# Part 02
# RESEARCH AND ANALYSIS

*The miracle of light pours over the green and brown expanse of saw grass [sic] and water, shining and slowly moving, the grass and water that is the meaning and the central fact of the Everglades. It is a river of grass.*

*– Marjory Stoneman Douglas*

## Introduction

The ROGG is proposed within a complex environmental, social and cultural region that has a long history of human use and occupation, but has undergone dramatic changes in land use, hydrology, and population over the last 50 to 100 years. Opportunities to experience and engage in this environment provide both the impetus for establishing a regional greenway as well as conditions and context that affect its feasibility and implementation.

The context provided by the regional setting, coupled with specific conditions within the corridor, represents the fundamental baseline that needs to be addressed by the feasibility study and master plan. This review of context and conditions does not occur in isolation from the extensive array of previous studies or the history of successful greenway and trail development across the world. The regional studies expand the knowledge base for issues, opportunities, and constraints posed by the context and conditions of the corridor, while comparable greenway projects provide technical and social examples of solutions to opportunities and constraints for the ROGG.

To that end, the purpose of this chapter is to provide summary documentation of context, existing conditions, relevant aspects of published studies and records, and comparable projects along with the implications of those elements for the feasibility study and master plan. To accomplish this, the chapter is divided into five sections, including the following:

1. **Corridor Context** – This section documents seven elements, including a) history, b) climate, c) geography, geology, and soils, d) hydrology and hydrogeology, e) ecology, f) public and tribal ownership, and g) transportation components of the lands in and adjacent to the ROGG Study Area. Descriptions of each element are provided, which are then followed by an assessment of the implications each element has for the feasibility study and master plan for ROGG.

2. **Existing Conditions** – This section documents the typical conditions and key nodes for potential alignment alternatives, points of interest, and relevant findings for the ROGG Study Area. For documentation purposes, the ROGG Study Area was divided into three segments to allow for more detailed focus on the conditions in specific areas of the corridor. While these segments provide convenience in documenting and presenting information for portions of the corridor, the feasibility study and master plan for the entire ROGG corridor addressed the findings from these segments as a whole for the entire corridor.

3. **Literature Review** – This section provides a comprehensive list of influencing documents that have been prepared for, or govern the lands within or adjacent to, the ROGG Study Area. It also summarizes a subset of these documents with particular relevance to the feasibility study and master plan. These summaries include a brief overview of each document and an assessment of issues relevant to ROGG that were identified in these documents.

4. **Comparables** – This section documents greenway and trail projects from state, national, and international locations that exhibit successful implementation of design, construction, and/or operational aspects relevant to the ROGG. It provides descriptions of seven categories of greenway and trail projects, documentation of best practices, and lessons learned from those projects.

5. **Summary** – This section provides a summary of the overall conditions and context, literature review, and comparable projects and it provides planning implications for those elements related to ROGG.

For the purpose of this approach and study, the following are defined terms utilized for a number of situations and descriptions:

- The use of the term Tamiami Trail refers to the concept and original configuration of the roadway built to provide a connection between Miami and Tampa, while the use of the term U.S. 41 refers to the current pavement types and widths and shoulder configuration of the existing roadway.
- The use of the term Old Tamiami Trail refers to the portions of the original roadway that were removed from motorized vehicular use by improvements and construction of U.S. 41.
- The use of "maintained U.S. 41 right-of-way (ROW)" refers to the portion of U.S. 41 ROW that consists of the paved roadway and grassed shoulder (in general, this ranges from 34 - 125 feet), while "U.S. 41 ROW" refers to the entire width of the established right-of-way for the U.S. 41 corridor (in some cases this is 200 feet wide).
- Words such as trailheads that can be written as one or two words will be referred to in the text as one word, except for re-printing of titles of published reports in which the word was spelled as two words for consistency with the original report.



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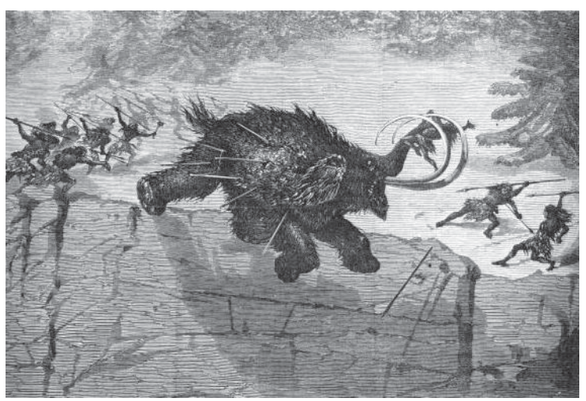
Approximate extent of Florida's shoreline during the Paleoindian period, with sea levels 130 to 165 feet below those of today.From: Milanich, J.T. 1995. Florida Indians and the Invasion from Europe.



Graphical depiction of megafauna hunting activities by prehistoric humans; Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/35557

## 2.1. Corridor Context

The purpose of this section is to document the physical, cultural, and ecological setting for the ROGG and planning implications for the feasibility study and master plan stemming from this contextual setting through a review of the following seven elements:

- **History** - This element summarizes the rich historical and cultural heritage of the corridor and notes the uses and features resulting from historical and current land uses within the corridor.
- **Climate** – This element summarizes weather and climatic conditions for south Florida.
- **Geography, Geology, and Soils** – This element provides an overview of the physiography, geology, soils, and significant geographic features of the region around the Study Area.
- **Hydrology and Hydrogeology** – This element summarizes the hydrological and hydrogeological setting for the Study Area.
- **Ecology** – This element provides an overview of the natural systems and related natural processes that support flora and fauna occurring within the corridor.
- **Public and Tribal Ownership** – This element reviews the ownership patterns for public and tribal entities within the Study Area.
- **Transportation** – This element summarizes traffic characteristics for U.S. 41, including the effects of visitation patterns for the parks on traffic patterns within the Study Area.

Each element begins with a summary of applicable data available and ends with an assessment of potential implications for planning efforts. A bibliography of documents from which information was compiled to prepare the summaries is included in **Appendix 1**.

### 2.1.1. History

In addition to its well-documented natural resources, the Everglades region has a rich and complex human history. The Everglades region has had a human presence for more than 12,000 years, even prior to the earliest formation of the Everglades system. This human presence has shaped and altered the natural systems of the region through that time, ranging from shell midden formation to fire patterns to regional drainage features. The population of the region rapidly expanded beginning in the early 1900s, which was coupled with construction of physical features such as the Tamiami Trail, levee and canal system, and expansion of residential and commercial uses on the eastern and western margins of the Everglades system. The following provides an overview of the historical and cultural context in which the proposed ROGG occurs. For purposes of this document, this context was broken down into three separate general categories for ease of reference, consisting of: Native Americans, 20th Century Development and Hydrology Alterations, and Conservation.

#### Native Americans

Like other parts of North America, Florida has been occupied by humans for more than 12,000 years. For south Florida and the Everglades, Lodge (2005) notes that four distinct cultural periods define the interaction of Native Americans with the Everglades system, including the Paleo-Indian Period, Archaic Period, Formative Period, and Seminole/Miccosukee Period. Paleo-Indians were early hunter/gatherers that hunted large animals, or megafauna, throughout the state. The Archaic Period began with the extinction of the megafauna and included the transition of subsistence from hunting to shellfish as well as the beginning occupation of the newly forming Everglades systems. Over subsequent centuries during the Formative Period, complex cultures developed in south Florida that cultivated agriculture and fired clay pottery, traded with groups throughout the southeastern United States, and developed temple mounds and village complexes. At the time of first European contact, two primary Native American groups controlled the south Florida region: the Calusa and Tequesta. After the decimation of these two people groups by disease and slave raids, few Native Americans inhabited the region until members of Maskókî tribes, referred to as the Creek Nation by white settlers, migrated into Florida and became known as the Seminole and Miccosukee tribes. The following provides a brief overview of the Native American use of the region consistent with the periods outlined in Lodge (2005).

#### Paleo-Indian Period

The Paleo-Indian period began with the advent of humans to Florida at least 12,000 years ago and extended until approximately 9,000 years ago. Archaeological research conducted at two sites in south Florida, Little Salt Springs near Charlotte Harbor (southwest) and the Cutler Fossil Site within the Deering Estate at Cutler (southeast), found evidence of Paleo-Indian occupation dated to approximately 12,000-13,000 years ago and 10,000 years ago, respectively. Large, now extinct, megafaunal species such as giant land tortoises, camels, and sloths occurred in the state. The semi-nomadic Paleo-Indians hunted these megafaunal species, but also supplemented their diets with smaller game and plant products. Although data is limited, human occupation of the region around the ROGG was likely sparse during the Paleo-Indian period.

During this time, the land area of the Florida peninsula was wider than current conditions due to lower sea levels and the climate was cooler and drier. The climatic conditions limited human habitation primarily to areas around coastal areas, rivers, and other large water sources. Moreover, the systems of the Everglades had not yet developed and the dry conditions on the interior of the state likely limited the occupation of the interior portions of the Everglades and Big Cypress regions. However, the coast line continually changed during this period as sea levels rose approximately six-feet per century, which also resulted in wetter climate conditions and more water sources for Paleo-Indians to use.

#### Archaic Period

The transition to the Archaic period began approximately 9,000 years ago with the extinction of the megafauna and extended until approximately 3,500 years ago when fired clay pottery began to be used and settlements began to be occupied. In the early part of the Archaic period, the extinction of the megafauna required modifications to hunting and food gathering, which included transitions to the use of shellfish and the use of different tools for food gathering. Coupled with the still rapid sea level rises characteristic of the end of the Paleo-Indian period, the early Archaic period exhibited drier conditions than the late Paleo-Indian period decreased available water resources, which made living conditions difficult in south Florida. However, conditions began to moderate 7,000 years ago through slower sea level rise, which allowed for more stable coastal resources such as shellfish availability, and increased moisture that allowed the formation of mesic habitats now common to south Florida, including the area that later became the Everglades.

As rainfall continued to increase and as Lake Okeechobee formed in the late Archaic, the modern ecological system of the Everglades completed its transformation into its current ecological system. People in the late Archaic period spread throughout the Everglades, using tree



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islands, hammocks, and other higher elevation areas within the marshes for habitation. The close proximity of extensive freshwater resources such as turtles and snails and productive coastal resources such as shellfish provided rich resources for continuous occupation of desirable locations, eventually leading to the establishment of villages and other settlements and the establishment of middens that may have contributed to the formation and longevity of some tree islands.

### Formative Period

Following the beginning of the use of fired clay pottery tempered with fibers from Spanish moss or palmetto fibers, the Formative Period contained the gradual transition from the late Archaic cultures to the increasingly complex social organizations associated with Glades cultures, including the Calusa and Tequesta peoples encountered by the early Spanish contacts in Florida. Populations increasingly drew upon the very productive estuaries in the region as well as the freshwater and upland habitats of the region, leaving behind middens in a widespread area of the Everglades including on tree islands. Associated with the population increase, increasing social organization included the development of social strata ranging from ruling classes to labor classes, an organization that allowed for the construction of large mounds used for burials and other social purposes and canals for drainage and transportation. These cultures also used fire as a management tool, potentially for the propagation and management of natural plant communities used for food supplies.

Within the vicinity of the proposed ROGG Study Area, this increasing social organization culminated in the chieftain social orders associated with the Calusa and Tequesta peoples, which were the two people groups dominant in south Florida when the Spanish first arrived in the state. The Calusa controlled the southwest portion of Florida centered around Charlotte Harbor and the Caloosahatchee River, while the Tequesta controlled the southeast portion of Florida around the Miami River. However, the Tequesta were required to show allegiance to the Calusa chief by the time of Spanish contact. The Calusa traveled extensively around the coastal systems and rivers of south Florida and were capable of using sea going canoes to travel to Cuba, while the Tequesta also canoed through the coastal systems rivers and seasonally used tree islands within the Everglades for habitation.

Led by Pedro Menendez des Aviles, the Spanish formally visited with the Calusa in their main settlement at the mouth of the Caloosahatchee River in 1566. In the following years, the Spanish introduced new foods and goods to the Calusa, while the Calusa worked to use the military skills and equipment of the Spanish to maintain influence in the region. However, the fatal diseases transmitted from the Spanish to the Native Americans, coupled with slave raids from other European powers, ultimately resulted in the destruction of the Calusa and Tequesta societies. In 1763, a group of 300 Calusa and Tequesta peoples left Florida for Cuba, thereby effectively ending these cultures in Florida.

### Seminole/Miccosukee Period

The Seminole/Miccosukee period includes the renewed habitation of the Everglades region by members of the Seminole and Miccosukee tribes beginning approximately in 1825 and extending to the present day. In the early 1700s, members of the Creek Nation began to move into Spanish-held Florida to occupy lands left essentially unoccupied by the effects of European diseases and slaving raids and/or to move away from encroaching European settlers. The Creeks that moved to Florida included speakers of the related, but separate, Mikasuki and Muskogee languages, but came to be collectively known as “Seminoles” by European settlers. In the early 1800s, a number of factors led to a series of conflicts called the Seminole Wars. These resulted from friction between the Seminoles and settlers in Georgia and Alabama resulting from the incorporation of escaped slaves into the Seminole population in Florida, raids by Seminoles into Georgia that were encouraged by the British during the American Revolutionary War, and forced relocations of Native Americans from the eastern United States after Florida became a state in 1821.

The Seminole Wars ranged throughout Florida, including the battle of Turner River during the Third Seminole War, with the Seminoles gradually being forced to withdraw into south Florida. These conflicts, coupled with forced relocations of Seminoles to lands west of the Mississippi River reduced the Seminole population significantly, with estimates of less than 500 Seminoles and 100 Miccosukee remaining. Moreover, these conflicts left the Seminoles living in lands around Lake Okeechobee, Big Cypress Swamp, and the eastern edge of the Everglades. Miccosukees were relegated to living deep in the wilderness of the Everglades, isolated from the majority of the other residents of Florida.

The late 19th century and first half of the 20th century brought changes in the use of the Everglades system for many of the Seminoles and Miccosukees. Following the cessation of the Seminole Wars, the remaining Seminoles and Miccosukees adapted to life within the Everglades In the late nineteenth century, living in small, temporary camps on “tree islands” and sustaining themselves through hunting, trapping, fishing, and trading with settlers at remote frontier outposts. Similar to the earlier Tequesta, they began to occupy trees islands for agriculture, hunting camps, and burial purposes.

The completion of the Tamiami Trail in 1928 blocked traditional north/south canoe travel, added east/west travel routes on the Tamiami Canal, and established tourist trade in formerly isolated portions of the lands used by the tribal members. Tribal members, especially from the Miccosukees, also began to leave the tree islands and settle along the Tamiami Trail. However, some continued to live traditionally within the Everglades system and requested to be left alone from assistance or interference from governmental agencies. This perspective was communicated to state and local officials at a meeting with tribal members and on the Tamiami Trail in 1936. The meeting is now commemorated with a historical marker on Tamiami Trail. Tribal access to lands south of Tamiami Trail was curtailed following the establishment of Everglades National Park (ENP).

The Miccosukee and Seminole Tribes of Florida maintain a significant presence within the ROGG corridor. The United States officially recognized the Seminole Tribe in 1957 and the Miccosukee Tribe in 1962 as sovereign governments, although a few individuals maintained a status as independent Seminoles separate from the tribes. Reservation lands were placed in trust for the tribes, including lands at the eastern terminus of the ROGG at Krome Avenue and the Miccosukee Indian Village. Both tribes established federal corporations to guide the economic development and independence of the tribes. Although the primary economic enterprise for the tribes is gaming such as the Miccosukee Resort and Gaming facility on the trust lands at Krome Avenue, the tribes also engage in agricultural activities associated with citrus and cattle; tobacco sales; educational, tourism, and cultural activities; and a variety of other enterprises. Tribal members own and/or live within single family residences on individual parcels or in small communities, some of which have been repatriated from federal land holdings within Federal parks. Significant cultural sites, including those used for the Corn Dance ceremonies occur near Tamiami Trail in or near portions of the proposed ROGG corridor.

Graphical depiction of a Spanish explorer in Florida; Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/2803

Drawing of Indian Mound near Fort Taylor, Monroe County, Florida. Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/3274

Seminoles canoeing through the Everglades - 1910s Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/35068



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Military Map of the peninsula of Florida south of Tampa Bay, 1856 (Lieut. J. C. Ives under the general direction of Capt. A. A. Humphreys by the order of the Hon. Jefferson Davis, NY: Leve & Alden Printing Co., 1856, downloaded from Maps ETC, at http://ect.usf.edu/maps #f3793

Monument for the 1936 Seminole Conference

**Native Americans - Relevance to ROGG:** The Native American cultural use of the ROGG corridor affected feasibility assessments, potential alignment selection, construction requirements, and material selection for the ROGG feasibility study and master plan efforts. Specific influences on analysis for the feasibility study included:

- **Archaeological Resources** – Archaeological resources reflecting the long use of the areas by Native Americans could be distributed throughout the ROGG corridor and have been noted in the vicinity of the Study Area as part of surveys completed for the Big Cypress National Preserve General Management Plan (GMP). However, specific surveys within the entire Study Area have not been done as part of the ROGG feasibility study. Surveys for archaeological and/or cultural resources will be required prior to construction activities consistent with laws and regulations such as the Antiquities Act of 1906 and National Historic Preservation Act.

  Sites determined to be significant during later studies will need to be addressed as the master plan is finalized. The final alignment of the ROGG should avoid or cause no impact to mounds, middens, burial grounds, or other archaeologically significant features determined through the surveys or through review of documented records. For those sites located in or adjacent to the ROGG Study Area, measures will be required to protect archaeological sites from looting and vandalism. Archaeological resources found during surveys, construction or operation of the ROGG will need to be placed into public museums, although Native American human remains, funerary objects, sacred objects or objects of cultural patrimony require coordination with Native American tribes for dispossession, including repatriation. The ROGG provides opportunities to interpret the archaeological resources in the region and along the proposed trail.

- **Tribal Lands** – Tribal lands consisting of reservation trust lands, repatriated home sites, or lands owned fee simple by tribes or individual Miccosukee or Seminole occur throughout the Study Area, although this ownership does not extend into the U.S. 41 ROW. Depending on the trust lands involved, the Miccosukee and/or Seminole Tribes of Florida would control the potential feasibility of any trail alignment options through reservation trust lands. Routing alignments extending on and through privately held, fee simple ownership land would not be considered feasible unless requested by the subject property owner(s).

- **Battle of Turner River Battlefield** - The battlefield for the Battle of Turner River is generally situated between Birdon Road and Burns Lake Road within the Turner River floodplain and related prairies, although the boundaries are indistinct. Additional studies on the complete extent of the battlefield would shed light on its boundaries. During the battle, multiple individuals from both sides of the conflict perished within the battlefield, with many bodies left unburied where they fell. Due to the loss of life within the battlefield and lack of distinguished grave sites, concerns were expressed during public workshops about potential impacts to unknown grave sites that would result from construction activities for the ROGG. Placing the trail on existing infrastructure such as U.S. 41 through the battlefield would likely not preclude feasibility of routing the ROGG through this portion of the corridor. Specific route locations that occur outside of existing infrastructure and disturbed lands within the battlefield were subject to additional public comment during the feasibility review.

- **Meeting Monuments** – The location of the 1936 meeting between state and tribal leaders has been commemorated with two separate monuments at the entry road into the Monument Lake Campground. One monument comprised of low stone walls in a square shape occurs on the south side of U.S. 41, while a stone historical sign marks the location on the north side of U.S. 41. Routing alignments that avoid the monuments would not preclude feasibility of the ROGG in this portion of the Study Area. Construction activities will need to be coordinated to avoid the monuments or other associated features identified during surveys for design and permitting. Review of activities in and around these monuments may require additional public review during permitting efforts.

- **Ceremonial Sites** – The Big Cypress National Preserve GMP notes the presence of two ceremonial sites important for the cultural practices of the Miccosukee and Seminole tribes that occur within the vicinity of U.S. 41 and the ROGG Study Area. The specific locations of the sites have been reviewed and addressed as part of the feasibility study and master plan process for ROGG, but are not documented here out of sensitivity to the significance of the sites. The Superintendent's Compendium 2012 documents buffers and closures to public use for those two sites within the Preserve. The feasibility for ROGG in this segment depends on routing locations that accommodate land use and construction requirements in the vicinity of these sites, including any restrictions on construction activities and public use associated with lands on which the ROGG would occur. The planning for specific routing alignments will need to address the buffers and associated restrictions, which may include limiting route locations to existing infrastructure associated with the U.S. 41 ROW. The master plan needs to accommodate access for tribal members as well as access controls to limit unwanted intrusions into the sites from non-tribal members.

## Native American Summary

Florida has been occupied by humans for more than 12,000 years, starting with the Paleo-Indian period when the land area of the Florida peninsula was wider than current conditions and the climate was cooler and drier. The Archaic period (9,000 – 3,500 years ago) included the advent of clay pottery and permanent settlements, and it was the period in which the modern ecological system of the Everglades formed. The Formative Period included the establishment of increasingly complex social organizations associated with Glades cultures, including the Calusa and Tequesta peoples encountered by the early Spanish contacts in Florida. The Calusa controlled the southwest portion of Florida, while the Tequesta controlled the southeast portion of Florida. The Spanish formally visited with the Calusa in their main settlement at the mouth of the Caloosahatchee River in 1566. Over the next 200 years, factors such as fatal diseases and slave raids resulted in the destruction of the Calusa and Tequesta societies. Archaeological resources from these centuries of human habitation occur within the corridor and provide potential constraints and interpretation options for the feasibility study and master plan for ROGG.

The Seminole/Miccosukee period includes the renewed habitation of the Everglades region by members of the Seminole and Miccosukee tribes. In the early 1700s, Mikasuki and Muskogee speaking members of the Creek Nation began to move into Spanish-held Florida, collectively becoming known as "Seminoles" by European settlers. Following the conflicts called the Seminole Wars, the remaining Seminoles and Miccosukees adapted to life within the Everglades. With the completion of the Tamiami Trail in 1928, some members of the Miccosukee tribe began to settle along the roadway, while others continued to live traditionally within the Everglades system. The ROGG Study Area includes reservation trust lands for the Miccosukee Tribe and several significant cultural sites, including those used for the Corn Dance ceremonies. Relevant elements of the Seminole and Miccosukee historical period considered in the feasibility assessment include considerations for tribal trust lands, the Battle of Turner River battlefield from the Seminole Wars, historical monuments from tribal and government interactions, and avoidance of significant ceremonial sites for the tribe.



