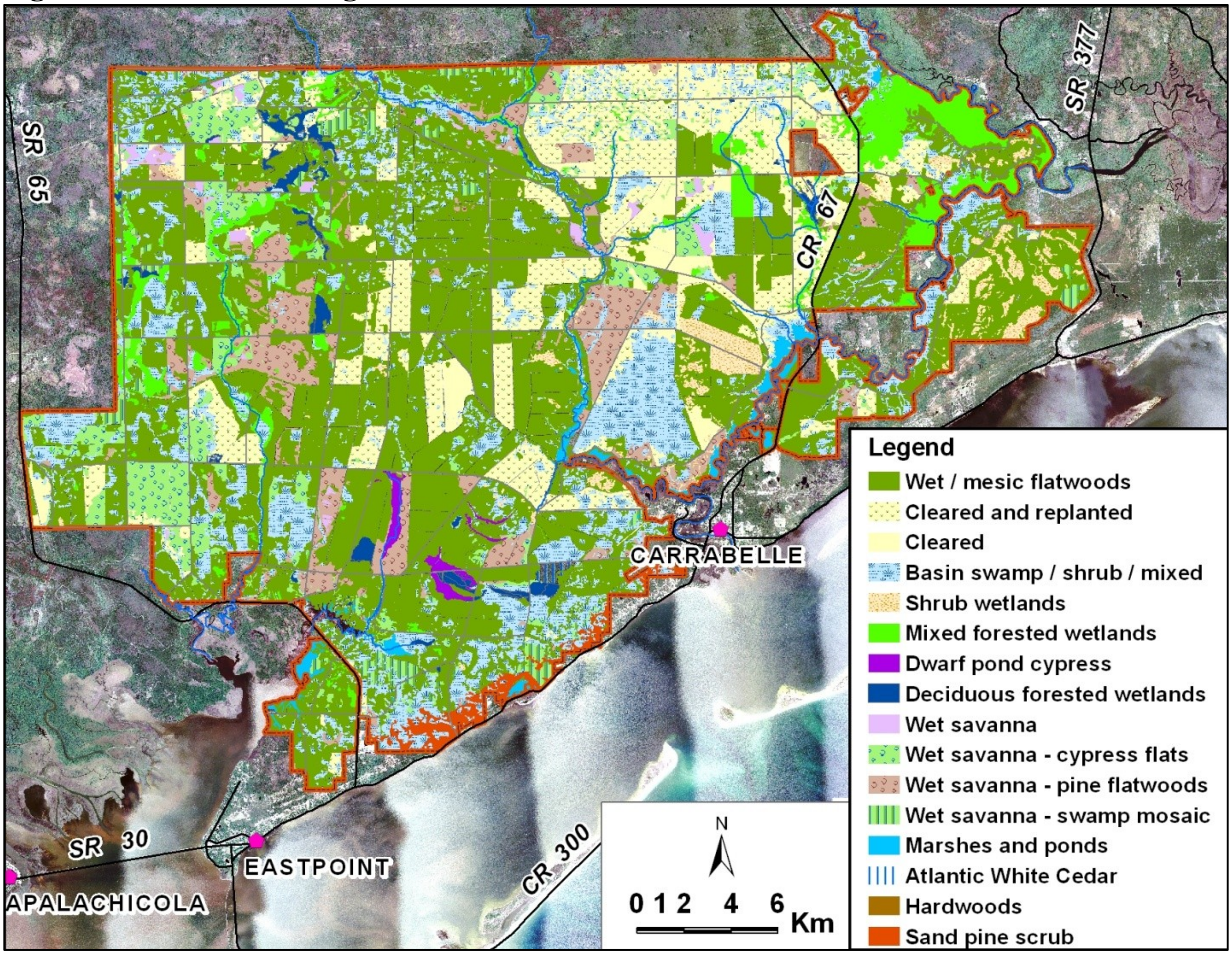
The GIS shapefile for each restoration tract contains many smaller polygons, each with unique habitat attributes. A GIS shapefile named "stand_pl" was obtained from the Division of Forestry and contained data for each forestry management unit including the forest cover, groundcover, age structure and timber size class. For some management units, the tree density and basal area also were available. The shapefile of stand management data was combined with a shapefile of the historical ecological communities delineated by FNAI (FNAI 2000). The result was a shapefile containing nearly 21,200 polygons. The attribute table contains data regarding both historical and the current vegetation conditions. Attributes include the historical ecological community type delineated by FNAI and the forest cover (e.g. slash pine, hardwoods), groundcover (where available), and origin (planted, natural, or clear-cut) and other data provided by the Division of Forestry. For areas planted in pines, the tree density, basal area, mean diameter, age structure, size class, and year planted may also be available.