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## 20th Century Development and Hydrology Alterations

Florida's Everglades were one of the final frontiers for European settlers in the United States. Although Europeans explored Florida as early as the 1500s, much of interior portions of South Florida remained essentially unoccupied by European-Americans for centuries. Some settlers began to arrive in the region as a result of the Armed Occupation Act of 1842, which granted 160 acres to anyone who would help settle the frontier. But for the most part, the subtropical climate, hydrology, landscape, and conflicts with indigenous populations of the region limited the settlement of the region by Europeans until the late in the 19th century. These early settlers were generally self-sufficient and valued personal independence and a restraint-free life over material possessions, characteristics associated with the "Florida Cracker" culture.

Over time, these residents adapted their lifestyles and subsistence patterns to include fishing and reliance on the diverse resources of the wetlands and tree islands of the Everglades and Big Cypress systems, giving rise to a regional variant of the Florida Cracker culture called "the Gladesmen Swamp/Folk Culture." The Gladesmen relied on the steady supply of fish and game provided by the Everglades ecosystem for sustenance and hides, pelts, and bird plumes for trading at outposts, all of which was similar in many respects to the subsistence and lifestyles of Native Americans within this area at the time. Although the homesteads of early Gladesmen tended to be in isolated locations, a number of informal fishing and hunting camps evolved over time into social gathering places. Practices that focused on access and use, both for subsistence and recreation, became significant features of members of this cultural group. Modern day Gladesmen retain many of the same independent, self-sufficient outdoorsmen characteristics of the early Gladesmen, but now rely on the natural resources of the Everglades more for cultural and recreational experiences than for subsistence, which arises from their respect of and traditional use of the natural areas. These Gladesmen actively participate in public forums to advocate for conservation of natural systems and access for their traditional uses.

Beginning with Hamilton Disston in the 1880s, large-scale drainage projects were implemented to lower natural water levels and drain the vast Central and South Florida wetlands, which created more arable land and provided land to supply development booms spurred by railroads along the coasts of south Florida constructed by Henry Flagler and Henry Plant. Although state policy for drainage of the Everglades and smaller scale drainage activities began prior to 1903, the

## Tamiami Trail

As early as the 1910s, a regional goal emerged to connect the growing population centers of Miami and Tampa through the Everglades and Big Cypress Swamp by the Tamiami Trail, a direct link between Miami and Tampa via the town of Naples. Counties connected by this roadway were responsible for funding segments of the roadway, although many of the counties through the proposed Tamiami Trail corridor lacked the funds to construct the roadway. As a result, private developers stepped in to complete the project. Beginning in 1921, the Chevelier Corporation constructed a southern route of the Tamiami Trail through Monroe County, a segment now known as the Loop Road. A few years later, the Florida State Road Department changed the route of Tamiami Trail back to a Collier County route. Barron Collier, a New York advertising mogul who owned almost one million acres in Lee County including areas now part of Everglades City, agreed to fund construction of the Collier County route of Tamiami Trail.

Completed in 1928, the Tamiami Trail stretched across the marshes and wet prairies of the Everglades. The paved road was originally 20-feet wide and stretched 30 feet when measured shoulder to shoulder with the borrow canal occurring on the north side of the road. Six roadside service stations were established along the road to provide gas, food, overnight facilities, and police patrols along the trail. Over time, bridges and culverts were added to the road to allow for water to pass from north to south and the width of the pavement and shoulder were expanded, especially in the Miami-Dade section of the road, to the current configuration of U.S. 41. As part of improvements to the current configuration, portions of Tamiami Trail east of the Miami-Dade County line were constructed to the north of the original roadway. The original roadway was detached from the main traffic flow and exists as a separate facility called the Old Tamiami Trail. Near Fakahatchee Strand Preserve State Park, small segments of the roadway were similarly detached from traffic use when a curve in the road was straightened. Although considered an engineering feat when constructed due to the harsh conditions of the Everglades through which it had been constructed, the roadway was a significant obstruction to the historical water flow patterns from north to south throughout the corridor, resulting in significant hydrological alterations in the region.

Relevance to ROGG: The Tamiami Trail/U.S. 41 corridor is the southernmost crossing of the Everglades and the primary infrastructure component within the ROGG Study Area. General aspects associated with the assessment of ROGG based on historical conditions are provided here, while other specific information and relevant aspects of the U.S. 41 corridor are provided in the Existing Conditions section of this chapter. The historical elements of Tamiami Trail relevant to ROGG consisted of assessments of feasibility for portions of the corridor, alignment routing options and infrastructure available for incorporation into a future ROGG, future construction requirements, and long-term operations, including:

- **Way Stations** –The way stations within the corridor provide opportunities for rest stations, trailheads, and other amenities and infrastructure for the ROGG. One of these stations, Monroe Station, is listed on the National Register of Historic Places (NRHP). The other way stations are more than 50 years old as well and may be evaluated as historical resources during future permitting or implementation efforts within the corridor.
- **Scenic Byway De-Designation** – Due to the historical significance and scenic nature of the roadway, the Tamiami Trail was designated as a National Scenic Byway in 2000. However, the roadway was de-designated in 2008 at the request of the sponsor organization. Requirements for a scenic byway will not apply to ROGG within the U.S. 41 corridor.
- **Historical Status** – Although the Tamiami Trail and associated Tamiami Canal on the north side of the road are more than 50 years old, non-historic alterations to these features for improvements and other work have rendered these features ineligible for listing on the NRHP.
- **Loop Road** – Consistent with an Environmental Assessment (EA) published in 2010, Loop Road has been enhanced to repair pavement in previously paved portions of the roadway and to enhance the gravel roadbed and drainage under the road in the remaining portions. The current gravel surface accommodates motorized vehicular traffic, but is a rough surface for cyclists. Loop Road provides a potential alignment alternative to U.S. 41 that was evaluated as part of the ROGG feasibility study and master plan. The NPS has also identified ORV trailhead improvements along Loop Road for future implementation. Potential improvements for trailheads or other amenities for ROGG separate from NPS initiatives would require extensive permitting and public coordination, especially with in-holders and other traditional users of Loop Road. Paving the remainder of Loop Road to accommodate the ROGG was not considered feasible based on previous NPS coordination for work on Loop Road.
- **Old Tamiami Trail** – Two primary segments of the Old Tamiami Trail occur within the ROGG Study Area, one consisting of approximately 9.5 miles stretching from the L-67 levee through the Miccosukee Indian Village to Loop Road and the other consisting of two segments near the Fakahatchee Strand Preserve State Park boardwalk. The Tamiami Trail also passes through a segment of Everglades National Park east of Shark Valley for a distance of 6 miles. Portions of the Old Tamiami Trail in the first segment have been removed and/or degraded to provide for additional water flow to the south. Another portion occurs within the trust lands of the Miccosukee Tribe of Florida. The Old Tamiami Trail segments were evaluated for potential alignments for ROGG. The original roadbed is generally extant, although the portions of the Old Tamiami Trail occurring east of the Miccosukee Indian Village have been targeted for removal as part of the regional restoration efforts. Dense and tall shrubs have grown on the banks on the side of the road, providing both shade for potential users as well as visual blocks to views of the adjacent marshes. In addition, exotic plant species comprise a significant portion of the shrubs.
- **Tamiami Trail Next Steps** – The NPS prepared the Tamiami Trail Next Steps Environmental Impact Study (EIS) to evaluate alternatives to address hydrologic alterations caused by U.S. 41 in the eastern portion of ROGG north of ENP. The EIS approved the construction of bridges and alterations to the existing road base for U.S. 41, one of which was completed in 2013. The proposed modifications to U.S. 41 approved in this EIS are noted in Section 3 – Literature Reviewed of this chapter.



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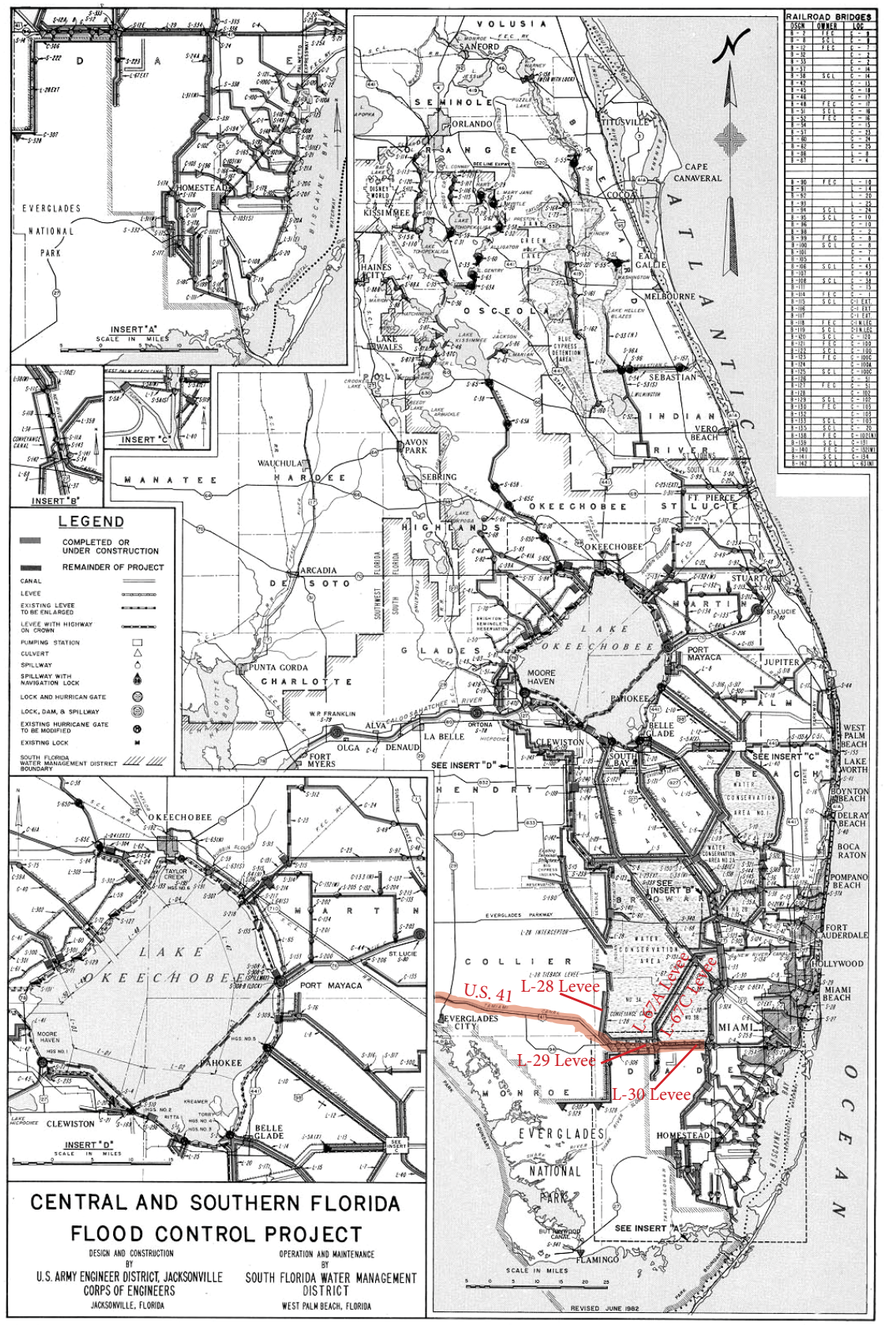



C&SF Project Map, 1962

Horse drawn carriage crossing of Everglades. 1906. Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/28871

Construction of Tamiami Trail. Before 1928. Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/25989

Constructing Tamiami Trail. 1924. Photo Credit: State Archives of Florida, Florida Memory,

ceding of more than 20 million acres of land from the U.S. federal government to Florida coupled with the establishment of the Everglades Drainage District in 1907 increased the rate and pace of drainage of south Florida. The populations of Miami and other existing south Florida cities rapidly increased as did tourism, including nature-based tourism. As populations increased on both coasts, the concept of and need for a roadway connecting the coasts through the Everglades became a regional goal, which was realized in 1928 with the construction of the Tamiami Trail.

Hydrological alterations to accommodate development activities and agriculture were initiated directly through drainage and flood control projects or indirectly through construction activities such as the Tamiami Trail. While an engineering feat, the Tamiami Trail had the effect of damming the flow of water into the Everglades and Florida Bay. Following catastrophic hurricanes in 1926 and 1928, flood control and navigation improvements began to be implemented within the Everglades system, including a dike around Lake Okeechobee that significantly altered water flows from the lake into the Everglades. After several years of drought that caused salt intrusions into regional water supplies, the southeast coast of Florida was inundated with more than 100 inches of rain followed by two additional hurricanes in 1947, resulting in extensive flooding. Congress authorized the Central and Southern Florida (C&SF) Project for Flood Control and Other Purposes in 1948 to prepare and implement a massive flood control plumbing system. The C&SF Project was comprised of four main components, including a perimeter levee on the eastern side of the Everglades for flood control, the designation of an agricultural area south of Lake Okeechobee, the establishment of Water Conservation Areas as water impoundments, and enlargement of the overall canal system for the region. The State of Florida created the Central and South Florida Flood Control District in 1949 to be the state manager of the C&SF Project, which was the predecessor agency to the South Florida Water Management District (SFWMD). Over the next two decades, the C&SF Project was implemented, resulting in flood control and drainage as well as significant alterations to the timing of water delivery, water quality and quantity, and freshwater available for water supply.

Beginning in the 1970s, several initiatives began to address the deterioration of the south Florida ecosystem caused by implementation and operation of the C&SF Project. The restoration of the Kissimmee River, an important source of water to Lake Okeechobee, began in the mid-1980s with the filling of a segment of the canal that had straightened the river. As part of the 1989 federal Everglades Expansion Act, activities were identified as part of the Modified Water Deliveries, or "Mod Waters," project to modify the C&SF Project to improve water deliveries to the Everglades National

Park. In 1994, the State of Florida enacted the Everglades Forever Act, which set criteria for phosphorus levels to address water quality issues in the Everglades. In 1992, Congress authorized the Water Resources Development Act, which gave federal approval to the Kissimmee Restoration Project and authorized the U.S. Army Corps of Engineers (USACE) to re-evaluate the C&SF Project performance and provide recommended improvements and modifications to restore south Florida ecosystems and provide other water resource needs. Over the next seven years, the USACE prepared the Central and Southern Florida Project Comprehensive Review Study, or Restudy, which was submitted to Congress in 1999 and became the Comprehensive Everglades Restoration Plan (CERP) upon approval in the Water Resources Development Act of 2000. Other efforts, such as the Tamiami Trails Next Steps EIS prepared by the NPS, were also initiated by state and federal agencies to identify projects to restore the Everglades and Big Cypress systems.

Projects to restore and enhance hydrology and ecology of the region have begun to be implemented within the ROGG Study Area. A one-mile long bridge raising U.S. 41 to allow for improved hydrological conveyance was completed in 2013. The portion of the Turner Road canal south of U.S. 41 was backfilled to route water back to Turner River. More than seven miles of canal have been backfilled and 65 miles of roadway removed within the Picayune Strand State Forest, which was coupled with the installation of a series of culverts under U.S. 41 to enhance sheetflow. In addition, the USACE and SFWMD are scheduled to complete the Project Implementation Report for the Central Everglades Planning Project (CEPP) in 2013. The CEPP report will be submitted to Congress upon finalization for funding approval for a number of projects designed to enhance the hydrology of the central Everglades.

### Comprehensive Everglades Restoration Plan (CERP)

The CERP is a guide and framework for the restoration of the south Florida ecosystem, which includes the Everglades. CERP was approved under the Water Resources Development Act of 2000 based on plans identified in the C&SF Project Comprehensive Review Study, or Restudy. The Restudy reviewed the status of the existing C&SF Project and made recommendations on how the C&SF Project could be modified to restore south Florida ecosystems and meet the flood abatement and water supply needs for south Floridians. Described as one of the world's largest ecosystem restoration projects, CERP provides a framework and guide for restoring, protecting, and preserving water resources over a 16 county/18,000 square mile area that centers on the infrastructure for the C&SF Project, which includes 1,000 miles of canals, 720 miles of levees, and several hundred water control structures. The USACE and SFWMD lead the implementation efforts, although a variety of federal, state, tribal, and local agencies were involved with the development and implementation of components of the plan.

The approved plan for CERP called for a series of more than 60 ecological and water system improvements across southern Florida ranging from construction projects to operational schedule changes. Construction projects were identified for nine regions that occur in or near the ROGG Study Area, including projects such as restoration of the Picayune Strand, modifications to the L-28 levee system on the east side of Big Cypress Swamp, modifications to the WCAs, and seepage management along the L-31 levee on the east side of the Everglades. The original Restudy identified many of these projects at a conceptual level and noted that additional details would be determined as implementation proceeded. Since the initial authorization for CERP only included certain projects, the implementation plan for CERP spelled out a process for additional studies to support project development and future Congressional authorizations, which included the Project Implementation Reports process. As noted on the CERP website, major benefits anticipated to result from CERP include:

- Restoring natural flows of water, water quality and hydroperiods;
- Improving the health of more than 2.4 million acres of the south Florida ecosystem, including the Everglades and Biscayne National Parks; and improving habitat for native flora and fauna, including threatened and endangered species;
- Ensuring a reliable, adequate supply of fresh water for use by all – the environment, urban residents and visitors, and agriculture;
- Maintaining flood protection set in place by the C&SF Project; and
- Creating wide-ranging economic benefits, not only for Florida, but the entire nation.

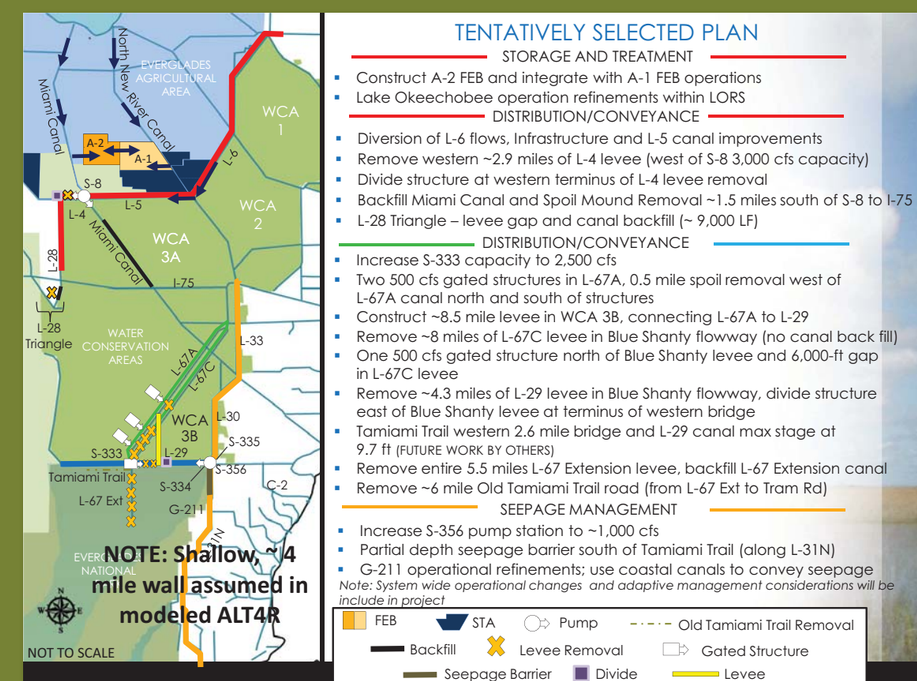
Additional details about ongoing projects that are part of the implementation for CERP can be found on the official website of the CERP at http://www.evergladesplan.org.

**20th Century Development and Hydrology Alterations - Relevance to ROGG:** The legacy of development and hydrological alterations affected feasibility assessments for: alignment selection and public access, connections to existing infrastructure, drainage to address hydrology, and temporal phasing considerations. Specific influences on analysis for the ROGG study included:

- **Gladesmen** – The region around the ROGG Study Area is extensively used by members of the Gladesmen culture for hunting, fishing, and backcountry access

## Central Everglades Planning Project (CEPP)

The CEPP is designed to advance restoration efforts in the central portions of the Everglades by identifying and planning projects on land already in public ownership to allow for more water to be directed south to the central Everglades, ENP, and Florida Bay. Since 2011, a team lead by the USACE in partnership with the SFWMD has been preparing a Project Implementation Report with the goal to deliver the report in late 2013. Project components to be developed as part of CEPP include increasing storage, treatment, and conveyance of water south of Lake Okeechobee; removing and/or plugging canals and levees within the central Everglades; and retaining water within ENP to protect urban and agricultural areas to the east from flooding. The tentatively selected plan as of July 2013 shown below included 19 projects requiring construction or operational changes including: removal of a portion of the L-29 levee, removal of portions of the Old Tamiami Trail, and levee modifications in the southwest corner of WCA 3B. Recreation elements have been evaluated as part of the plan and have been identified for construction in the final Project Implementation Report. A draft Project Implementation Report was issued in August 2013, which identified the preferred plan and implementation plan. Based on this report, although the projects identified in the CEPP are anticipated to take multiple years to implement subject to available funding. Generally, the current draft phasing plan identifies projects in the northern portion of CEPP needing to be completed, along with the construction of bridges authorized for the Tamiami Trail Next Steps project, prior to removal of portions of the L-29 levee.



Man guiding boat in the Everglades 1913. Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/2778

Dedication for Everglades National Park. 1947. Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/67965

Collier-Seminole State Park entrrance

for recreation and property use. Consistent with access control requirements for national and state land holdings, this access generally ranges from pedestrian to Off Road Vehicles (ORV) access. Restrictions on use, pedestrian access and parking, speed limit changes, and parking for ORVs on U.S. 41 have faced significant opposition from members of the Gladesmen cultural group. Considerations of the traditional uses of the Gladesmen for ROGG included alignment alternatives that limit encroachments onto access and parking for traditional uses, designs that accommodate ORV access, and evaluations of potential trailheads on parking access. An ethnographic study of the Gladesmen culture conducted in 2011 identified two sites, including the Airboat Association of Florida in the eastern portion of the ROGG Study Area, as Traditional Cultural Properties (TCP) eligible for listing in the National Register of Historic Places. Routing options for the ROGG that avoided known TCPs were not precluded from being considered feasible by the presence of the TCPs.

- **C&SF Project**– Infrastructure from the C&SF Project, including levees (L-28, L-29, and L-31), canals, and structures, occur within the ROGG Study Area and were evaluated for feasibility as alternative routes for the ROGG. However, much or all of several of these levees have been identified for removal as part of the regional hydrological restoration efforts for CERP. Due to operational concerns, canals pose a constraint on ROGG routing options by limiting crossing locations to existing or proposed control structures and/or limited locations for bridges. Trail crossings of structures are currently maintained by the SFWMD and are not precluded from feasibility for the ROGG. These crossings require routing protocol that will not impact operation and water flow in case of an accidental fall from the trail.

- **Regional Restoration** – Regional restoration efforts for CERP, Tamiami Trail Next Steps, and other projects will change the infrastructure available for ROGG routing alternatives, especially in the eastern portion of the corridor. CEPP has designated a 4.3 mile long segment roughly from the Blue Shanty flow way to the L-67 for removal, although implementation of other elements such as construction of additional bridges would likely need to be constructed prior to the levee removal to accommodate water flows. A temporary route for ROGG on the levee while it still remains was evaluated for feasibility. Public comment from a consortium of environmental groups indicated that the establishment of a trail on the levee, even if designed to be temporary, would set an expectation of use as a trail that could undermine public approval for the long-term removal of the levee. The design for the bridges identified in the approved plan for the Tamiami Trail Next Steps project did not include a trail facility separated from traffic use, but did include wide shoulders for vehicle recovery.

## 20th Century Development and Hydrology Summary

Florida's Everglades were one of the final frontiers for European settlers in the United States as the subtropical climate, hydrology, and conflicts with indigenous populations limited extensive settlement until late in the 19th century. Over time, the early settlers adapted to the diverse resources of the wetlands and tree islands of the Everglades and Big Cypress systems, giving rise to a regional variant of the Florida Cracker culture called "the Gladesmen Swamp/Folk Culture". The early Gladesmen relied on the steady supply of fish and game provided by the Everglades ecosystem for sustenance and for trade items. Modern day Gladesmen retain many of the same independent, self-sufficient outdoorsmen characteristics of the early Gladesmen, but now rely on the natural resources of the region more for cultural and recreational experiences than for subsistence. They also actively participate in public forums to advocate for conservation of natural systems and access for their traditional uses. Considerations for the traditional uses of the Gladesmen including access and parking requirements and ORV access are elements relevant to the planning, design, and operation for ROGG.

Beginning in the 1880s, large-scale drainage projects were implemented to lower natural water levels and drain the vast Central and South Florida wetlands. The populations of Miami and other existing south Florida cities rapidly increased as did nature-based tourism. As populations increased on both coasts, the concept of and need for a roadway connecting the coasts through the Everglades became a regional goal. This was realized in 1928 with the construction of the Tamiami Trail. While an engineering feat, the Tamiami Trail had the effect of damming the flow of water into the Everglades and Florida Bay despite later additions of bridges and culverts to assist in movement of hydrological flow. Elements of Tamiami Trail relevant to the feasibility assessment of ROGG consisted of the existing infrastructure for the road and way stations available for future ROGG trails, the historical status of facilities, existing improvements and permits for Loop Road, Old Tamiami Trail segments, and the Tamiami Trail Next Steps improvements program.

Congress authorized the C&SF Project for in 1948, which included four main components: a perimeter levee on the eastern side of the Everglades for flood control, designation of an agricultural area south of Lake Okeechobee, establishment of Water Conservation Areas as water impoundments, and enlargement of the overall canal system for the region. Over the next two decades, the C&SF Project was implemented, resulting in flood control and drainage as well as significant alterations to the timing of water delivery, water quality and quantity, and freshwater available for water supply. Elements of the C&SF Project relevant to ROGG include existing infrastructure such as levees and canals that could be available for ROGG routing alternatives consistent with the regional hydrological restoration efforts, and trail crossing requirements for structures.

Beginning in the 1970s, several initiatives began to address the deterioration of the south Florida ecosystem caused by the C&SF Project. As part of the 1989 federal Everglades Expansion Act, the Mod Waters project was identified to modify the C&SF Project to improve water deliveries to the ENP. In 1992, Congress authorized the Water Resources Development Act that included approval to re-evaluate the C&SF Project performance, provide improvements to restore south Florida ecosystems and provide other water resource needs. This re-evaluation resulted in the CERP upon approval in the Water Resources Development Act of 2000. In 1994, the State of Florida enacted the Everglades Forever Act to address water quality issues. Projects to restore and enhance hydrology and ecology of the region have begun to be implemented within the ROGG Study Area, including a one mile long bridge to allow for improved hydrological conveyance under U.S. 41, backfilling of portions of the Turner Road canal, and restoration efforts in the Picayune Strand State Forest. In addition, the Project Implementation Report for the CEPP is scheduled for 2013. Elements of the restoration efforts relevant to the feasibility assessment of ROGG include the removal and/or modification of existing infrastructure that would not be available for future trail options, the necessity for ROGG to be consistent with regional restoration efforts, and opportunities to incorporate ROGG elements on future bridges.

## Conservation

In the midst of the drainage and development activities of the early 1900s, concerns about their effects on natural resources began to be expressed in public forums, and proposals to protect and conserve the natural systems of the Everglades began to appear. Initial efforts by local citizens groups resulted in the State of Florida establishing Royal Palm State Park in 1916 to set aside a unique hammock in the glades, which grew to a 4,000 acre state park through acquisition and donation by 1921. Between 1925 and 1934, Ernest Coe advocated for the creation of the "Tropical Everglades National Park" to protect the nationally unique resources of the Everglades. Congress eventually authorized the establishment of ENP in 1934, but the ENP was not dedicated until 1947 due to lack of funding and the need for land acquisition. Beginning at 460,000 acres, the ENP expanded to 1.4 million acres in 1958. In 1989, Congress passed the Everglades National Park Protection and Expansion Act that added 109,506 acres to the ENP, including lands adjacent to U.S. 41. At approximately 1.5 million acres, the ENP is the largest designated wilderness east of the Rocky Mountains and protects a large portion of the original "River of Grass" noted in the book by Marjory Stoneman Douglas published in the same year the ENP was dedicated called The Everglades: River of Grass. The approval and implementation of CERP has provided a focus on continued efforts to protect and enhance the hydrology and natural resources of the ENP.

In 1944, land conservation efforts within the Big Cypress basin began with the acquisition of the Collier-Seminole State Park. The State of Florida acquired title to the initial area of Collier-Seminole State Park through a donation from the Lee County Land Company. Over subsequent years, the park was expanded through the acquisition of additional parcels through perpetual leases and fee simple title. One of the significant reasons for creation of the park was the high quality rockland hammock vegetation near the current park facilities. The entire extent of the park is listed on the NRHP based on the presence of high quality natural systems representative of south Florida and the presence of cultural features, including the last walking dredge used in the construction of the Tamiami Trail. The hydrology of the park has been altered by regional drainage and canals within the park. Efforts associated with the Picayune Strand Restoration project will route additional water through the park to assist in enhancing hydrology.

The C&SF Project established three Water Conservation Areas (WCA) to provide detention reservoirs for excess water from agricultural areas, flood protection, recharge for the Biscayne Aquifer, and to assist in limiting salt water intrusion. The only WCA adjacent to the ROGG Study Area is WCA 3, which is the largest of the three WCAs in the original C&SF Project plan. In 1962, the WCA 3 was divided into two separate facilities called WCA 3A and WCA 3B through the construction of two interior levees called the L-67A and L-67C. In the vicinity of the ROGG Study Area, three levees forming part of the boundary for WCA 3A and WCA 3B include the L-28 and L-31 levees on the west and east, respectively, and the L-29 along U.S. 41. The ownership of WCA 3 is comprised of a mixture of interests, including the State of Florida, SFWMD, and private ownership. The Florida Fish and Wildlife Conservation Commission (FFWCC) manages the WCA 3 as part of the Francis S. Taylor Wildlife Management Area.

Initial plans for a large project known as the Everglades Jetport elicited substantial public debate and development of a coalition of interests that resulted in the formation of the Big Cypress National Preserve. In 1969, the initial runway at the Everglades Jetport, now known as the Dade-Collier County Transition and Training Airport, was constructed and put in operation on a portion of an approximately 23,500 acre parcel on the eastern edge of the Big Cypress Swamp just west of the Collier/Miami-Dade County line. Following substantial public debate and comment concerning the environmental impact of the proposed facility, the U.S. federal government, state of Florida, and Miami-Dade and Collier Counties entered into a pact to not enlarge the Jetport and to find a suitable alternative location for an airport. Based on plans developed in 1971 arising from work done to support the pact, the U.S. Congress authorized the formation of the Big Cypress National Preserve in 1974. Although included in the authorized boundary for the Big Cypress National Preserve, the Jetport remained a non-federal holding at the time of the ROGG study. Based upon substantial input by a coalition of interests including local conservationists, Gladesmen, Seminoles and Miccosukee Tribes of Florida, the establishing legislation for the Big Cypress National Preserve did not include the property within the Everglades National Park with its accompanying restrictions. Instead, provisions such as maintenance of traditional uses by the Miccosukee and Seminole tribes, ORV access, and hunting were maintained for the lands within the Big Cypress National Preserve. The reservation of oil exploration and extraction was also maintained as a use within the preserve.

In 1974, the State of Florida acquired property that later formed the Fakahatchee Strand Preserve State Park, an approximately 75,000 acre conservation parcel centered around the Fakahatchee Strand. Nicknamed "the Amazon of North America," the Strand is the largest linear cypress strand within the Big Cypress system, extending approximately twenty miles in length. Although much of the canopy of large cypress trees was harvested from the area between 1944 and 1954, the cypress canopy is recovering within the strand. Known for its plant diversity, the strand provides habitat for at least 11 species of plants found nowhere else in North America as well as the Florida panther and a variety of other listed and non-listed wildlife species. Access from U.S. 41 includes a boardwalk near a gift shop. The park is currently designing and permitting the construction of a visitor interpretation center, which is anticipated to be built on a segment of Old Tamiami Trail on the north side of U.S. 41.

Primarily comprised of two major tracts of land, the approximately 79,000 acre Picayune Strand State Forest is located in west central Collier County within the Big Cypress basin. In the 1960s, a large subdivision called the Golden Gate Estates was planned for the western side of the Big Cypress watershed near Naples. Roadways and canals supporting this future development were constructed over a broad area significantly altering the hydrology of the area. However, the developer eventually entered bankruptcy and the development was not completed. In 1985, the State of Florida embarked on a large undertaking to acquire lands from more than 17,000 landowners within the South Golden Gate Estates using Conservation and Recreation Lands funds supplemented by money provided by the federal government. The restoration of the Picayune Strand was identified as one of the restoration projects in CERP. This restoration is anticipated to include plugging miles of canals, removal and degrading of roadways, exotic species removal, and other flood control and hydrological operation elements.

Conservation efforts of the Big Cypress basin continued through the 1980s and 1990s with the acquisition and establishment of the Florida Panther National Wildlife Refuge (NWR) and the Ten Thousand Islands NWR. Consistent with the final recovery plan for the Florida panther, the Florida Panther NWR was established in June of 1989 under the Endangered Species Act to protect Florida panthers. The U.S. Fish and Wildlife Service (USFWS) acquired 24,300 acres in 1989 and 26,400 acres in 1996 from the Collier family through fee title acquisitions. The primary purpose of the Florida Panther NWR is the protection of the Florida panther and habitat for the panther and its prey. Under the provisions of the Arizona-Florida Land Exchange Act of 1988, the Department of the Interior was authorized to exchange 108,000 acres of land in Collier County owned by Collier family interests for 68 acres of land in Phoenix, Arizona. In 1996, the Ten Thousand Islands NWR was established through the conveyance of approximately 35,000 acres acquired as part of this exchange to the USFWS. The remaining 73,000 acres were conveyed to the Big Cypress National Preserve and the Florida Panther NWR as part of the 1996 acquisition. The Ten Thousand Islands NWR protects estuarine and freshwater marshes, shell midden islands, and other habitats for a variety of listed and non-listed wildlife species.

Large cypress trees in Florida;
Photo Credit: State Archives of Florida, Florida

Oil well derrick for Sunniland Well #2, Collier County. 1944.
Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/125520

Steam shovel in cypress area constructing Tamiami Trail. 1924.
Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/27040



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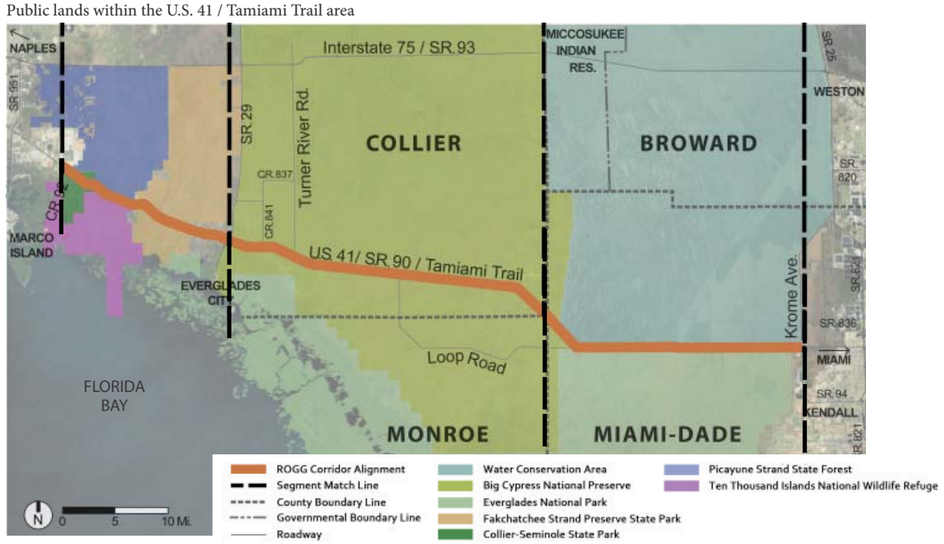
**Conservation - Relevance to ROGG:** The substantial public conservation lands within the ROGG Study Area affected feasibility assessments for potential alignment selection, considerations for public and regulatory coordination, the identification of destinations and amenities that could be co-located, connections to existing infrastructure, and post-construction operation options. Specific influences on analysis for the ROGG study included:

- **Everglades National Park** – The Shark Valley Entrance provides a potential destination for connection from ROGG, but parking is limited within and near the facility. Options that allow ROGG users to access the Shark Valley Entrance without requiring parking, including transit options and parking in the vicinity, were evaluated. Use of the Old Tamiami Trail at the park entrance was considered as a potential route alternative.
- **Collier-Seminole State Park** – The Park provides a destination for ROGG trail users. Connections to the main park facilities were evaluated as part of the master plan development. Existing tram roads within the park provide opportunities for routing alternatives separated from U.S. 41. Hydrological improvements in the park that would result from the upstream Picayune Strand Restoration project would affect the design, configuration, and maintenance requirements for ROGG alignments using these tram roads. The main entry for the Park adjacent to U.S. 41 provides open lawn and shade trees for a shelter for ROGG.
- **Water Conservation Area 3** – The levees around and through WCA3 provide potential routing alternatives for ROGG separated from the U.S. 41 ROW, although these may be only available for the short term until the regional restoration plans are completed. The feasibility of short term use of the levees considered the perspective that even short-term use of the levees for the ROGG sets public expectation about trail use that may limit or affect the anticipated removal of the levees. The CEPP-proposed Blue Shanty levee and L-67 levee would provide a spur trail loop option for connection to the ROGG. The L-31 levee is anticipated to remain for seepage control and was evaluated for use as connections to other trail networks. The recreation plan for CEPP identifies parking facilities and boating access points on portions of the levee near the S-333 structure at the L-67 levee that provide trailhead connection opportunities for ROGG.
- **Big Cypress National Preserve** – The Preserve provides multiple opportunities for ROGG to connect to destinations and/or provide trailhead facilities, including the Big Cypress Swamp Welcome Center, the Turner River canoe launch, H.P. Williams Park, Burns Lake Campground, Monument Lake Campground, Oasis Visitor Center, and Midway Campground. These facilities occur on both sides of U.S. 41, which requires feasible portions of the ROGG to have design features for safe crossings of the roadway. Roads and scenic drive loops like Loop Road within the Preserve were evaluated for potential connections to ROGG. Options, including transit and parking in the vicinity, that allow ROGG users to access facilities such as the Turner River canoe launch without requiring parking were prioritized. Route alternatives outside of the U.S. 41 ROW would require NPS review and approval as well as extensive regulatory coordination. The NPS recently completed several ORV trailheads in portions of the Preserve along U.S. 41 and Loop Road. These trailheads are open to the public and could potentially support ROGG uses.
- **Fakahatchee Strand Preserve State Park** – The current boardwalk and proposed visitor center occur on the north side of the road, which requires design elements to accommodate pedestrian road crossings if trail alignments for the rest of the corridor occur on the south side of U.S. 41. The proposed visitor center is a destination within the corridor and has parking and restroom facilities that would provide trailhead facilities for the ROGG. Options to use the Old Tamiami Trail segments in this vicinity were evaluated with respect to currently proposed mitigation activities and potential conflicts with extending the ROGG through a parking lot.
- **Picayune Strand State Forest** – The Picayune Strand State Forest occurs on the north side of the ROGG Study Area, but restoration activities within the Picayune Strand will result in hydrological restoration along U.S. 41 and within conservation lands within the Study Area. Accommodations of hydrological flows consistent with the restoration project were incorporated into design elements for ROGG.
- **Ten Thousand Islands NWR** – The Marsh Trail facility provides a destination and potential trailhead options for ROGG. Trail alignment options outside of the U.S. 41 ROW would require review and approval from the USFWS, extensive regulatory coordination, and potential impacts to salt marsh and/or mangrove systems.

Public lands within the U.S. 41 / Tamiami Trail area




## Conservation Summary

In the midst of the drainage and development activities, protection and conservation of the natural systems of the Everglades and Big Cypress also occurred. The State of Florida established Royal Palm State Park in 1916. Congress authorized the establishment of ENP in 1934, but the ENP was not dedicated until 1947 due to lack of funding and the need for land acquisition. At approximately 1.5 million acres, the ENP is the largest designated wilderness east of the Rocky Mountains and protects a large portion of the original "River of Grass." In 1944, land conservation efforts within the Big Cypress basin began with the acquisition of the Collier-Seminole State Park. The C&SF Project established three WCAs ( including WCA3 - the only WCA in the ROGG Study Area) to provide detention reservoirs for excess water from agricultural areas, flood protection, recharge for the Biscayne Aquifer, and to assist in limiting salt water intrusion.

Conservation within the western portion of the Study Area began after the ENP conservation activities, but has grown into a significant aggregation of conservation lands owned by a variety of agencies. Following the construction of an initial runway for the Everglades Jetport in 1969, substantial public debate resulted in the formation of the Big Cypress National Preserve. Based upon substantial input by a coalition of interests including local conservationists, Gladesmen, Seminole and Miccosukee Tribes of Florida, the establishing legislation for the Big Cypress National Preserve did excluded the property from the ENP to allow for continued maintenance of traditional uses by the Miccosukee and Seminole tribes, ORV access, and hunting. In 1974, the State of Florida acquired property that later formed the Fakahatchee Strand Preserve State Park, an approximately 75,000 acre conservation parcel centered around the Fakahatchee Strand. Conservation efforts of the Big Cypress basin continued through the 1980s and 1990s with the acquisition and establishment of the Florida Panther National Wildlife Refuge (NWR), Picayune Strand State Forest, and the Ten Thousand Islands NWR.

The substantial public conservation lands within the ROGG Study Area affected feasibility assessments for potential alignment selection, considerations for public and regulatory coordination, the identification of destinations and amenities that could be co-located, connections to existing infrastructure, and post-construction operation options.



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## 2.1.2. Climate

The Everglades region occurs at the southern end of the State of Florida at the interface between subtropical and temperate climate conditions, due in part to the warm waters of the Gulf of Mexico and Atlantic Ocean. Because the average monthly temperature for all months is above 64°F (18°C) and the area exhibits a pronounced wet and dry seasons, classification systems such as the Köppen classification defines the region south of Lake Okeechobee as "Tropical Savannah," which is a climate classification normally characterized by grasslands with scattered trees. Climate in the area is moderated both by extensive rainfall and occasional cold events from continental systems. As a consequence, an abundance of tropical species is generally limited to the coastal portions of the Everglades region.

The region exhibits two distinct seasons based on rainfall and temperatures. Temperatures in the winter/spring dry season (November through April) are generally mild and pleasant, though rare cold fronts may create near freezing conditions. The average temperatures in the winter/spring dry season generally range between a high of 77°F (25°C) and a low of 53°F (12°C). The summer wet season (May through October) is hot and humid, with temperatures exceeding 90°F (32°C) and humidity over 90%. Afternoon thunderstorms in the summer wet season form quickly and frequently are accompanied by heavy rainfall and frequent lightning strikes. Average rainfall is approximately 53-inches per year, and more than 60% of this total falls during four months of the wet season from June to September. Water levels in the Everglades typically rise rapidly during the wet season, reaching maximum levels late in the season, while the area slowly dries out during the dry season.