Polygons greater than 0.1 acres in area comprise more than 98% of the total area of Tate's Hell. To reduce computational effort in subsequent GIS analyses, the polygons smaller than 0.1 acres were deleted. The resultant shapefile contains approximately 14,000 habitat polygons.

Aerial Photo Interpretation of Current Vegetation

The FNAI classification system was used to classify the current ecological communities within each of the 14,000 habitat polygons that comprise Tate's Hell State Forest (FNAI 2000). Additional categories were added for roads, buildings, and borrow pits. The determination of the current ecological community type was based largely on the review of available GIS data in combination with field verification of selected areas. The following data were reviewed: aerial photography (1953, 2004, and 2007), color-infrared aerial photography (2004), forest stand attributes (DOF 2007), National Wetlands Inventory maps, and soils maps. LiDAR data had not yet been received by the District when this analysis was performed in late 2007. Aerial photography was reviewed for all polygons greater than 10 acres in size (88% of Tate's Hell Hell State Forest). For polygons less than 10 acres in size, the current ecological community generally was assigned based on forest stand attributes (canopy species, groundcover, etc.). The results are shown on Figure B.1. Although forest stand data and aerial photography can generally provide a reasonable approximation of canopy conditions, shrub cover and groundcover conditions are often largely unknown. Thus, an area that appears to be wet flatwoods community from aerial photography may in fact be an overgrown wet savanna. As a result, this map should continue to be reviewed and updated based on the results of future forest stand inventories and ongoing field verification.

Figure B.1. Current Ecological Communities at Tate's Hell State Forest



Classification of the Likelihood of Long-term Timber Management

The Vegetation Management Guidelines (DOF and FNAI 2001) and available GIS data were used to classify the likely degree of long-term timber management for each habitat polygon as either: (1) short-term timber management, (2) perpetual management for timber production, or (3) no timber management, except for prescribed burning. In the context of wetland restoration, short-term refers to a planning horizon that may range from five to 20 years or more. Many of the areas targeted for hydrologic restoration are currently planted in pines, frequently at tree densities that exceed appropriate or desirable canopy conditions. Such areas may require two or more cycles of tree thinning along with multiple prescribed burns over a 10 to 20 year period before desired pine densities and basal areas can be achieved. Thus, the Division of Forestry will use silvicultural management practices, such as harvesting and burning, as "short-term" restoration tools. In some clear-cut areas, plants have been recently replanted at high densities (720 TPA). The Division of Forestry has used this approach in some areas because planting pine seedlings at a high density in clear-cut areas and then thinning to desirable densities over time may minimize invasion by titi shrubs (Ace Haddock, personal communication).

The Vegetation Management Guidelines specify that wet and mesic flatwoods will be managed perpetually for timber production along with the drier portions of wet savanna - pine flatwood mosaics, wet savanna - swamp mosaics, and basin swamps (DOF and FNAI 2001). Forest stand data and aerial photography were used to distinguish between wetter and drier areas. (LiDAR data had not yet been received by the District when this analysis was performed in late 2007). Areas planted in longleaf pine and designated as mesic flatwoods by the Division of Forestry were presumed to be drier areas that will be managed perpetually for timber production. Areas designated by the Division of Forestry as bogs, basin swamps, bottomland forest, and wet prairies, were presumed to be wet areas that are unsuitable for timber production. The likelihood of long-term timber management was interpreted for each of the 14,000 habitat polygons as indicated below. The resultant map is shown as Figure B.2.

Perpetual pine management for timber production

Includes:

- All historical wet and mesic flatwoods, excluding isolated wetlands occurring within these ecosystems.
- The drier portions of the historical wet savanna – pine flatwoods mosaics, wet savanna – swamp mosaics, and basin swamp/shrub/mixed wetlands.
- Historical sand pine scrub areas that have been planted in slash or longleaf pines, excluding isolated wetlands occurring within these ecosystems.