Daily weather conditions are similar during the summer wet season and more variable during the winter/spring dry season. During the wet season, trade winds bring a near continuous supply of wet air from the Gulf of Mexico and Atlantic Ocean. As this warm, wet air passes over land areas, it heats up and frequently causes heavy afternoon thunderstorms often characterized by a high frequency of lightning. The Atlantic hurricane season is June through November. During this period, tropical storms or hurricanes result in significant weather disturbances in the area. Continental frontal systems periodically pulse cold fronts through the area, which are preceded by limited rainfall events during the dry season. Following the passage of a front, the area exhibits lower temperatures and humidity levels for a few days until temperatures moderate.

Climate - Relevance to ROGG: The climate and weather conditions of the region primarily affect material selection and shelter requirements for the ROGG feasibility and planning efforts. These include:

- **Afternoon Thunderstorms** – Heavy rainfall and lightning from frequent thunderstorms in the summer wet season pose both a safety and design issue. Shelters providing protection from rain and lightning located periodically along the corridor will be required to provide trail users refuge from quick-forming storms. Trail stormwater systems will need to treat and disperse water from heavy rainfall events sufficient to not flood adjacent roadways or users, while maintaining usable trail surfaces.
- **Tropical Storms** – Periodic tropical storms and hurricanes can provide extreme rainfall and wind conditions. Structures on the trail will need to be sufficient to withstand wind loads caused by these tropical storms. The trail itself will likely be located within areas exposed to occasional storm surges, and its design will need to be resilient to these periodic, extreme events.
- **Sunlight and Temperature** – The intense sunlight and variable temperatures in the region will affect material selection and shelter requirements. Materials used in trail construction should be resistant to fading and degradation from exposure to sunlight. Similarly, materials used for trail surfacing and furnishings will need to accommodate long periods of warm temperatures and short term exposure to near-freezing temperatures. Shelters providing shade and potable water will need to be located periodically along the corridor to provide refuge from sunlight and respite from the heat.

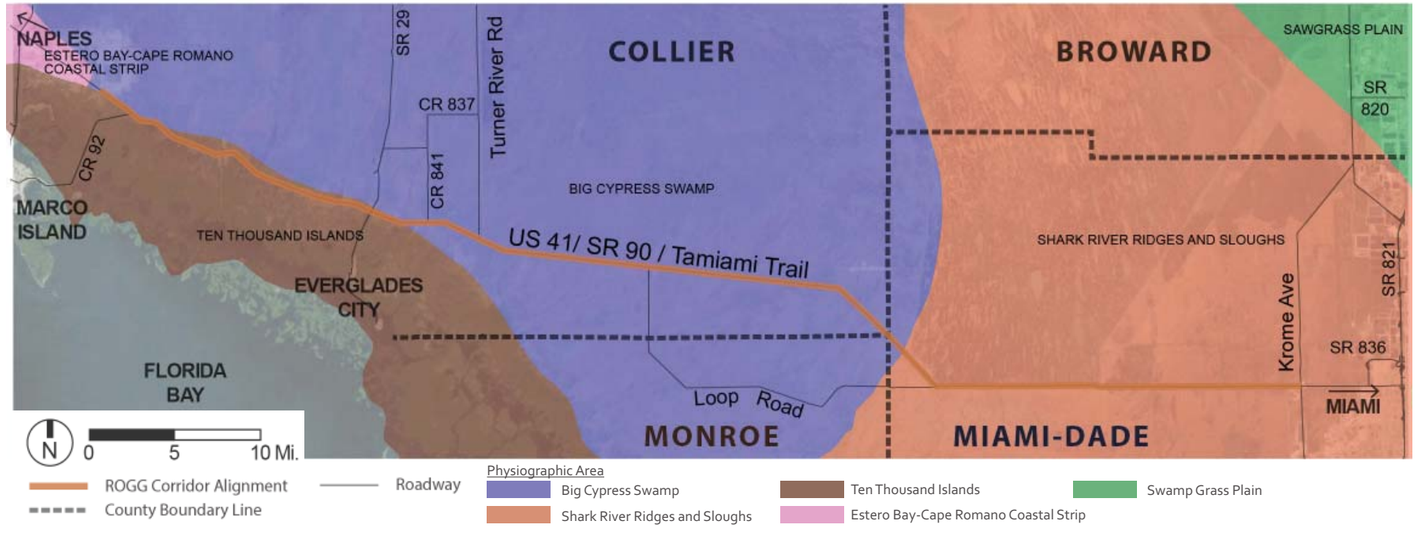
Thunderstorm over Everglades Natinal Park (nps.gov))

### Climate Summary

The ROGG Study Area occurs in south Florida at the interface between subtropical and temperate climate conditions within the climate classification of Tropical Savannah. The region exhibits two distinct seasons based on rainfall and temperatures. Temperatures in the winter/spring dry season (November through April) are generally mild and pleasant, though rare cold fronts may create near freezing conditions. The summer wet season (May through October) is hot and humid with frequent afternoon thunderstorms accompanied by heavy rainfall and frequent lightening. During the Atlantic hurricane season from June through November, tropical storms or hurricanes result in significant weather disturbances in the area.

Significant elements of climate relevant to the design and operations for ROGG considered for the feasibility assessment include rapidly developed afternoon thunderstorms, tropical storms, and intense sunlight and high summer temperatures. These climate specific impacts necessitate a need for periodical shelter for ROGG users which can withstand high winds and intense sunlight and temperatures.

Physiographic Map of U.S. 41 / Tamiami Trail area



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## 2.1.3. Geography, Geology and Soils

South Florida lies within the Atlantic Coastal Plain physiographic region. This region is divided into several provinces that span the ROGG Study Area, which includes the Atlantic Coastal Ridge, Big Cypress Swamp, Everglades (comprised of the Saw Grass Plains and Shark River Ridges and Sloughs subprovinces), and Mangroves and Coastal Glades (including the Ten Thousand Islands subprovince). The Atlantic Coastal Ridge is a narrow belt along the east coast of Florida that ranges from 10 to 50 feet in altitude. The Everglades is slightly lower than the Atlantic Coastal Ridge and the Flatwoods, and gently slopes to the south at a rate of less than two inches per mile. This expansive, gentle slope leads to shallow inundation and slow drainage to the south during the rainy season. The Big Cypress Swamp is west and slightly higher than the Everglades and is comparatively flat with numerous strands and sloughs that drain water south and southwest. The Mangroves and Coastal Glades province is a relatively flat band around the southern tip of Florida that lies at or near sea level and is comprised of swamps and marshes.

The Florida Peninsula rests on a deep backbone of ancient (>650 million years old) igneous and metamorphic rock covered by thick layers of sedimentary rocks of younger vintage (1.5 to 140 million years old). These sedimentary layers are comprised of a variety of materials ranging from sands and silts to marls and shellbeds. During inter-glacial periods, sea levels rose and inundated the region with shallow seas resulting in surficial geological layers comprised primarily of limestone. Wind, waves, and currents moved sediments around and influenced the formation of the shallow ridge and slough systems found in the region. Over time, limestone formed from compressed layers of carbonaceous materials, sand, and shells deposited during these inundation periods.

Surface soils are generally comprised of limestone, marls, peats, and sand. The underlying limestone stone is exposed in various areas throughout the Study Area. This limestone typically exhibits karst characteristics where exposed due to acidic water drainage through the carbonate rock. Typically found in short-hydroperiod wetland areas, marls are mixtures of calcareous clays and calcite particles, sand, and/or shell fragments, often resulting from oxidation of periphyton (algal mats). Peats and the associated muck soils are derived from partially decayed plant materials that form in anaerobic conditions associated with long periods of inundation. Sand deposits are infrequent in natural settings in the corridor and likely derived from old shorelines.

Several natural and man-made geographic features within the Study Area deserve mention for their relevance to ROGG due to physical conditions, recreational connection opportunities, or uniqueness in the landscape. Occurring approximately eight miles from the western boundary of the Study Area, the Fakha Union Canal provides boating connections between the Port of the Islands community to Fakahatchee Bay. The Fakahatchee Strand is a linear swamp system and drainage feature in the western portion of the Study Area that was incorporated into the Fakahatchee Strand Preserve State Park. Approximately 2.5 miles east of Ochopee, the Turner River meanders through forested floodplain forests, marshes, and mangroves to Chokoloskee Bay. Approximately 21 miles west of Krome Avenue, the L-28 levee extends north from U.S. 41 where it forms the western edge to the WCA-3A. The L-29 levee and canal runs along the north edge of U.S. 41 in the eastern portion of the Study Area. The Shark Valley Slough is the primary source of water for Everglades National Park and occurs south of U.S. 41 in the eastern portion of the Study Area.

**Geography, Geology and Soils - Relevance to ROGG:** The geology and geography of the region affect potential alignment selection, construction requirements, and material selection for the ROGG feasibility and planning efforts. These include:

- **Soils** –Soils in the vicinity of the project would serve as either the base on which the trail is constructed or as the source for fill material. Limestone provides a firm base for pilings or fill, although solution holes or subsurface caverns will need to be evaluated during final construction. Significant peat or muck aggregations increase the costs and complexity of construction, so alignment alternatives through sloughs and marshes with the potential for muck require careful consideration. Although limestone can be a fill material, sources of fill material within the Study Area will be limited due to the protected status of lands in the area. To the extent that importation of fill was considered feasible, these costs were addressed as part of the implementation assessment.
- **Drainage** – The flat character of the Study Area influences the location, sizes, and configurations of drainage systems serving future facilities. Positive drainage from trail features will require elevating the features either through pilings or fill so that drainage outfalls can accommodate discharge during dry and wet conditions. Because of the perviousness of the underlying limestone, and the prevalence of surface-water and groundwater throughout much of the year, opportunities to excavate stormwater treatment facilities are limited. Consideration of drainage requirements were a part of the assessment of the feasibility of installing potential trail features.
- **Geographic Features** – Features within the Study Area provide opportunities for connections to recreation opportunities, such as blueways or other experiences as well as potential constraints for alignment selection or construction requirements for crossing or connecting to the feature. Crossings for canals or channels like the Fakha Union Canal and the Turner River will require new or expanded bridges, and the alignment location and/or feasibility for the crossing was evaluated based on effects on species using the channel (i.e. manatees) or the need to maintain boat access. Landscape features such as the Fakahatchee Strand provide opportunities for environmental interpretation and destinations for trail users, although the feasibility for access necessitates safe trail connections that minimize potential impacts to function of the natural systems. Regional drainage structures like the L-28 and L-29 levees provide existing infrastructure that were evaluated for trail use, although the long-term use of these features for the ROGG will continue to be guided by regional restoration efforts.
- **Mineral Resources** – Active oil and gas production occurs in the vicinity of the central portion of the ROGG Study Area, although all production fields are located outside of the Study Area. Operations for the production fields required accommodation for continued access. Similarly, the design of the ROGG included consideration for separation of pedestrians from truck traffic on U.S. 41. The operator of the production fields began an EA during the ROGG feasibility study to extend electric lines to production facilities, which would assist in reducing the truck traffic required for operations. Opportunities to co-locate ROGG facilities with infrastructure identified in the alternatives evaluated in the EA were evaluated as part of the ROGG Feasibility Study and Master Plan.

### Geography, Geology and Soils Summary

The ROGG Study Area lies within the Atlantic Coastal Plain physiographic region, which consists of several provinces including the Atlantic Coastal Ridge, Big Cypress Swamp, Everglades, and Mangroves and Coastal Glades. Geologically, the Florida peninsula rests on a deep backbone of ancient igneous and metamorphic rock covered by thick layers of sedimentary rocks of more recent origin. The sedimentary layers are comprised of a variety of materials ranging from sands and silts to marls and shellbeds that were deposited during higher sea levels associated with inter-glacial periods and compressed over time to form limestone. Surface soils are generally comprised of limestone, marls, peats, and sand. Significant elements of geology and soils relevant to the design and operations for ROGG considered for the feasibility assessment include the structural capacity of local soils and use of soils for fill material, drainage conditions that result in marl soils, and accommodation for mineral extraction.

Several natural and man-made geographic features occur within the ROGG Study Area. Large canals, including the Fakha Union Canal and L-29 canal, and natural streams such as the Turner River provide fishing and/or boating opportunities. The L-28 and L-29 levees occur in the eastern portion of the ROGG Study Area and provide existing infrastructure available for potential ROGG use, although this use cannot affect the long-term regional hydrological restoration efforts. Landscape features including the linear Fakahatchee Strand and wider Shark Valley Slough serve as natural drainage features and sources of freshwater for downstream areas. Geographic features provide opportunities for connections to recreation, design considerations for new water crossings, environmental interpretation, and/or infrastructure that could be used consistent with regional hydrological restoration goals.

## 2.1.4. Hydrology and Hydrogeology

The ROGG Study Area occurs within a complicated hydrological setting associated with the Everglades and Big Cypress Swamp watersheds, both of which have been subjected to extensive hydrological alterations that changed flow conditions, direction of flow, water quantity and quality in the region. The Everglades watershed originates in central Florida in lakes draining into the Kissimmee River and then flows south through Lake Okeechobee into the Everglades and south into Florida Bay. The Big Cypress Swamp headwaters originate in the northern sandy flatlands south of the Caloosahatchee River drainage area. Water from the northwest portion of this watershed drains west into Estero Bay, while several large slough and strand systems drain the remainder of the watershed west and south. Significant strands in the Big Cypress watershed include Devil's Garden, Corkscrew Swamp, Okaloacoochee Slough, Fakahatchee Strand, roberts Lake Strand, Turner River, and Mullet Slough. The surface hydrology interacts with and is influenced by the hydrogeology of the relatively permeable geological strata underlying the peninsula. Due to the significance of hydrology to the ecology of the ROGG Study Area, understanding historic and current conditions coupled with the hydrological improvements anticipated from the regional restoration projects that are proposed or underway was a critical aspect of the feasibility study.

### Hydrogeology and Aquifers

There are three aquifers within the marine carbonate sediments: the Floridan aquifer system, the intermediate aquifer system, and the surficial aquifer system. The Floridan aquifer is the lowest of the strata. It starts roughly 500 feet below sea level on the west coast and slopes to about 750 feet below sea level on the east coast. The intermediate aquifer system is located above the Floridan aquifer. Its domed shape peaks in Big Cypress Swamp and the Everglades at sea level and slopes off towards both coasts. The surficial aquifer system is composed of two triangular-shaped features located between the peak of the intermediate aquifer and each coast. The eastern triangle is called the Biscayne aquifer, and the western is called the shallow aquifer. The Biscayne aquifer is a significant water source for the east coast population. Freshwater in the WCA3 limits saltwater intrusion into the Biscayne aquifer. Restoration activities within the region are anticipated to maintain hydrological inputs into the aquifers.

### Pre-Drainage Conditions

The hydrological system in which the ROGG Study Area occurs is dominated by the watersheds of the Everglades and Big Cypress, both of which were historically interconnected with uplands, coastal areas, and marine systems. The vast wetlands associated with these watersheds dominated the pre-drainage landscape of south Florida. Throughout their extent, the majority of these basins are characterized by extremely flat topography that slopes generally north/northwest to south/southwest with a very low gradient, typically ranging from one to two inches per mile. The soils and upper geological strata are highly permeable limestone, which provide connections to surficial aquifers and allow groundwater seepage into creeks, rivers and other surface waters.

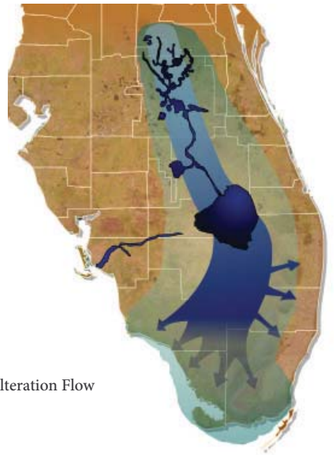
The pre-drainage wetland systems exhibited three essential characteristics: dynamic storage and sheet flow, large spatial scales of drainage, and heterogeneity in habitat. The large expanse of wetlands spread rainfall and upstream drainage into shallow sheetflows over a wide area, the depth of which significantly influenced vegetation heterogeneity and the formation of peat and marl substrates. Drastic seasonal variations in rainfall interacted with this hydrological action to create dynamic water conditions within the system. This broad flow of freshwater strongly influenced the upstream extent of salt marshes and other brackish systems as well as the salinity levels within downstream estuaries. The slow rate of flow through the topographically flat system resulted in a discharge of freshwater into estuaries well into the dry season.

Water flowing through both the Everglades and Big Cypress systems was generally low in nutrients. Nutrients transmitted through the water column were rapidly removed by vegetation and periphyton communities, all of which were adapted to low-nutrient environments. Although conditions in both the Everglades and Big Cypress watersheds were generally oligotrophic for phosphorus and nitrogen compounds, Big Cypress surface waters typically would have exhibited slightly higher total phosphorus and nitrogen levels than those in the central Everglades marshes due to different soil conditions.

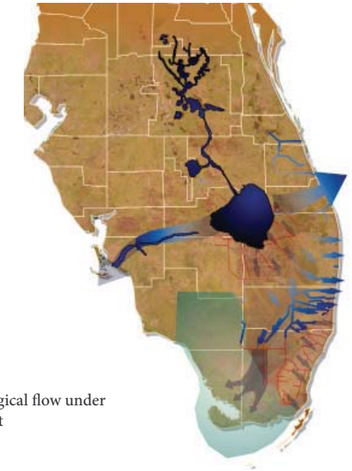
### Post-Drainage Conditions

Drainage and development projects such as C&SF Project, roads and associated ditches such as Birdon Road in the central portion of the study area, and Tamiami Trail altered the hydrological elements that were characteristic to the Everglades and Big Cypress watersheds and resulted in significant ecological changes. Roadways served as dams, which effectively blocked or rerouted the broad sheet flow characteristic of the systems into narrow channels that could pass through culverts or narrow bridges. Canals captured and channelized sheetflow as well as intercepted groundwater that was then conveyed towards the coast, often in a direction that contrasted with historical flow patterns. Canals modified the period of inundation and provided avenues for saltwater or brackish water to extend into interior portions of south Florida. Levees were constructed as part of the C&SF Project to retain floodwaters and control flow discharge, which had a pronounced effect on the hydrology of the eastern half of south Florida. However, the Tamiami Canal and Tamiami Trail coupled with the extensive network of roads and ditches that extend north and south from the Tamiami Trail also impacted a large drainage area, and interrupted the historic overland sheet flow as well as direction of flow within sub-watersheds through the Big Cypress. These alterations reduced the depth and duration of inundation, introduced tidal influences into interior freshwater systems, and modified surface discharges to occur too often, too little, or at the wrong times of the year. As described in Section 2.5 – Ecology, the changes to hydrology resulted in ecological changes to the plant and wildlife populations of south Florida.

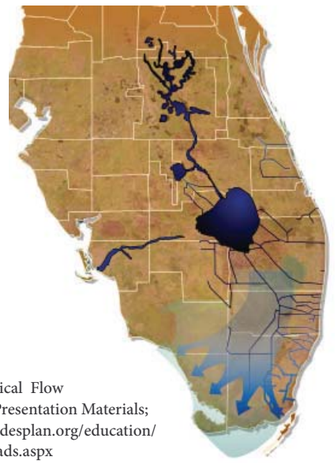
In addition to water flow and quantity issues, the water quality of the region has also changed, although water quality inputs for the Big Cypress have generally been affected less than those of the Everglades. The Everglades occurs at the end of a hydrological gradient beginning near Orlando, a gradient that includes extensive agricultural lands. Water from cattle operations occurring upstream of Lake Okeechobee along the Kissimmee River contain phosphorous and nitrogen at higher levels than historic background levels. Between Lake Okeechobee and the remaining Everglades lies the 700,000 acre Everglades Agricultural Area (EAA). Sugarcane, the predominant crop in the EAA, is chemically intensive to grow on a sustained basis. In south Dade County, farming operations use heavy tilling to break up sea shells and coral (limestone) covering the area in order to cultivate vegetables. This farming method requires extensive use of fertilizer and pesticides, some of which drains into the Everglades watershed. Moreover, altered water levels within the region result in the oxidation of the underlying organic soils. This oxidation releases organically bound nitrogen that combines with other elements to form



Pre Hydrological Alteration Flow



Current hydrological flow under the C&SF Project



Restored Hydrological Flow
CERP Everglades Presentation Materials; http://www.evergladesplan.org/education/requested_downloads.aspx



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Turner River canoe launch at Big Cypress National Preserve

View northwest of WCA3 near Gator Park

View east of the L-29 canal from the S-334 structure

nitrates at higher levels than the historical levels, including both in surface waters and the aquifer. In addition, regional hydrological alterations reduced seepage into the aquifer, allowing salt water to intrude into portions of the aquifer and to extend farther upstream into historically freshwater wetland systems. The Big Cypress watershed is less affected by altered nutrient loads as upstream drainage into the watershed is limited, but salt water intrusion through canals has modified conditions in upstream freshwater wetlands.

The waters of Big Cypress National Preserve, ENP, Florida Panther NWR, Collier-Seminole State Park, and Fakahatchee Strand Preserve State Park are currently designated as Outstanding Florida Waters. This is a state designation overseen by the Florida Department of Environmental Protection (FDEP) and codified in Rule 62-302.700 Florida Administrative Code (F.A.C). It is intended to protect existing, high-quality waters. For the most part, these wetland systems are located at the down-gradient end of an altered watershed, and they are subject to the effects of upstream water management practices.

## Hydrological Features

The ROGG Study Area includes a number of hydrological features and/or structural components of water control efforts, including levees and canals, natural creeks, and sloughs in additional to extensive wetland systems. The following provides an overview of these different features.

### Natural Water Features

Natural water features ranging from sloughs to creeks and rivers occur within the ROGG Study Area, with the Shark Valley Slough dominating the eastern portion of the study area and a variety of rivers and lakes occurring in the western portion of the study area. The Fakahatchee Strand occurs west of S.R. 29 and is a five mile wide, 20 mile long swamp forest that ultimately drains south of U.S. 41 into the Fakahatchee and East Rivers and related estuarine tidal systems. Several other tidal creeks, including the Whitney and Blackwater Rivers, occur south of U.S. 41 in the western portion of the ROGG Study Area. Extending to Chokoloskee Bay, the Turner River intersects U.S. 41 east of Ochopee. Restoration efforts, including plugging of the Turner River Canal, have increased flows within the river, which has increased the accessibility of this river for canoeists and kayakers. Preliminary restoration efforts have helped return more natural water flows to the area, however, additional work is needed to fully restore flows and hydroperiods. Historically approximately 20 miles wide at U.S. 41, the Shark River Slough occurs in the eastern portion of the study area and is the primary source of water for the ENP. It consists of extensive wet prairies and slough vegetation until it discharges into the Shark River.

### Water Conservation Areas

As part of the CS&F Project, three WCAs were established in the mid-1940s to provide flood protection, water supply storage, and environmental resource protection for the lands lying south and east of Lake Okeechobee. The southernmost element of this system, WCA3, occurs north of and adjacent to U.S. 41 in the ROGG Study Area and is the largest of the three WCAs covering more than 921 square miles. The L-67A and L-67C levees subdivide WCA3 into two portions, which are known as WCA3A west of the levees and WCA3B east of the levees. Other levees, including the L-28 and L-29 levees, form the exterior boundary for WCA3, except for a seven mile long gap on the west side that allows for free water exchange from the Big Cypress via Mullet Slough. WCA-3A receives water from Lake Okeechobee, WCA-2 and the EAA via the North New River and Miami Canals, and from several other canals and pump stations and delivers water to ENP and Miami-Dade County. The majority of WCA3 consists of sawgrass marsh and tree islands, although the inundation depths and durations differ from the natural free-flowing sheetflow that historically occurred within the Everglades. The direction of flow has also been modified by the canals and levee system, with the L-67A and L-67C levees directing flows in a more southwesterly direction than historically occurred. WCA3B is a significant recharge area to the Biscayne aquifer and helps control saltwater intrusion in municipal wells in populated areas along the coast. It receives most of its water from rainfall and occasionally from WCA3A via the Miami and L-67 Canals. Water is discharged from WCA3B via the Miami Canal although plans are underway to enable discharges to the Northeast Shark River Slough along the northeast boundary of ENP from WCA3B.

### Big Cypress Canals

Water within the Big Cypress watershed generally flows southwest under U.S. 41 and other roads through several culverts and bridges before discharging through tidal marshes and mangroves into the Gulf of Mexico, although the eastern portion of the watershed is connected hydrologically to the eastern Everglades. U.S. 41 and other roads such as Birdon Road, Loop Road, and Turner River Road and their accompanying parallel canals obstruct sheet flow in the region and channel water to narrow culverts or bridges. The sheetflow and channelization elements from the canals along the road significantly altered the Turner River watershed so that the river became shallow, slow-moving, and clogged with vegetation, thereby affecting the ecology of the river and estuarine areas at the outflow in Chokoloskee Bay. A system of plugs was placed into the canal and culverts were placed under Turner River road to slow and redirect water flow back to the river in the 1980s, resulting in increased flows for Turner River and adjacent wetland habitats, and a series of small connected ponds in the remainder of the Turner River Road Canal. Flows in some sections of U.S. 41 were improved in the mid-1990s by the construction of several new culverts or bridges under the road, although many of these were still widely separated in the landscape. An additional 16 culverts were installed under U.S. 41 between 2003 and 2006 as part of the Western Tamiami Trail Culverts Critical Project to further enhance water movement under U.S. 41. Recently, the NPS completed improvements to Loop Road to stabilize the road and install additional culverts to improve hydrological connections. Restoration work to date is considered preliminary with current infrastructure projects helping to restore hydrology.

Several other large canals were constructed in the western portion of the ROGG Study Area to provide drainage for development tracts planned for the area. The Halfway Canal provides drainage for lands now used for the Big Cypress National Preserve headquarters and Visitor's Center. Ideally, headwater flows feeding into Halfway Creek would be diverted into upstream wetlands instead of draining directly to tide. Restoration of this is currently being planned. The canal along S.R. 29/C.R. 29 provides drainage for the road serving Everglades City. The Faka Union Canal was constructed as the primary drainage feature for the Port of the Islands development, but also served as an outlet for the Golden Gate Estates planned development. A number of roads and canals were constructed in the planned southern portion of the Golden Gate Estates, which modified water movement within the western portion of the ROGG Study Area. These roads and canals are now part of the Picayune Strand State Forest and restoration activities are ongoing to remove roads and modify these canals as part of the Picayune Strand restoration efforts. All three of these canals channelized sheetflow and provided an avenue for brackish water to extend further inland.

### Brackish Marsh Considerations

The extent and salinity of tidally influenced wetlands in the western portion of the ROGG Study Area were altered



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by the installation of U.S. 41 and the Tamiami Canal, particularly near the intersection of S.R. 29/C.R. 29. The canals in this area provide an avenue for brackish water to extend into freshwater wetland systems, while the Tamiami Canal spreads this brackish water east/west through the landscape. U.S. 41 blocks the movement of freshwater from the north and tidal, brackish water from the south except through a limited number of bridges and culverts. This results in differences in salinity on the north and south sides of U.S. 41. Planning and implementation of projects to restore tidal exchange to these areas by increasing groundwater recharge and reducing large and unnatural freshwater inflows are underway. The Picayune Strand Restoration Project, a sub-project of CERP, includes 55,000 acres located between Alligator Alley and U.S. 41. This project involved plugging canals, building and operating pump stations, placing culverts under U.S. 41 and removing old road beds, which were designed to restore freshwater flows south of U.S. 41 and improve the tidal exchange.

## Future Restoration Considerations

Hydrological restoration activities have begun to be implemented in the vicinity of the ROGG Study Area. Several projects associated with the Mod Waters project have been completed in recent years, including improvements to the 8.5 Square Mile area to protect private lands from increased flows in the ENP, conveyance and seepage control features such as raising the elevation of Tigertail Camp, and the completion of construction of a one mile bridge for U.S. 41 to facilitate flow into Shark River Slough. Several CERP projects have had elements that were completed, including the construction of Stormwater Treatment Areas (STA) and the Picayune Strand Restoration Project. To improve water quality flowing in to the WCAs through the removal of phosphorus, the SFWMD has constructed several STAs between the EAA and the WCAs providing an effective treatment area of more than 57,000 acres as of late 2012. In the western portion of the ROGG Study Area, the Picayune Strand Restoration Project has included removal of more than 160 miles of roadways, installation of plugs for more than 20 miles of canals, and installation of pump stations to assist with water control.

Additional projects are anticipated to be implemented in the next 10+ years to continue to improve the hydrology of the Everglades, primarily through the implementation of projects identified for CEPP. Projects identified for CEPP include elements in the vicinity of the ROGG Study Area include the removal of portions of the L-29 levee and six miles of the Old Tamiami Trail, installation of a new levee adjacent to the Blue Shanty flow-way, and modifications to water control structures. Projects occurring north of the ROGG Study Area include construction of additional storage and detention basins, backfill of the Miami Canal, levee removal, and other canal improvements to route more water into WCA3. The CEPP plan identifies project details that will guide phasing of projects identified for CEPP. Generally, the projects north of the ROGG Study Area will need to be completed prior to constructing and completing the CEPP projects within the ROGG Study Area. In addition, the construction of the bridges associated with the Tamiami Trail Next Steps project, especially the 2.6-mile bridge between the proposed Blue Shanty flow-way and L-67 levee, is required prior to the removal of the L-29 levee and/or discharge of the increased water quantity from the northern projects. The draft Project Implementation Report for CEPP that documents the final plan elements, schedules, and other elements was released in August 2013 with the goal to have it available for congressional review and approval as part of an upcoming Water Resources Development Act project. Additional projects within the CEPP study area that were identified as part of the Decompartmentalization of WCA3 CERP project, including the removal of the L-28 levee and the remaining portions of the L-29 levee, were not included in the CEPP plan and are not anticipated to be implemented in the next 10+ years unless other funding is secured.

Although not addressed in current CERP projects, hydrological restoration activities in the Big Cypress have also been identified for future implementation within the ROGG Study Area. Although the Western Tamiami Trail Culverts Critical Project has been partially implemented, funding has limited the implementation of the remainder of the culverts (approximately 60) under U.S. 41 and Loop Road. Hydrological restoration activities for wetlands in the Ochopee area of the Big Cypress National Preserve have been identified to enhance sheetflow and are currently being designed and permitted. These activities include scraping roadbeds used for historical agricultural activities back to existing grade, installing new culverts under Birdon Road, Wagon Wheel Road and Turner River Road , and installing plugs in the Birdon and Diagonal canals. These activities are anticipated to restore sheetflow to drained wetland systems and to eliminate saltwater intrusion along Birdon Road.

**Hydrology - Relevance to ROGG:** Regional hydrology is one of the most significant elements affecting the regional character and ecology in which ROGG would occur as well as a primary consideration for the design and implementation of ROGG. The role of hydrology at both the regional levels associated with watershed drainage and restoration activities as well as local sheetflow and water movement affects feasibility assessments for routing options, design of trail and trailhead facilities, regulatory coordination, and constructability. Specific influences on analysis for the ROGG included:

- **Regional Hydrological Restoration** – The regional hydrological restoration efforts associated with CERP and other projects are the primary drivers for the prevailing physical conditions, improvements and infrastructure that would be available for ROGG. Further, hydrologic restoration and management must be accommodated as part of design. Any aspect of ROGG that would compromise the fundamental objectives or implementation of regional hydrological restoration efforts are considered infeasible for this study. The post-restoration configurations and conditions for infrastructure, water levels, and/or flows are the baseline condition for feasibility evaluations of routing alternatives and design options for ROGG. Infrastructure with particular relevance to feasibility assessments for ROGG includes the proposed U.S. 41 bridges identified in the Tamiami Trail Next Steps EIS, levee removals associated with CEPP, Turner River and Copeland Prairie hydrological modifications, and culverts and bridges for the Picayune Strand Restoration Project. The water levels and flow requirements for post-restoration systems set the baseline for the design of trail surface elevations and stormwater treatment drainage requirements.

- **Sheetflow/Channelization** – U.S. 41 hinders sheetflow in much of the corridor due to the effects of channelization from the adjacent Tamiami Canal as well as the limited number of bridges and culverts that occur under the road. Installation of new culverts through projects such as the Western Tamiami Trail Culverts Critical Project or the Copeland Prairie Mitigation Plan assists in providing additional avenues for flow under U.S. 41 that will contribute to re-establishing sheetflow. The feasibility evaluation for the design and routing for ROGG segments and/or facilities considered the current and proposed future sheetflow conditions as well as proposed structural improvements to enhance sheetflow. Opportunities to design ROGG facilities to enhance sheetflow by diverting or collecting the runoff from the culvert channel under U.S. 41 and spreading it across the relatively flat landscape was also considered as part of the feasibility evaluation, especially for portions of the ROGG occurring on the south side of U.S. 41. Projects to enhance sheetflow over a broad area identified by the NPS or other public landowners such as the Copeland Prairie Mitigation Plan were considered as potential mitigation activities for the ROGG feasibility assessment.

- **Water Features/Canals** – A number of natural rivers and canals occur within the ROGG Study Area, many of which are or can be utilized for fishing or other water related recreation. ROGG facilities would be designed to accommodate existing canal crossings through the construction of bridges or culverts that accommodate future restoration efforts. The incorporation of safety features for trail crossings over water features was included in the feasibility evaluation. Fisherman and pass-through trail users pose potential conflicts for trail crossings of water features. Incorporation of methods to separate users and/or provide separate facilities to accommodate fishing was considered as part of the feasibility assessment.

Faka Union Canal bridge crossing



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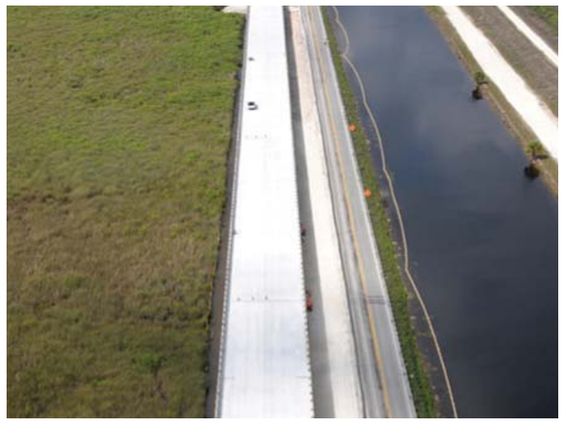
- **Saltwater Intrusion** – Tidal exchange has been affected by U.S. 41, especially in the Copeland and Ochopee areas of the ROGG Study Area, resulting in salinity changes on the north and south sides of U.S. 41. In addition, canals and freshwater diversion have allowed brackish or saltwater intrusion into historically freshwater systems. The routing and design of ROGG facilities should not negatively affect tidal exchange nor limit opportunities to restore appropriate tidal dynamics. Opportunities to use ROGG to limit surface saltwater intrusions by disconnecting or filling artificial channels that undesirably allow saltwater intrusion to occur into historically freshwater systems as part of trail placement and configuration were evaluated as part of the feasibility assessment.

- **Aquifer** – Aquifers are naturally replenished by rainfall and surface waters that saturate into the ground and work their way through the soil and geological substrate to the water table. ROGG facilities may include the installation of impervious surfaces that would hinder percolation into the groundwater and/or surface aquifers. However, stormwater facilities and the relative narrow profile of the ROGG relative to the thousands of acres of natural lands in the vicinity may limit or negate the potential effects on aquifer recharge from ROGG facilities. ROGG facilities would be designed to maintain existing recharge to the surficial aquifer or improve recharge in areas where existing impervious surfaces could be removed or replaced with pervious structures in the Study Area. Where ROGG facilities require water sources, the feasibility of using surficial water sources rather than other aquifers was evaluated.



Completed one-mile bridge for the Mod Waters Project; Photo Credit: USACE Tamiami Trail Construction Update March 2013

## Hydrology and Hydrogeology Summary

The ROGG Study Area occurs within the Everglades and Big Cypress Swamp watersheds, both of which have been subjected to extensive hydrological alterations. The Everglades watershed originates in central Florida in lakes draining into the Kissimmee River and then flows south through Lake Okeechobee into the Everglades and south into Florida Bay. The Big Cypress Swamp headwaters originate in the northern sandy flatlands south of the Caloosahatchee River drainage area. The surface hydrology interacts with and is influenced by the hydrogeology of the relatively permeable geological strata underlying the peninsula. There are three aquifers within the marine carbonate sediments underlying the southern peninsula: the Floridan aquifer system, the intermediate aquifer system, and the surficial aquifer system that includes the Biscayne aquifer, a significant water source for the east coast population. Restoration activities within the region are anticipated to maintain hydrological inputs into the aquifers.

### Historical and Current Conditions

The hydrological system in which the ROGG Study Area occurs consisted primarily of vast wetlands associated with the Everglades and Big Cypress watersheds in the extremely flat topography of the pre-drainage landscape of south Florida. The pre-drainage wetland systems exhibited three essential characteristics: dynamic storage and sheet flow, large spatial scales of drainage, and heterogeneity in habitat. The slow rate of flow through the topographically flat system resulted in a discharge of freshwater into estuaries well into the dry season. Water flowing through both the Everglades and Big Cypress systems was generally low in nutrients. Drainage and development projects such as C&SF Project and Tamiami Trail altered the hydrological elements that were characteristic to the Everglades and Big Cypress watersheds. Roadways and canals blocked or rerouted sheet flow into narrow channels, changed the direction of historical flow patterns, and modified brackish water exchange. Levees were constructed as part of the C&SF Project to retain floodwaters and control flow discharge. These alterations and legacy Big Cypress road and canals reduced the depth and duration of inundation, introduced tidal influences into interior freshwater systems, and modified surface discharges to occur too often, too little, or at the wrong times of the year. In addition to water flow and quantity issues, the water quality of the region has also changed through increased nutrient levels, although water quality inputs for the Big Cypress have generally been affected less than those of the Everglades. The Everglades occurs at the end of a hydrological gradient beginning near Orlando, a gradient that includes extensive agricultural lands.

### Hydrological Features

The ROGG Study Area includes a number of hydrological features and/or structural components of water control efforts, including levees and canals, natural creeks, and sloughs in addition to extensive wetland systems. Natural water features ranging from sloughs to creeks and rivers occur within the ROGG Study Area, with the Shark Valley Slough dominating the eastern portion of the study area and a variety of strands and rivers occurring in the western portion of the study area. These include the Fakahatchee Strand, Whitney River, Blackwater River, and Turner River. The Turner River is the only river that passes under U.S. 41 within the ROGG Study Area. Constructed as part of the CS&F Project, WCA3 occurs north of and adjacent to U.S. 41 in the ROGG Study Area. The L-67A and L-67C levees subdivide WCA3 into two portions, while the L-28 and L-29 levees generally form the exterior boundary for WCA3. U.S. 41 and other roads, such as Birdon Road, Loop Road, and Turner River Road, and their accompanying parallel canals obstruct sheet flow in the Big Cypress watershed and channel water to narrow culverts or bridges. Several other large canals were constructed in the western portion of the ROGG Study Area to provide drainage for development tracts planned for the area, including the Halfway Canal, the canal along S.R. 29/C.R. 29, and the Faka Union Canal. All three of these canals channelized sheetflow and provided an avenue for brackish water to extend further inland, while the Tamiami Canal spreads the brackish water from these canals east and west.

### Future Restoration Considerations

Hydrological restoration activities have begun to be implemented in the vicinity of the ROGG Study Area. Several projects associated with the Mod Waters project have been completed in recent years, including the completion of construction of a one-mile long bridge for U.S. 41 to facilitate flow into Shark River Slough. Several CERP projects have had elements that were completed, including the Picayune Strand Restoration Project. Additional projects are anticipated to be implemented in the next 10+ years as part of CEPP, including the removal of portions of the L-29 levee and six miles of the Old Tamiami Trail, installation of a new levee adjacent to the Blue Shanty flow-way, and modifications to water control structures. The CEPP plan identifies that projects north of the ROGG Study Area will need to be completed prior to constructing and completing the CEPP projects within the ROGG Study Area to ensure that water quality meets project objectives and to manage the amount of water flowing through the system. In addition, the construction of the bridges associated with the Tamiami Trail Next Steps project, especially the 2.6-mile long bridge between the proposed Blue Shanty flow-way and L-67 levee, is required prior to the removal of portions of the L-29 levee and/or discharge of the increased water quantity from the northern projects. Although not addressed in current CERP projects, hydrological restoration activities in the Big Cypress have also been identified for future implementation within the ROGG Study Area, including hydrological restoration activities for wetlands in the Ochopee area of the Big Cypress National Preserve to enhance sheetflow.

### Feasibility Considerations

Regional hydrology is one of the most significant elements affecting the character and ecology of the ROGG Study Area and a primary consideration for the design and implementation of ROGG. Any aspects of ROGG that would compromise the fundamental objectives or implementation of regional hydrological restoration efforts are considered infeasible for this study. The post-restoration future conditions for infrastructure, water levels, and/or flows were considered the baseline condition for feasibility evaluations of routing alternatives and design options for ROGG. Other elements with specific relevance to ROGG include maintaining or enhancing existing sheetflow, incorporating water related recreation opportunities and opportunities to restore historic patterns of tidal exchange.



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## 2.1.5 Ecology

The ecological resources in the regional context of the ROGG Study Area provide both the impetus for establishing a regional greenway and the challenge of managing human access into such a unique and sensitive ecosystem. The suite of ecological resources found in south Florida are uniquely adapted to the region's subtropical climate, geology and soils, and the overriding influence of water at the regional scale. At the same time, this area is extremely sensitive to perturbations caused by the presence and activity of humans who live, recreate, or visit within the systems. Although many of the component species are similar across vegetation communities, the characteristics of specific community types can be distinguished due to differences in the way the species and vegetation assemblage responds to natural processes and alterations caused by human activity. While the regional ecosystem provides a uniquely recognizable setting, a full appreciation for the ecological setting for the ROGG Study Area requires a more detailed review of specific elements occurring across the ecosystem. These range from the resources of vegetation communities and wildlife to the ecological processes that interact subtly to form the diverse mosaic of the overall system.

The purpose of this portion of the report is to document these ecological conditions within the ROGG Study Area and the relevance those conditions have to the feasibility and master plan of ROGG. To accomplish this purpose, this Ecology element is divided into five elements, including:

- **Vegetation Communities** – Provides an overview of the composition, relevant ecological processes, and issues for the vegetation communities that occur within the ROGG Study Area.
- **Listed Wildlife Species** – Provides an overview of the range, habitat requirements, life history, and threats to the listed wildlife species that could be affected by ROGG.
- **Exotic Species** – Summarizes the types, areas affected, and issues posed by exotic and invasive species.
- **Wetlands** – Provides a consolidated assessment of the jurisdictional requirements and issues associated with wetlands.
- **Ecological Processes** – Provides an overview of the natural processes that affect or drive the ecological character and that pose specific constraints or opportunities for design and construction requirements.

Each element begins with a description of resources or processes for the section and ends with an assessment of potential implications to feasibility assessments and master plan design. For simplified presentation, the common names of plant and animal species are used throughout the text. Scientific names are provided for reference in **Appendix B.**

## Natural Resource Regulatory Context

Impacts to natural resources in the Study Area would require authorization from several agencies having jurisdiction over Waters of the United States (WOUS), including wetlands and water bodies, and protected wildlife and plant species. The review and authorization for proposed impacts would be coordinated through a variety of regulatory mechanisms, ranging from National Environmental Policy Act (NEPA) coordination to application and approval of various environmental permits. Construction of the ROGG may require coordination with the USACE, USFWS, EPA, National Marine Fisheries Service (NMFS), State Historic Preservation Office (SHPO), SFWMD, FDEP, FFWCC and the Miami-Dade County Department of Regulatory and Economic Resources (MDRER), resulting in the need to obtain one or more of the following permits:

- USACE Individual Permit (IP),
- SFWMD Environmental Resource Permit (ERP) and/or Dewatering Permit,
- FDEP National Pollutant Discharge Elimination System (NPDES),
- MDRER Environmental Permit (Class I-VI) commensurate with impact details,
- USFWS Biological Opinion (BO) or Bald and Golden Eagle Protection Act (BGEPA) Permit for Non-Purposeful Take of Eagles,
- FFWCC Incidental Take Permits or Relocation Permits.