Short-term pine management

Includes:

- Historical wetland types that are unsuitable for timber production and have a high need for hydrologic restoration but that are currently planted in pines with a basal area greater than 60 ft^2/ac. or a density of more than 200 TPA.
- Areas of historical sand pine scrub included in the 5-year Harvest Plan. (DOF 2007)

No pine management (except for prescribed burning)

Includes:

- Areas with a natural tree canopy that have not been planted and were not proposed to be planted in pines in the 5-Year Reforestation Plan (DOF 2008).

Timber management may change in some areas as conditions become wetter following hydrologic restoration activities. Market conditions and timber prices also will affect future timber management activities.

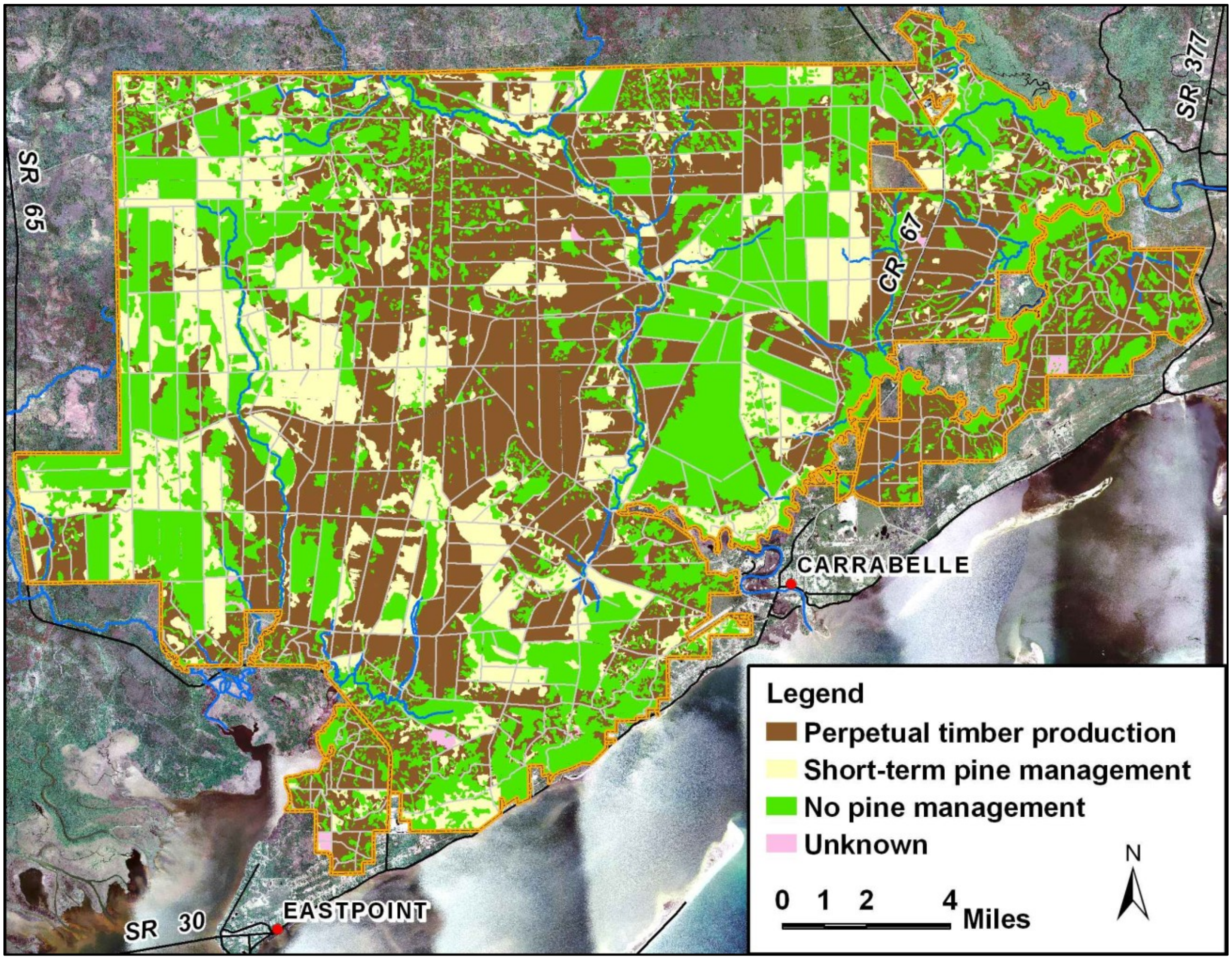


Figure A.2. Silvicultural Management