Current regulations and permitting requirements for each regulatory agency are summarized in **Appendix C**.

**National Environmental Policy Act (NEPA) Coordination:**

The objectives for the National Environmental Policy Act (NEPA) must be met when federal funds are used, a federal nexus exists, or funds are contemplated to be used for any aspect of a project. Signed into law on January 1, 1970, NEPA was established to "foster and promote the general welfare, to create and maintain conditions under which man and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of present and future generations of Americans." Generally speaking, NEPA requires that federal agencies consider the effects of their decision on the quality of the human environment based on one of three levels of analysis: Categorical Exclusion Determination, EA/ Finding of No Significant Impact (FONSI), or Environmental Impact Statement. The analyses are accomplished through a variety of methods depending on the subject federal agency, but typically include an extensive review of the project purpose, project alternatives, data review, and public involvement. Coordination with regulatory agencies is part of the NEPA process, but construction authorization is still required subsequent to completion of the study.

**Wetland Permitting:**

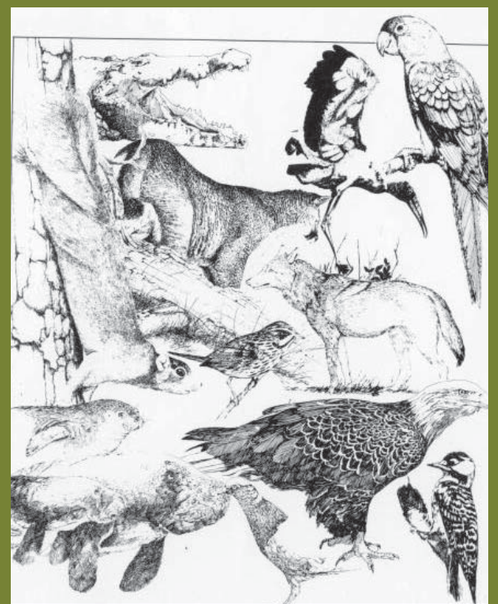
Impacts to WOUS would be subject to USACE review under the Section 404 regulatory program in compliance with the Clean Water Act (CWA). A permit application would be submitted to the USACE for proposed activities that are regulated by that agency in conformance with Section 404 of the CWA. If construction actions involve activities in the surface waters and wetlands of Florida, an ERP would need to be obtained from SFWMD. Stormwater requirements are integrated into the state dredge and fill ERP permitting process in Florida. An ERP serves as water quality certification under Section 401 of the CWA. Issuance of an ERP is also the means of obtaining concurrence with the federal consistency provisions of the Coastal Zone Management Act. Adjacent residents and the public at-large are encouraged to participate in the wetland permitting process at both the state and federal levels.

**Listed Species Permitting:**

Listed plant and wildlife species and habitats are protected by the USFWS, the FFWCC, NMFDS, and the Convention on International Trade in Endangered Species. The USFWS, through the Endangered Species Act (ESA) and other regulatory instruments, and the FFWCC, through Chapter 68 of the F.A.C., regulate activities that may affect protected plant and wildlife species. Impacts and mitigation are determined on a species-by-species basis, and potential impacts to an individual animal or nest structure, nesting habitat, foraging habitat or all suitable habitat may require permits.

**Relevance to ROGG:** Although the permit process would be initiated after the ROGG feasibility study and master plan are completed, an assessment of the types and kinds of permits as well as the potential impacts to resources that would trigger the need for those permits was a critical aspect of the feasibility assessment of ROGG. The types of permit process required to address different types of impacts and mitigation informs the costs and schedule for implementation, and potential scrutiny to which permit applications or regulatory reviews would be subjected. All of these were incorporated into the feasibility assessment.

Wetlands near Kirby Storter Park



Depiction of rare and extinct animals from Florida; Photo Credit: State Archives of Florida, Florida Memory, http://floridamemory.com/items/show/17723

## Everglades System Overview

Subject to some of the largest civil works projects in the world, the ecological resources of the Everglades have experienced significant changes over the last century, yet are proving resilient after implementation of restoration efforts to address the alterations. The characteristic view of the Everglades is the near monotonous expanse of wet prairies dominated by sawgrass and dotted with tree islands. Yet, the ridge and slough landscape adds subtle diversity to the system where differences in elevation of only a few inches may cause significant differences in water flow and vegetation communities. Regional drainage alterations have led to habitat changes and exotic/ invasive species encroachment, but restoration efforts targeted to restore appropriate hydrology promise possibilities of improved ecological function over time. For the ROGG Study Area, the Shark Valley Slough provides a representative landscape feature that has been significantly impacted by regional drainage projects, but is now the target for significant hydrological enhancements that include features that will directly affect the feasibility and master plan for ROGG.

## Big Cypress System Overview

Comprising the western 2/3 of the ROGG Study Area, the Big Cypress watershed is driven by similar elements as the Everglades, but contrasts in ecological character and relative degree of alterations. The forested strands, sloughs, and prairies of the Big Cypress comprise one of the largest stands of interconnected cypress wetlands in Florida, and provide a home for rare and endangered species unique to North America. Hydric pine flatwoods and scattered hammocks weave through the mosaic of the Big Cypress wetlands in areas with elevations that may be only inches above the adjacent cypress. The freshwater passing through the Big Cypress gradually grades into the brackish estuarine system of the Ten Thousand Islands characterized by salt marshes and mangroves. Although alterations in the hydrology of the Big Cypress such as canal and road construction in the Picayune Strand and the construction of the Tamiami Trail and associated canal occurred, the degree and intensity of these changes across the watershed were less concentrated than the levee and canal system through the Everglades. These regional alterations have resulted in habitat changes through increased salinity and inundation changes, but restoration efforts have begun to address some of the elements. The ROGG Study Area traverses the entire range of systems within the Big Cypress and could provide a window on the ecological processes of this region.

### Vegetation Communities

Typically the most visible aspect of the south Florida ecosystem, vegetation communities vary from freshwater systems of the Everglades and the Big Cypress to tidally connected estuarine systems. Locally, diversity and structure depend on soil, hydrology, and topographic variability. The vast majority of the ROGG Study Area consists of vegetation communities associated with wetland habitats such as wet prairies, freshwater sloughs, salt marshes, cypress systems, hydric pine flatwoods, and coastal mangroves. Generally, the eastern portion of the ROGG Study Area exhibits marsh and wet prairie systems, while the western portion exhibits cypress systems, hydric pine flatwoods, and tidally connected estuarine systems. Open water systems also occur throughout, including those associated with natural stream bodies like the Turner River, although the majority are associated with canals or other excavated water bodies. Naturally vegetated upland areas such as pine flatwoods and hammocks exhibit limited to no inundation during average years, but typically grade gently into the adjacent wetland areas both in vegetation composition and topographic elevation. Other upland areas occur within the corridor on filled areas associated with roads, fill pads for current or historical structures, and/or levees and often exhibit dense stands of exotic, invasive vegetation. The following provides a summary description of the dominant habitat types found within the corridor.

### Freshwater Vegetation Communities

**Marsh** – Sawgrass marsh is the dominant vegetation community and one of the defining characteristics of the Everglades, but can also occur in smaller patches within the Big Cypress. Sawgrass overwhelmingly dominates these marsh systems ranging from dense monospecific stands with plants up to nine feet in height to low growing and patchy plants intermixed with a diversity of other marsh species depending on soil conditions, fire history, and depth and duration of inundation. A variety of grasses and forbs such as maidencane, pickerelweed, spikerush, and arrowhead occur in more open areas of the sawgrass marsh. Cattails occur throughout sawgrass marshes as a minor component of the diversity, although elevated nutrient levels can result in dense stands of cattails that replace sawgrass as the dominant species. The culms of sawgrass provide an attachment area for periphyton, or algal mats, which can form dense mats in more open areas of the marsh. Sawgrass marshes can grow and thrive in a variety of hydroperiods, but these marshes typically occur where inundation of 1.0 to 1.5 feet occurs for most of the year. Fire is an important natural process for sawgrass marshes depending on the timeframe and intensity of the fire. Fires during the wet season can renew vegetation growth and provide nutrients to the system, while fires that burn into the soil during drought conditions can destroy sawgrass roots and change the composition of the community.

**Freshwater Sloughs** – Freshwater sloughs are deeper channels that are one to two feet deeper than the adjacent sawgrass marsh. They remain inundated for most months out of any given year, including through typical drought conditions. These channels provide significant areas of water flow for the Everglades throughout the year. Vegetation within freshwater sloughs in the Everglades typically includes a variety of submerged vegetation such as bladderwort, water hyssop, waterlily, and spatterdock and emergent vegetation such as maidencane, but sawgrass typically exhibits little to no presence within the sloughs. Sloughs in the Big Cypress are generally dominated by herbaceous species such as waterlily, water hyssop, ludwigia, and southern wild rice, although a variety of shrubs such as pond apple and pop ash can occur on the margins of the slough. Transitions between sawgrass marsh and sloughs typically are abrupt in vegetation composition with a dense “wall” of sawgrass vegetation bordering the more open slough with lower growing vegetation. This pattern is termed as a ridge and slough landscape. Major sloughs in the ROGG Study Area include Shark River Slough, which drains to Florida Bay, and smaller sloughs in the Big Cypress National Preserve, Fakahatchee Strand Preserve State Park, and Collier-Seminole State Park.

**Wet Prairies** – Wet prairies are treeless features dominated by herbaceous understory species that occur throughout the Big Cypress as well as shallower areas of the Everglades. Wet prairies are characterized by diverse flora including sedges, rushes, and grasses such as muhly grass, blue maidencane, and south Florida bluestem that grow over marl or fine sand soils, although the presence of limestone near the soil surface can also provide substrate for wet prairies to grow. Sawgrass may occur, but generally is a minor component of this system. Wet prairies typically inundate for three to seven months of the year at an average depth of approximately four inches. Periphyton mats occur within many wet prairies during the wet season. Prairies will burn during periods of drought, which limits the growth of shrubs. Wet prairies can grade with cypress systems to form the cypress prairies that are characteristic of the Big Cypress National Preserve.

**Forested Wetlands** – Forested wetlands occur primarily in the Big Cypress watershed and exhibit several forms ranging from cypress dominated domes, strands, and prairies to mixed hardwood swamps. The underlying soils and hydrology as well as the history of fire interact to allow the growth of the three types of cypress communities. Cypress domes are characterized by a monospecific overstory of cypress, which grow tallest in the center and taper off toward the fringes, forming a dome-like feature. Domes occur where the limestone substrate has given way to circular solution holes and appear visually isolated from other canopy systems within the landscape.

Cypress strands form along major drainages and generally retain a north-south orientation, parallel with the flow of water. Very large cypress trees may occur in these strands, especially in remote areas that were relatively inaccessible to timber harvesting operations. Strands such as the Fakahatchee Strand can extend for miles and be a mile or more in width. A variety of mixed hardwood species can occur with the cypress trees in interior portions of the wide sloughs. The near constant presence of water, coupled with high humidity provides conditions favorable for large numbers of orchids, bromeliads, and other epiphytic plants to grow on canopy and shrubs within or near large strands. They exist in microcosms where soils are richer and the area is protected from fire. Cypress prairies are characterized by an open forest of stunted cypress trees, called dwarf cypress. They are distributed in low densities in poor soils, and scattered, sparse growths of understory vegetation. Fires from the adjacent marshes and prairies burn into the margins of cypress domes and strands, which limits shrub growth and can lead to smaller trees due to damage from fire and nutrient changes.

**Hydric Pine Flatwoods** – One of the most diverse south Florida vegetation communities, fire dependent hydric pine flatwoods, also termed as wet pinelands, are comprised of a south Florida slash pine canopy over a groundcover generally dominated by herbaceous species and scattered shrubs. The herbaceous layer is generally dominated by grasses and sedges such as muhly grass, sand cordgrass, broomsedge, and beaksedges similar to the wet prairies, but can also include scattered shrubs such as wax myrtle and saw palmetto. The shrubs can become dense in the absence of fire. The boundaries between hydric pine flatwoods and wet prairies or cypress strands can be gradual due to intergradation between the communities. These systems typically exhibit a short hydroperiod with

inundation or saturation generally lasting for two months or less. These communities are dependent on frequent fires that burn the fine fuels of the grasses and pine needle litter, thereby limiting the growth of shrubs.

**Tree Islands** - Tree islands consist of aggregations of canopy trees and/or shrubs that look like tear-drop shaped islands of taller vegetation amidst the surrounding marshes and prairies. The majority of the tree islands within the Everglades consist of wetland vegetation and experience some inundation during the wet season, although some tree islands do include higher elevation hardwood hammocks that do not inundate regularly, if at all. Tree islands were extensively used by Native Americans and often exhibit archaeological or historical artifacts. Although cypress domes are sometimes called tree islands, reference to tree islands in this report are targeted towards the bayhead and willowhead communities more common in the Everglades. Bayheads are typically dominated by a variety of shorter trees such as swamp bay, pop ash, sweetbay, cocoplum, pond apple, and dahoon, although cabbage palms can project through these lower growing trees. Willowheads generally occur in slightly lower elevations than the bayheads and are dominated by Carolina willow. A variety of herbaceous species often dominated by ferns can occur within the tree islands. Willowhead islands occur on peat, which is very sensitive to fire during drought conditions.

### Tidally Connected Vegetation Communities

**Tidal Marsh** - Tidal marshes are generally dominated by herbaceous communities that exhibit a low diversity of species adapted to high salinity and tidal fluctuations. Characteristic species found in tidal marshes include saltmarsh cordgrass, needle rush, perennial glasswort, saltgrass, saltwort, seaside oxeye, and saltmeadow cordgrass. Tidal marshes often exhibit distinct zones of vegetation in which one or two species of these characteristic species occurs, depending on frequency, depth, and salinity. The uplands adjacent to tidal marshes are dominated by salt tolerant shrub species such as grounsel, marshelder, and cocoplum. Salt pans occur within the marshes in areas that only periodically inundate and exhibit much higher salinity levels than the adjacent marshes. Vegetation within these pans is limited to species that tolerate high salinity levels such as saltgrass, perennial glasswort, and saltwort. Tidal marshes are highly productive and are important in the lifecycles of a variety of commercial marine species for food and shelter. The corridor exhibits salt marshes through significant portions of the corridor west of Ochopee, Florida.

**Mangroves** - Mangrove wetlands are intertidal wetlands common to coastal habitats. In the ROGG Study Area they also occur on the banks of canals exposed to tidal fluctuations. These wetlands are dominated by trees that are specially adapted to the high-salinity environment found on and near the coast. Typically, mangroves forests are dominated by a mix of white, red, and black mangroves or buttonwood, a mangrove associate. The most salt tolerant is the red mangrove, which also occurs in the deepest inundation zones. As flooding becomes less frequent, black mangroves and white mangroves can be found with buttonwood occurring on the areas with least frequent flooding. These species help protect the coastline during storms and high surf and they provide nursery habitat for fish and other wildlife in the coastal systems. Inundation and salinity levels within mangrove forest stands are influenced both by tides and runoff from upstream sloughs and swamps. Fires and frosts can limit mangrove growth, while hurricanes and storm surges can result in death or removal of mangroves. Within the ROGG Study Area, mangroves are found primarily west of Ochopee to near the Collier-Seminole State Forest along tidal creeks and open water bodies such as excavated ponds and canals subject to tidal influences, including the banks of the Tamiami Canal.

### Upland and Transitional Habitats

**Mesic Pine Flatwoods** – Similar to hydric pine flatwoods in canopy composition, mesic pine flatwoods typically occupy higher elevations and experience little, if any, inundation during normal hydrological conditions. Pinelands are dominated almost exclusively by south Florida slash pine in the canopy, although cabbage palms can also occur, especially in areas that were historically logged. In contrast to hydric pine flatwoods, mesic flatwoods generally exhibit dense shrub layers of saw palmetto with lesser amounts of herbaceous species. In drier portions of the mesic flatwoods, a variety of scrub oaks such as sand live oak and myrtle oak can occur, although this scrubby flatwoods variant is limited in distribution through the ROGG Study Area. These forests often take root in the exposed limestone substrate of south Florida. Pineland communities are adapted to frequent fires that burn through the shrubs and accumulated pine needles. Long-term exclusion of fire can result in the increase in shrub density as well as more extreme fire events when fires do occur. These can result in the loss of canopy trees. Mesic pine flatwoods occur in the western portion of the ROGG Study Area in the Collier-Seminole State Park, although smaller aggregations occur in other portions of the Big Cypress watershed.

Forested wetlands

Mesic pine flatwoods

Wet praries

Hardwood hammock lining the entry to Collier-Seminole State Park

Mangroves

Tamiami Canal near the Big Cypress National Preserve Oasis Visitor Center



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## Wetland Regulatory Framework

Generally, wetlands are defined as low-lying areas in the landscape that are seasonally to permanently inundated and vegetated with plants tolerant of flooding or frequent saturation. Formal definitions of wetlands and the methods for determining the extent of wetland jurisdiction are found in the following applicable regulatory instruments: Chapter 24 of the Miami-Dade County Code of Ordinances, Chapter 62-340 of the FAC, and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual (2010). Wetlands within the ROGG Study Area were mapped by the USFWS as part of the National Wetlands Inventory. The majority of the ROGG Study Area is classified as wetland with the exception of scattered hardwood hammocks, some pinelands, and artificially filled areas. Wetlands within the ROGG Study Area occur in both non-forested and forested form and included as Freshwater Vegetation Communities and Coastal Vegetation Communities vegetation community categories. All of the prairies, marshes, cypress, slough, mangrove, and some of the hardwood hammock and pineland communities are wetland.

Wetlands in the ROGG Study Area provide substantial habitat value for wildlife and are crucial for water storage and sustaining or enhancing water quality. Wetlands within ENP, Big Cypress National Preserve, Fakahatchee Strand Preserve State Park, and Picayune Strand State Forest are designated as Outstanding Florida Waters (OFWs), which is a designation intended to protect existing, high-quality waters by mandating that proposed projects within these areas to not degrade the existing water quality. If determined to be feasible, implementation of ROGG would likely require impacts to jurisdictional wetlands. As noted in Appendix 3, this requires the review and approval of a number of environmental permits from regulatory agencies. The reviews of any permits for future segments of ROGG will include functional assessments of potential impacts and mitigation to offset those impacts to ensure no net loss of wetland function resulting from ROGG.

Slough provides a representative landscape feature that has been significantly impacted by regional drainage projects, but is now the target for significant hydrological enhancements that include features that will directly affect the feasibility and master plan for ROGG.

NWI Wetland Delineation within the vicinity of the ROGG Study Area

**Pine Rockland** – Pine rocklands occur on outcrops of limestone that have hydrological conditions similar to hydric and/or mesic pine flatwoods depending on ground elevations. Similar to mesic and hydric pine flatwoods, the canopy of pine rocklands is dominated by south Florida slash pine. However, the herbaceous layer is typically comprised of shrubs such as saw palmetto and scattered cabbage palm. Typically, herbaceous species are more diverse in this community with a higher number of endemic species than herbaceous layers in the pine flatwoods. The limestone within pine rocklands is typically pitted with fissures. Pine rocklands depend on frequent fire to discourage the growth of shrubs. In the absence of fire, pine rocklands gradually transition to rockland hammock communities dominated by a variety of fire intolerant shrub and canopy species. Pine rocklands in the ROGG Study Area are most prominent within ENP, but do occur in scattered areas within the Big Cypress watershed. This habitat is unique to south Florida within the continental United States.

**Hardwood Hammock** – Hardwood hammocks occur on higher elevations that are scattered throughout the ROGG Study Area and are a habitat unique to south Florida within the continental United States, especially those that provide conditions suitable for royal palms. Many of the hammocks are located on shell mounds, while the remaining hammocks occur on natural rises within pine flatwoods, pine rocklands, or strands. Hammocks on shell mounds vary in composition depending on location with hammocks in coastal areas being dominated by tropical hardwoods such as gumbo limbo, mastic, and poisonwood and inland hammocks dominated by live oak and/or cabbage palm. Rockland hammock areas occur on broader areas of higher elevation and consist of diverse tropical hardwood forests dominated by species such as inkberry, satinleaf, Jamaica dogwood, and strangler fig. Rockland hammocks can grade into pine rocklands and can represent the successional climax community when fire is excluded. For both types of hardwood hammock forests, the herbaceous layer is generally sparse, while shrub and vine layers can be dense. Typically, hardwood hammocks in the ROGG Study Area are relatively small in size, although larger expanses of hardwood hammock can occur such as the rockland hammock in Collier-Seminole State Park. Fire in hardwood hammocks is generally an infrequent to rare occurrence, but can significantly change the composition of the hammock, especially if occurring during dry conditions.

**Disturbed Lands** – A variety of disturbed upland habitats occur throughout the ROGG Study Area. These uplands consist of areas that were historically cleared and/or filled for residential or commercial structures, levees, roadbeds, or other uses. Existing residential or commercial parcels include houses or other structures as well as lawns and/or parking facilities that are often landscaped with a variety of native and non-native vegetation. Vacant lots often exhibit dense stands of exotic plants, typically comprised of Brazilian pepper and melaleuca although a variety of other exotic invasive species can also occur. Levees exhibit a variety of conditions; sand or gravel serves as a driving surface on the top or bench of the levee and the slopes are comprised of ruderal vegetation subject to frequent mowing. Roadbeds range from the paved road section and grassed shoulder of U.S. 41 to narrow filled gravel/limestone roads through marshes and swamps used for historical logging operations. The banks of many of these roadways are lined with shrubs ranging from natives such as cocoplum and wax myrtle to exotic plants such as Brazilian pepper. Other lands used in historical agricultural production have been left fallow and now consist of ruderal lands.

### Open Water

**Waterbodies** - Significant surface water features within the ROGG Study Area include rivers, canals, lakes and excavated reservoirs. Several natural riverine drainage ways occur in the vicinity of U.S. 41, including the Blackwater, Whitney, Faka Union, Fakahatchee, New, East, and Turner Rivers. The majority of these rivers are tidally influenced and occur south of U.S. 41, although Turner River extends north of U.S. 41 as a significant freshwater drainage way. One major canal feature, the Tamiami Canal was excavated to create fill for road construction and is located north of U.S. 41. Additional regional canals, including the S.R. 29, L-28, L-67A, L-67C, L-30, and Faka Union canals, intersect the Tamiami Canal within the ROGG Study Area. These features are detrimental to sheet flow in that the roads block flow, and the canals divert water from adjacent wetlands. The Faka Union is tidally influenced and provides Critical Habitat for manatees. Several small lakes and water bodies occur throughout the ROGG Study Area, some of which naturally occur in depressions or sinks in the landscape, while others were created as borrow ponds. These water bodies provide year round aquatic habitats for wildlife refuge during drought conditions.



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**Vegetation - Relevance to ROGG:** Vegetation communities within the ROGG Study Area affected feasibility assessments for routing options, design of trail and trailhead facilities, considerations for public and regulatory coordination, and post-construction operation. Specific influences on analysis for the ROGG included:

- **Routing Alternatives** – Routing alternatives for ROGG considered both the potential presence of rare vegetation communities and options that would primarily traverse previously disturbed habitats. Several rare vegetation community types occur within the ROGG Study Area, including hardwood hammocks and pine rockland. Although these habitats typically include shade trees and upland habitat that would provide beneficial elements for ROGG, they can also be home to rare plant and animal species. The route alternatives for ROGG included an assessment of both the educational and experiential opportunities associated with access to the rare communities as well as potential impacts to the species comprising the habitats and/or management implications that would be caused by a trail through the natural community. Management implications could include reduced capacity to apply prescribed fire and/or breaks in vegetation structure that cause vegetation communities to experience increased susceptibility to damage from hurricane winds, native hardwood encroachment into historically open sytems, and exotic species and native hardwood encroachment. Routing alternatives that used previously disturbed lands were prioritized both to take advantage of conditions favorable for trail use as well as opportunities for the trail operation to remove exotic plants present in the disturbed areas.

- **Wetlands** - Vegetation communities in the vast majority of the ROGG Study Area are wetlands subject to the regulatory authority of local, state, and federal entities, which are described in more detail in **Appendix C**. Construction of a trail within wetland communities will require extensive permitting and was a significant factor for the overall feasibility of implementing all or portions of the ROGG segments. Accommodations for wetlands were included in design options evaluated for ROGG facilities, which included boardwalks to reduce fill and allow light penetration, and options to use the trail to spread out the flow of water from channelized flow-ways to closer mimic the historical sheetflow of the region.

- **Lack of Shade** – The majority of the ROGG Study Area consists of prairies, marshes, or other relatively non-forested communities. Trail sections for ROGG through these areas would have little natural canopy available to provide shade for trail users, which could require the installation of shade structures or way stations to mitigate the heat and sun in south Florida.

- **Waterbodies** – A number of excavated canals and ponds occur within the ROGG Study Area, the majority of which have steep banks and no vegetated edge. Some of these have structures that limit access to the water, such as the guardrails between the road surface of U.S. 41 and the Tamiami Canal. Likewise, trails located adjacent to, or over water will require railings to limit access. Some of these water features may be targeted for restoration, which would affect both the slopes anticipated at the water's edge as well as the experience of trail users. Water features also serve as a fishing location. Fishing provides a potential user conflict between pass-through trail users and the fisherman that want to stay near good fishing locations. The incorporation of design features such as platforms and "no fishing" locations were evaluated as part of the study.

- **Shrub Management** – Many of the natural vegetation communities in the ROGG Study Area have a sparse shrub layer due to the history of fire and inundation, which creates the characteristic vista across open prairies in the region. However, areas that have been disturbed by historical agricultural activities, hydrological alterations, and/or fill placement provide drier conditions and protection from fire that allows dense shrubs to grow, including both native and exotic invasive shrub species. Along roadways and fill pads of the Old Tamiami Trail and portions of Loop Road, these shrubs can grow into an almost impenetrable thicket that limits views across the natural systems. These shrub thickets have become part of the cultural landscape along roadway corridors, which may limit the amount or intensity of management allowed to thin the shrubs and allow additional views into the surrounding natural systems. New trail facilities built on filled areas will require management during trail operations to limit the growth of undesirable shrubs. In areas where exotic invasive shrub species occur, the ROGG was identified as a potential catalyst for removal of these undesirable species.

- **Landscape Palette** – The ROGG Study Area traverses vast expanses of native vegetation communities in which a diversity of native plants that should be used for landscape designs within the region. The incorporation of native plants into the landscape palette for the trail and/or trail facilities can minimize abrupt transitions between constructed features and the adjacent natural areas. These species are adapted to the ecological setting of the region, which can limit the maintenance requirements once the species are established.

- **Tidal Communities** - Vegetation communities that rely on tides and the associated influence of salinity occur in the western portion of the ROGG Study Area. Routing alternatives and design options that would alter historical tidal fluctuations were deemed essentially infeasible. On the other hand, opportunities to use ROGG to enhance or restore historical tidal operation and salinity levels were evaluated as part of the feasibility study.

## Vegetative Communities Summary

The vast majority of the ROGG Study Area consists of vegetation communities associated with wetland habitats. Generally, the eastern portion of the ROGG Study Area exhibits marsh and wet prairie systems, while the western portion exhibits cypress systems, hydric pine flatwoods, and tidally connected estuarine systems. Unique tear-drop shaped tree islands occur within the marshes and wet prairies of the Everglades. Forested wetlands occur primarily in the Big Cypress watershed and exhibit several forms ranging from cypress dominated domes, strands, and prairies to mixed hardwood swamps, such as the Fakahatchee Strand. Open water systems also occur throughout, including those associated with natural stream bodies like the Turner River, although the majority of these systems are associated with canals or other excavated water bodies.

Naturally vegetated upland areas such as pine flatwoods and hammocks exhibit limited to no inundation during average years, but typically grade gently into the adjacent wetland areas both in vegetation composition and topographic elevation. Small portions of the ROGG Study Area consist of pine rockland, a habitat unique to south Florida that consists of pine forests growing on limestone outcrops. Other upland areas occur within the corridor on filled areas associated with roads, fill pads for current or historical structures, and/or levees. These uplands often exhibit dense stands of exotic, invasive vegetation.

Specific influences on analysis for the ROGG from vegetation communities included routing alternatives in the vicinity of rare vegetation communities, areas requiring intensive management, and previously altered sites, the need for additional shade features due to limited available tree canopy, access to water features, design and management considerations to address shrub management and tidal communities, regulatory requirements for wetlands, and vegetation that could be incorporated into a landscape palette for the ROGG.



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## Primary Listed Species Regulations Summary

A number of regulations require review of activities with the potential to impact listed species and changes to project design and/or permits if the impacts would be realized in the final implementation. Five of these have specific relevance to ROGG as the primary regulations affecting potential impacts to listed species in south Florida. The following provides a brief summary of each regulation.

**Endangered Species Act (ESA) of 1973, as amended (PL 93-205)**

The ESA was developed to protect threatened and endangered species and the ecosystems upon which they depend by prohibiting the take of a species through a variety of actions defined in the ESA. Plants and animals listed as federally threatened and endangered are protected under the ESA, which is administered and enforced by the USFWS. The ESA allows for exceptions to prohibited activities through the issuance of a permit for taking of a listed species incidental to otherwise lawful activities.

The ESA also regulates Critical Habitat, which is a defined land area containing the habitat area essential for the conservation of the species. Critical Habitat may require special management considerations or protection, but the area does not necessarily represent the total extent of suitable or occupied habitat for the species. Approximately 50% of species listed by the USFWS have Critical Habitat designations.

**Magnusson-Stevens Fishery Conservation and Management Act (MSFCMA)**

The MSFCMA is the primary law governing the management of fisheries for marine fish species within waters subject to the federal jurisdiction of the U.S. The MSFCMA provides statuatory authority for the protection of Essential Fish Habitat (EFH), which is the habitat essential for survival and reproduction federally managed fish species across their life stages. Working with regional fishery management councils, the National Marine Fisheries Service (NMFS) has designated EFH for approximately 1,000 managed species, including EFH within the ROGG study area. Some of this EFH overlaps with Critical Habitat for species protected under the ESA. The NMFS reviews potential impacts to EFH as part of the review of Federal agency actions and provides conservation recommendations that need to be addressed by the permitting agencies, including by incorporating conditions that acquire compliance as part of permits issued for a project.

**Migratory Bird Treaty Act (MBTA)**

Most native birds within the ROGG Study Area are protected under the Migratory Bird Treaty Act (MBTA). The MBTA made it illegal for people to "take" migratory birds, their eggs, feathers or nests. "Take" is defined in the MBTA as an attempt at hunting, pursuing wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof by any means or in any manner. The MBTA allows for legal hunting of certain species protected under the MBTA and within the hunting regulations established by the State of Florida.

**Bald and Golden Eagle Protection Act (BGEPA)**

Following the removal of the bald eagle from the ESA in 2007, the USFWS implemented a permitting program under the auspices of BGEPA for potential impacts to bald eagles. BGEPA prohibits the taking of bald eagles and golden eagles, their parts, nests, or eggs within the United States without appropriate permits issued by the Secretary of the Interior. Originally issued as the Bald Eagle Protection Act of 1940, BGEPA was expanded in 1962 to address protection of the golden eagle. Under BGEPA, "take" is defined as any action that will kill, injure, molest, or disturb these species to the point where productivity or reproduction is affected. Both the FFWCC and the USFWS implement elements of the permitting program for BGEPA.

**Chapter 68 of the Florida Administrative Code**

Through Chapter 68 of the F.A.C., the FFWCC regulates activities that may affect listed species within the State. The purpose and intent of this chapter is to conserve or improve the status of endangered and threatened species with the understanding that lawful, nature-based recreational activities may be managed to be compatible with species protection measures. The FFWCC regularly reviews the status and listing designation for species meeting the criteria of the Code, develops and implements management plans that are designed to protect the target species throughout the state, and administers the permitting program.

Federally Listed Species Considerations within the vicinity of the ROGG Study Area

### Listed Wildlife Species

The ROGG Study Area traverses expanses of publicly-owned land noted for or set aside specifically to conserve habitat suitable for occupation by rare and endangered species protected by state and/or federal government regulations (hereafter listed species). Management plans for parks and conservation lands produced by county, state, and federal agencies that manage these parcels have documented occurrences of listed species throughout the ROGG Study Area. In addition, the USFWS completed a Multi-Species Recovery Plan for 68 federally listed species that occur in south Florida to assist with project planning, management actions, and environmental compliance. Based on the species noted in these plans, the following 20 listed wildlife species have the potential to occur in or adjacent to the ROGG Study Area and/or be affected by the proposed project:

- Florida panther,
- West Indian manatee,
- Everglade snail kite,
- American alligator/ American crocodile,
- Cape Sable seaside sparrow,
- Wood stork,
- Eastern indigo snake,
- Bald eagle,
- Limpkin,
- Little blue heron,
- Roseate spoonbill,
- Snowy egret,
- Tricolored heron,
- White ibis,
- Southeastern American kestrel,
- Osprey (Monroe County population),
- Florida sandhill crane,
- Everglades mink,
- Big Cypress fox squirrel,
- Florida black bear,
- Red-cockaded woodpecker,
- Smalltooth sawfish,
- Florida bonneted bat.

The USFWS has designated Panther Focus Areas, Critical Habitat for Cape Sable seaside sparrow, American crocodile, West Indian manatee and Everglade snail kite, and Core Foraging Areas (CFAs) for wood storks within the vicinity of the ROGG Study Area. The NMFS has disignated Critical Habitat for the Smalltooth sawfish with the vicinity of the ROGG Study Area. These designations include habitat occupied or suitable for occupation, roosting, foraging, and nesting by species listed as threatened and/or endangered by the USFWS. These designations are a tool used to guide agencies in fulfilling conservation responsibilities by requiring them to consult with the USFWS if projects occur in these locations.

Listed plant species occur within or near the ROGG Study Area, including several species within the Fakahatchee Strand Preserve State Park that are found nowhere else within North America. The majority of these plant species



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occur within wetlands that would be subject to a variety of regulations intended to protect wetlands and wetland-dependent species. In addition, regulations addressing potential impacts to listed wildlife species typically require consideration of potential impacts to listed plants. As such, additional detailed descriptions of listed plant species within the corridor are not included in this document.

### Florida Panther

The Florida panther is a tawny-colored, medium-sized cat that historically occupied much of Florida, but has experienced significant range and population reductions due to a variety of factors, including habitat loss and road mortality. The Florida panther occupies an estimated two to three million acres in south Florida, which is less than five percent of its historic range. The population is estimated to be 100 - 120 individuals that generally prefer large, remote tracts of land with adequate prey, cover, and reduced levels of disturbance as suitable habitat. The small population size makes this species susceptible to a bottleneck caused by a lack of genetic diversity. The lack of genetic diversity can render the population more susceptible to the spread of contagious diseases, which have the potential to wipe out the remaining population if the disease is severe.

The quality of suitable panther habitat is largely driven by forage available for prey species, which include white-tailed deer, feral pig, raccoon, armadillo, and rabbit. Mature forested uplands provide relatively dry conditions with dense vegetation enabling panthers to rest and den while still providing visibility and access to large prey in bordering swamps, marshes, or pinelands. Much of the prime panther upland habitat is north of I-75, but the conservation lands within the corridor, including the Florida Panther National Wildlife Refuge, the Big Cypress National Preserve, Big Cypress Seminole Indian Reservation, ENP, Fakahatchee Strand Preserve State Park and Picayune Strand State Forest, form a large contiguous tract of panther habitat.

The home range of this solitary species varies according to gender, habitat availability, and habitat quality, although males generally have larger home ranges than females. Males are polygamous and their home ranges typically overlap with the home ranges of several females and their dependent offspring. Florida panther breeding may occur throughout the year with a peak during the period of winter and spring. The gestation period is 90 to 95 days and litter size ranges from one to four kittens. The young will disperse between 18 to 24 months after birth. The overall breeding cycle lasts two years.

Threats to this species include road mortality, habitat loss and fragmentation, disease, and inbreeding. Regional habitat loss and declines in habitat quality have decreased suitable habitat available, which has contributed to dispersal of panthers. Habitat fragmentation has separated the large blocks of habitat desired by panthers. Instead, panthers have to use corridors of unsuitable habitat to disperse (even through corridors with human activity). Corridors that cross roadways expose panthers to potential motorized vehicular collisions, which accounted for 20% of panther deaths between 1972 and 2004. Regionally, wildlife underpasses along I-75 and S.R. 29 have decreased motorized vehicular accidents. However, the majority of panthers using these crossing are males looking for additional habitat, while females still rarely cross major roads or use the underpasses, essentially sustaining their habitat as fragmented. Panther mortality on S.R. 29 has historically been a significant percentage of the total deaths caused by vehicles, even following the installation of wildlife fencing along the roadway. Panther mortality has also occurred on U.S. 41, especially in the vicinity of the Turner River.

The ROGG Study Area includes portions of the U.S. 41 corridor within the Big Cypress National Preserve that have been equipped by FDOT with the Roadside Animal Detection System (RADS) technology. RADS are electronic motion and/or infrared sensors that detect the movement of large animals on or near roadways. When sensors are activated, RADS triggers a warning message that signals drivers to reduce their speed and proceed with caution.

The ROGG Study Area is located within the primary zone of the Panther Focus Area. Conservation of these lands is essential for the long-term survival of this species, and any disturbance within the Focus Area has the potential to impact the species.

### West Indian Manatee

The West Indian manatee is a large aquatic mammal that can be found in saltwater, brackish, and freshwater environments. Manatees can be found in shallow, slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas, particularly where foraging areas for seagrass or freshwater submerged vegetation occur. Manatees are mostly herbivores, however small fish and invertebrates can be ingested when they consume a large variety of submerged, emergent, and floating plants. This migratory species travels to peninsular Florida in the winter to use warm waters, such as natural springs or power plant discharges. Reproductive rates are low for manatees with one calf being born every two to five years. Gestation lasts 11 to 14 months and mothers nurse their young for one to two years. Manatees have no natural enemies and can live 60 years or more. Historically, the major cause of natural death was likely exposure from cold weather. Most human-related manatee fatalities occur from collisions with watercraft, but other causes for human-related mortality include being crushed and/or drowned in canal locks and flood control structures; ingestion of fish hooks, litter and monofilament line; and

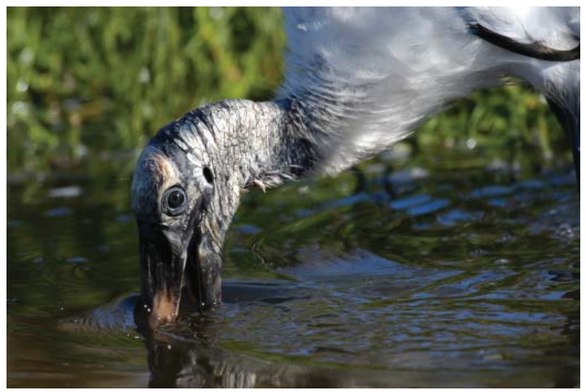
Florida panther - Photo Credit: fwsgov

Roadside Animal Detection System (RADS) on U.S. 41

Western Indian manatee - Photo Credit: fwsgov

Cape Sable seaside sparrow - Photo Credit: fwsgov

Male Everglade snail kite


Wood stork

American alligator

Eastern indigo snake

entanglement in crab trap lines. Critical Habitat has been mapped by the USFWS for this species, which includes the Faka Union Canal and portions of the Tamiami Canal within the ROGG Study Area.

### Everglade Snail Kite

The Everglade snail kite is a medium-sized raptor that forages for its primary prey, the apple snail, in open herbaceous wetlands of south Florida. This subspecies is limited to wetlands of central and south Florida. In the vicinity of the ROGG Study Area, this species regularly occurs in the expansive marshes of the WCA3 and ENP. The Everglade snail kite is highly mobile and will move from one portion of its range to another in search of food if foraging conditions decline in one area. Open herbaceous wetlands comprised of spike rushes, maidencane, and bulrushes comprise important components of habitat since they provide suitable conditions for apple snail availability. Dense vegetation is not optimal for the Everglade snail kite because it complicates the ability to forage successfully. They nest in a variety of vegetation types, including both native and exotic woody vegetation and cattails. Typically, nests occur approximately three to ten feet above the water in areas with good foraging habitat nearby. Critical Habitat has been mapped for this species, which includes much of the eastern portion of the ROGG Study Area.

### American Alligator/ American Crocodile

The American alligator and American crocodile are two similar-looking reptiles found in open water bodies of south Florida. American Alligators are protected to their similarity to American crocodiles, which are much rarer in terms of population numbers and range. Alligators are common throughout the Coastal Plain of the southeastern United States, while crocodiles are limited to south Florida and the neotropics. Alligators are found primarily in freshwater habitats, while crocodiles typically occur in coastal estuaries. Both are opportunistic predators that will consume any prey that is easily accessible. Both reptiles are an important part of their ecosystem because they establish depressions through their nesting activities that can provide habitat for a number of other species. Along the ROGG Study Area, the American alligator is abundant and often observed thermo-regulating along the banks of canals adjacent to roadways. Critical Habitat has been mapped by the USFWS for the American crocodile, but it does not occur within the ROGG Study Area. Activities involving American alligators are regulated by the FFWCC.

### Cape Sable Seaside Sparrow

The Cape Sable seaside sparrow historically occupied a range in Collier, Miami-Dade, and Monroe counties, including areas in the vicinity of the ROGG Study Area. The population has declined due to loss of habitat as a result of development, changes in vegetation, fire, natural disasters, and hydrologic alteration. The Cape Sable seaside sparrow is a relatively small bird with drab colors that uses the marshes and wet prairies of interior southern Florida that remain dry most of the year, but become seasonally flooded with fresh to slightly brackish water. These vegetative communities burn periodically and the timing of these fires are critical to the survival of the sparrow. Sparrows build nests near the ground with an average nest height of approximately 6 inches. Nesting may happen two to three times in a nesting season, which begins as early as late February and can persist into early August commensurate with rainfall. Fires that occur late in the dry season threaten eggs and newly fledged young. Ideally, fires would occur during the wet season and water levels would not be artificially elevated during the dry season to prevent disturbance to nesting sparrows. The USFWS has mapped Critical Habitat for this species and it does not occur within the ROGG Study Area. However depending upon the final location of the alignment, the ROGG may occur within the consultation area for this species.

### Wood Stork

Wood storks are large wading birds that utilize shallow marshes and prairies throughout Florida. They have exhibited population declines attributed to loss of wetland habitat and regional hydrological alterations. Wood storks feed on small fish in shallowly-inundated wetlands or manmade water bodies. The ideal hydrologic regime for wood stork foraging includes periods of flooding (at which time prey items proliferate) alternated with dry periods (at which time prey items become concentrated). Periods of drought typically instigate the breeding season, and ultimately this timing results in concentrated prey for fledgling wood storks. Artificial impoundments, levees, and canals in south Florida have changed the natural hydrology of wetlands, which has impacted prey availability and foraging potential for this species.

Beginning as early as October in south Florida, wood storks produce nests in colonies that utilize large cypress trees or mangrove islands. Wood stork nesting within the ROGG Study Area is rare, but sporadic nesting has been documented since the mid-90s. In south Florida, wood



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stork CFA is defined as any suitable foraging habitat located within 18.6 miles of a known wood stork rookery.

The ROGG Study Area is located within the CFA of several currently active wood stork colonies. For projects occurring in a CFA, activities ranging from filling of foraging habitat to hydrological alterations that change the depth and/or duration of inundation may be considered as adverse impacts to wood storks. Minimization of adverse impacts to the wood stork can include replacement of foraging habitat through hydrological and habitat improvements or in the purchase of wetland credits from an approved mitigation bank as long as the impacted wetlands occur within the permitted service area of the bank.

### Eastern Indigo Snake

The eastern indigo snake is a large, black, non-venomous snake found in a variety of upland habitat types throughout the State, although they are not commonly found in great numbers in the wetland complexes of the ROGG Study Area. Eastern indigo snakes frequent several habitat types ranging from scrubby uplands to freshwater marsh edges to agricultural fields and typically require a mosaic of habitats to meet their complex habitat needs. In wetter habitats such as those in the vicinity of the ROGG Study Area, eastern indigo snakes may take shelter in hollowed root channels, hollow logs, or the burrows of rodents, armadillo, or land crabs. Their diet includes fish, snakes, frogs, turtles, eggs, small alligators, birds, and small mammals. Critical Habitat has not been mapped for this species by the USFWS.

### Bald Eagle

The bald eagle is a large raptor found throughout most of the US that exhibited significant population declines in the 1900s, but has since substantially recovered throughout the state. This species typically nests in expanses of forested habitat located within 1.8 miles of open fresh or salt water where they forage. Bald eagles nests, or eyries, are usually built in native pines, but they have been observed in cypress, mangroves, and artificial structures. Their diet is comprised primarily of fish and waterfowl, although mammals, amphibians, and reptiles are also consumed. The bald eagle uses a variety of methods to obtain food, including eating carrion, stealing fish from other birds or hunting for its own prey. Bald eagles are no longer protected under the ESA, but They are protected under the MBTA and the BGEPA. Based on data obtained by the FFWCC in triennial surveys through the 2011-2012 nesting season, a total of nine bald eagle nests, all of which are in Collier County, (nests numbered CO-006, CO-011, CO-012, CO-013, CO-016, CO-017, CO-037, CO-042, and CO-044) are known to occur within one mile of U.S. 41 in the ROGG Study Area.

### Red-cockaded Woodpecker

Named for the red streak (or cockade) on the side of the black cap of the males, the red-cockaded woodpecker is a small woodpecker that historically were common throughout the longleaf pine ecosystem, but declined in numbers as these forests were timbered in the early to mid-1900s. Red-cockaded woodpeckers live in family groups that include a breeding pair and “helper” non-breeding woodpeckers that typically consist of male offspring from previous years. The helpers typically assist in raising the offspring of the breeding pair. Red-cockaded woodpeckers live and nest within cavities that typically are excavated within living mature pine trees generally more than 80 years old. These older pines often are subject to a fungus that makes the inner heartwood soft enough for excavation. Cavity trees for a family group are aggregated in clusters that may include 1 to 20 or more cavity trees spread out over an average of 10 acres. Red-cockaded woodpeckers typically have territories of approximately 125 to 200 acres within which they forage, although this is dependent on habitat suitability and population density. Red-cockaded woodpecker clusters occur within the Big Cypress National Preserve, where the population is relatively stable.

### Smalltooth Sawfish

The smalltooth sawfish is one of two sawfish species that inhabit U.S. waters, primarily within waters south of the Everglades region of south Florida. This species typically inhabits shallow coastal waters very close to shore over muddy or sandy bottoms such as those found in estuaries. Typically, they occur within waters with warmer temperatures (71-82 degrees F), but will ascend inland in river systems periodically. Nursery areas for juvenile sawfish include mangroves and other shallow habitats with vegetation. Limited data is available concerning the population size of this species, but indications are that the population has dramatically declined over the last century likely due both to death caused by bycatch in various fisheries and the loss of juvenile nursery areas due to habitat modifications. This species was listed as endangered under the ESA by the NMFS in 2003 and Critical Habitat for this species was designated in 2009. Critical Habitat for this species occurs in the vicinity of the ROGG Study Area.

### Florida Bonneted Bat

Known only from roosts in seven south Florida counties, the Florida bonneted bat is the largest and rarest bat within Florida with an estimated population of only a few hundred individuals. Like many other bat species, the Florida bonneted bat is a colonial roosting species that is known to roost in tree hollows, buildings, chimneys, limestone out-croppings, dead palm fronds, under Spanish tile roofs, and bat houses. Open fresh water and wetlands are the prime foraging habitats for this non-migratory bat species where they typically forage on night-flying insects. The Florida bonneted bat is thought to have low reproductive capacity with potentially up to two breeding seasons a year. The habitat and foraging requirements of this bat are not well documented or studied. Roosts for this bat species are known to occur within the Fakahatchee Strand Preserve State Park and the Big Cypress National Preserve within the ROGG Study Area.

### Limpkin / Little Blue Heron / Roseate Spoonbill / Snowy Egret / Tricolored Heron / White Ibis

Six species of wading birds that occur in the ROGG Study Area are listed as Species of Special Concern by the FFWCC: limpkin, little blue heron, roseate spoonbill, snowy egret, tricolored heron, and white ibis. The population of wading bird species declined rapidly in the early 1900’s due to egg and plume hunting, but the population declines have continued and been attributed to habitat degradation and loss, reduced prey availability, and disturbance at breeding and foraging sites. All six of these species range throughout Florida, where they generally forage in shallow water on a variety of fish, crustaceans, insects, and small reptiles. Estuaries and wetlands along the ROGG Study Area are prime habitat for these wading birds. All but the limpkin breed in colonies, many of which include multiple wading bird species. According to FFWCC’s Florida Breeding Bird Atlas and the 2010 South Florida Wading Bird Report, a number of rookeries have been documented in and around the ROGG Study Area. The FFWCC Board of Directors recently approved the removal of the white ibis and snowy egret and limpkin from Florida’s endangered and threatened species list pending adoption of a management plan that is currently in process.

### Florida Sandhill Crane

The Florida sandhill crane is a subspecies of sandhill crane that inhabits Florida year round where it forages and nests within a variety of open habitats. These large birds with distinguishing red crowns utilize prairies,

Bald eagle

Little blue heron

Sandhill crane



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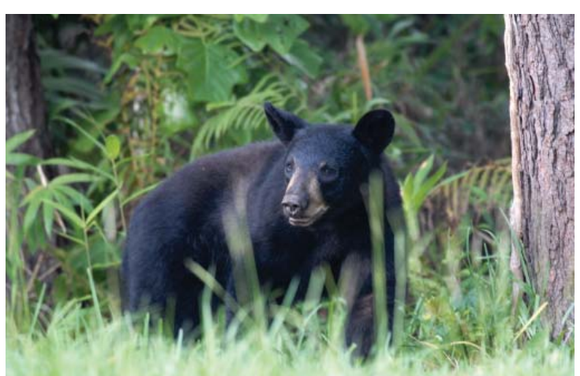
Osprey

Big Cypress Fox squirrel



Florida black bear

freshwater marshes, and pasture lands for foraging and nesting, but generally avoid forests and deep marshes. Florida sandhill cranes typically nest in late winter and early spring in matted vegetation surrounded by shallow water. They are omnivorous and forage on seeds, roots, berries, insects, invertebrates, small reptiles, amphibians, and mammals. Florida sandhill cranes have large home-range requirements, so protection measures are concentrated on the acquisition and/or conservation of land that bolster existing populations. Periodic fire is important to retard invasion of woody vegetation in marshes on protected habitat. In addition, the FFWCC approved upgrading the status of roseate spoonbill, little blue heron, and tricolored heron from Species of Special Concern to Threatened.

### Osprey

The osprey is large raptor that ranges throughout Florida year round and uses open water bodies such as freshwater lakes and oceans for foraging on a variety of fish species. Pesticides, shoreline development and declining water quality threaten the abundance and availability of food and nest sites for ospreys. They build large stick nests on live or dead trees as well as manmade structures such as utility poles, channel markers and nest platforms. Nest initiation typically begins between December and February. There is both a resident population and a migrant population that passes through Florida each spring and fall. The osprey is protected in Monroe County only, but permits are required to remove nests located anywhere within the state and a replacement structure must be erected to mitigate the removal of the nest. Suitable habitat occurs continuously without geographic barriers to movement throughout the ROGG Study Area. Osprey are protected under the MBTA and state protected under Chapter 68A F.A.C., where they are specifically protected in Monroe County as a Species of Special Concern.

### Southeastern American Kestrel

The southeastern American kestrel is the smallest North American non-migratory falcon. It uses a variety of agricultural and natural systems for foraging and nesting. Both resident and migratory kestrels occur within Florida; only the resident kestrel population is present between April and October when wintering northern kestrels have returned to their nesting ranges. Territory sizes can range up to approximately 800 acres in size. Suitable habitat includes pastures and low-intensity agriculture, open woodlots and fields within residential areas as well as fire-dependent sandhill and open pine savannah habitats. Ideal habitat provides suitable nesting and foraging habitat. In Florida, their diets are comprised primarily of grasshoppers and small lizards, but other invertebrates can also be eaten. Kestrels prefer to hunt from perches, but will hunt from the air if perches are lacking. Southeastern American kestrels breed from mid-March to early-June, typically using cavities previously excavated by woodpeckers in large dead trees and/or artificial nest boxes. A breeding pair of kestrels will defend their territory for multiple years. Mortality sources include mammalian and avian predators, but vehicle collisions also occur. An overall decline in nesting and foraging habitat as a result of development and agricultural conversion is the primary threat to this species. This species benefits from acquisition and management of suitable habitat, planting of canopy species in prairies and pastures, and prescribed fire to maintain a grassy, open understory and snags for nesting sites.

### Big Cypress Fox Squirrel

The Big Cypress fox squirrel is a relatively secretive, large squirrel that uses a variety of habitats in south Florida. This species is found in Collier County, mainland northern Monroe County, and extreme western Miami-Dade County, including lands within the ROGG Study Area. Most information concerning the Big Cypress fox squirrel is based on ecological characteristics of fox squirrels in general as subspecies specific information is limited. Preferred habitat includes pine forests and cypress and mangrove swamps from which they eat fungi, nuts, seeds, and other plant material. They breed in late winter and the middle of summer, and typically the litter is comprised of two or three young. Primary threats to the Big Cypress fox squirrel include loss and fragmentation of habitat, suppression of fire that allows the growth of an undesirable dense understory, and disease.

### Everglades Mink

The Everglades mink is a member of the weasel family with a limited range in the marshes and swamps of the ENP, Big Cypress National Preserve, and Fakahatchee Strand Preserve State Park. It is a semi-aquatic species with partially webbed toes specially adapted to hunting in water. This carnivorous species is an opportunistic hunter that will kill much larger aquatic and terrestrial species. They are solitary animals unless they are raising young, which typically consist of litters of three to six kits born in the spring. They den in hollow logs and stumps or under tree roots. The quality of their habitat has been degraded through development, stream channelization, and the drainage of wetlands and they are susceptible to the canine distemper virus. Other threats include the increase of invasive species into their habitat, especially the Burmese python.

### Florida Black Bear

The Florida black bear is a subspecies of the American black bear that historically ranged throughout Florida and the southern portions of adjoining states, but currently occupies only a small portion of their historic range. There are five subpopulations of Florida black bear in Florida and the ROGG Study Area traverses habitat occupied by the Big Cypress subpopulation. Florida black bears are adaptable to a wide variety of habitats, including flatwoods, swamps, bayheads, and hammocks common to south Florida. The Florida black bear is the largest mammal in Florida with adult males typically weighing an average of 250 to 350 pounds and females weighing 130 to 180 pounds. Florida black bears are generally solitary by nature, with typical home ranges ranging from 50 to 120 square miles for males and 10 to 25 square miles for females. Their diet is comprised of predominantly plant material with insects with occasional consumption of meat. This species was delisted by the FFWCC in 2012 upon approval of the Black Bear Management Plan and passage of the Florida Black Bear Conservation Rule (Chapter 68A-4.009 F.A.C.). The rule continues to make it illegal to "take" a bear and also states that the FFWCC will assist landowners and regulating agencies with the objectives of the minimizing and avoiding negative human-bear interactions.

**Listed Wildlife Species - Relevance to ROGG:** The presence of listed species within the ROGG Study Area affected feasibility assessments for routing options, design of trail and trailhead facilities, considerations for public and regulatory coordination, and post-construction operation options. Specific influences on analysis for the ROGG included:

- **Routing Alternatives** – The ROGG Study Area occurs within the primary zone of the Panther Focus Area and includes Critical Habitat for West Indian manatee and Everglade snail kite. While the occurrence of the project within the primary zone for the Panther Focus Area does not necessarily preclude the construction of new facilities, any new facilities, and activities including the construction of new facilities or modifications to existing facilities that result in



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changes to land uses and/or loss of habitat within the primary zone would require substantial public and regulatory review, especially for those that affect high quality forested systems. Routing alternatives that utilized previously disturbed habitats and/or accounted for high use areas for panthers within the corridor, including near Turner River, were evaluated as part of the study. Similarly, routing alternatives across Critical Habitat for West Indian manatees and Everglade snail kite would be subject to additional regulatory and public review.

- **Panthers and Roadways** - Vehicle collisions result in the death of numerous panthers. Anecdotal accounts during workshops for ROGG suggested that guardrails and canals for U.S. 41 complicate a panther's ability to quickly avoid ongoing traffic. Although the RADS system is in place, the location of the RADS system close to the paved road surface limits the time between the signal being triggered and the panther crossing the roadway. Other factors, including frequent vandalism has limited the effectiveness of the system. Opportunities to support or enhance the effectiveness of the RADS were evaluated as part of ROGG.
- **Wildlife Friendly Design Elements** – The ecology and behavior of several listed species affected considerations for design features for the trail. American alligators and American crocodiles warm themselves in the sun on canal banks and pavement to regulate their body temperature. ROGG facilities would be designed to deter use by these species, especially when located adjacent to open water bodies, and to minimize potential for reptile/human interaction. Wildlife, including Florida black bears, have been known to scavenge trash receptacles as a part of their foraging routine. Design accommodations for wildlife-proof trash receptacles were evaluated for ROGG to provide users the opportunity to dispose of food appropriately so that wildlife do not further associate people with food. Several species of wildlife discussed above tolerate nest boxes and/or platforms to augment nesting opportunities. ROGG facilities would be designed to maximize the opportunity to install nest platforms suitable for use by osprey and bald eagle and artificial cavities suitable for use by southeastern American kestrel.
- **Permitting** – The permit process associated with listed species and/or their habitats was considered as part of the costs and schedule for public involvement and permitting for the ROGG. Future construction activities will require authorization through permits that specify the scope of impact and species-specific compensatory mitigation to offset unavoidable impacts. Specific permitting requirements for several species of note include:
  - **Florida Panther** – Potential impacts to Florida panther habitat, especially forested habitat, for ROGG would require an assessment of Panther Habitat Units through a functional panther habitat assessment administered by the USFWS. This assessment would determine the habitat value of the lands impacted and the mitigation requirements to compensate for the impacts. Mitigation could include purchase of Panther Habitat Units from one of the several conservation banks permitted by the USFWS to offset impacts to panther habitat. If unavoidable impacts to panther habitat are required as a part of the construction of the ROGG, mitigation requirements will be negotiated and quantified during the formal USFWS consultation process.
  - **Wood Stork** - If construction impacts result in more than five acres of impacts to CFA occurs with 0.47 mile of active colony, and/or has greater than 0.5 acre of impact to wetlands within an active colony CFA, the impact and mitigation areas require a functional assessment as outlined in the "Wood Stork Core Foraging Analysis Methodology". If unavoidable impacts to wood stork foraging habitat are required as a part of the construction of the ROGG, mitigation requirements will be negotiated and quantified during the formal USFWS consultation process.
  - **Everglade Snail Kite** - The ROGG Study Area occurs within the Consultation Area for Everglade snail kites administered by the USFWS. Critical Habitat occurs in the eastern portion of the Study Area. Impacts to Critical Habitat will require review and approval by the USFWS. Nest protection buffers of 500 feet (no-entry zone) and 1,640 feet (limited activity buffer zone) will be required for active nests.
  - **Red-cockaded Woodpecker -** Potential impacts to red-cockaded woodpecker habitat will require review by the USFWS. Impacts to pinelands with mature pines greater than 6 inches dbh will require surveys and/or assumption of the presence of red-cockaded woodpeckers within the Consultation Area administered by the USFWS, which occurs in the western portion of the ROGG Study Area. For impacts that are unavoidable, mitigation and/or a habitat management plan may be required as part of the USFWS review.
  - **Smalltooth Sawfish and EFH -** The construction of ROGG within areas in or adjacent to EFH such as mangroves and/or Critical Habitat designated for the smalltooth sawfish will require consultation with the NFMS. As part of this consultation, an EFH Assessment will likely be required including a description of the proposed action, analysis of the effects of the action on EFH and smalltooth sawfish, and proposed mitigation.
  - **Florida Bonneted Bat** - Potential impacts to habitat used for roosting and/or foraging by Florida bonneted bats will require consultation with the USFWS. Surveys for Florida bonneted bat roosts may be required to evaluate for the presence of active colonies. Potential impacts to active roosts may require modifications to the ROGG design.
  - **Eastern Indigo Snake** - The construction of the ROGG may require impact to habitat preferred by this species. Typically, impacts are minimized to this species by adhering to the "Eastern Indigo Snake Programmatic Effect Determination Key and "Standard Protection Measures for the

## Listed Species Summary

The ROGG Study Area traverses expanses of publicly-owned land noted for or set aside specifically to conserve habitat for listed wildlife and plant species. Although a variety of listed species could occur within the public lands, the following 20 listed wildlife species have the potential to occur in or adjacent to the ROGG Study Area and/or be affected by the proposed project:

- Florida panther,
- West Indian manatee,
- Everglade snail kite,
- American alligator/ American crocodile,
- Cape Sable seaside sparrow,
- Wood stork,
- Eastern indigo snake,
- Bald eagle,
- Limpkin,
- Little blue heron,
- Red-cockaded woodpecker
- Smalltooth sawfish
- Florida bonneted bat
- Roseate spoonbill,
- Snowy egret,
- Tricolored heron,
- White ibis,
- Southeastern American kestrel,
- Osprey (Monroe County population),
- Florida sandhill crane,
- Everglades mink,
- Big Cypress fox squirrel,
- Florida black bear.

The USFWS has designated Panther Focus Areas; Critical Habitat for Cape Sable seaside sparrow, American crocodile, West Indian manatee and Everglade snail kite; and Core Foraging Areas for wood storks within the vicinity of the ROGG Study Area. In addition, the NFMS has designated Critical Habitat for Smalltooth sawfish within the vicinity of the ROGG Study Area. These designations include habitat occupied or suitable for occupation, roosting, foraging, and nesting by species listed as threatened and/or endangered by the USFWS. These designations are used to guide agencies in fulfilling conservation responsibilities by requiring them to consult with the USFWS if projects occur in these locations. Listed plant species occur within or near the ROGG Study Area, including several species within the Fakahatchee Strand Preserve State Park that are found nowhere else within North America. The majority of these plant species occur within wetlands that would be subject to a variety of regulations intended to protect wetlands and wetland-dependent species. In addition, regulations addressing potential impacts to listed wildlife species typically require consideration of potential impacts to listed plants. As such, additional detailed descriptions of listed plant species within the corridor are not included in this document.

The presence of listed species influenced the analysis for the ROGG through evaluations of routing alternatives that could affect Florida panther habitat within the Panther Focus Area and Critical Habitat for other listed wildlife species, opportunities to incorporate design elements that could minimize impacts to Florida panthers such as enhancement to the Roadway Animal Detection System, accommodations to minimize wildlife use of trail facilities that would be adverse for wildlife or trail users, and permitting requirements for future ROGG facilities relative to listed species.

## Definitions

Exotic invasive species are often described with a variety of terms, such as exotic, nuisance, noxious, invasive, or non-indigenous. For the purposes of this report, the following definitions are used for exotic invasive species.

**Native Species** – Those plant or animal species that were found within south Florida prior to the advent of Europeans.

**Nonnative Species** - Those plant or animal species that were introduced or expanded into the south Florida region as a result of human-related activities and are not native to Florida.

**Exotic Invasive Species** – Plant or animal species that are not native to south Florida and whose introduction causes or is likely to cause economic or environmental harm or harm to human health.

Brazilian pepper

Burmese pythons; Photo Credit: EDDMaps (http://www.eddmaps.org/report/images/25565.06.jpg)

Eastern Indigo Snake".

- **Bald Eagle** – Construction activities inside of a 660 feet zone adjacent to a bald eagle nest tree will require a permit from the FFWCC and USFWS. This permit will include requirements for monitoring and timeframes for construction within the buffer zone.
- **Osprey** – Currently, a federal permit is required to take an active osprey nest, and state permits are required to take both active and inactive nests. Any nests observed within the project area would be avoided or removed after the appropriate permits are secured.
- **Florida Sandhill Crane** - Impacts to this species are minimized by complying with the provisions set forth in guidelines provided by the FFWCC, which include survey requirements and management considerations for a requisite 400-foot buffer around sandhill crane nest sites to prevent disturbance or take of this species during nesting.

### Exotic Invasive Species

Exotic invasive species are the cause of extensive environmental damage to natural systems throughout south Florida. Due to the lack of natural enemies and frequently robust survival rates, exotic invasive species can displace or alter the composition of natural vegetation communities, change physical or ecological processes and nutrient availability, cause the death of native plant or animal species, or change conditions for the growth and reproduction of native plant or animal species. Exotic invasive species can also reduce recreational opportunities through clogging waterways used for boating or swimming, encroaching on trails and camp facilities, or reducing the aesthetics of facilities. Hundreds of thousands of acres of land in south Florida have been affected by exotic invasive species, although management activities including the exotic invasive management efforts for national and state parks in the area provide some measure of control. While desirable for ecosystem management, management efforts can be both costly to implement and can cause unintended negative local effects on cultural resources or non-target species.

Although exotic invasive plants occur throughout the ROGG Study Area, the amount and density of exotic invasive plants varies based on disturbance and management history. Monocultures of exotic invasive plants such as melaleuca, Brazilian pepper, or cogongrass occur on some vacant parcels that were filled many years ago, along the banks of the Old Tamiami Trail, and in areas with significant hydrological alteration. These monocultures have displaced native plant communities or exclude the natural re-establishment of native vegetation due to the density of the exotic plant population. In other locations, scattered individuals of exotic invasive plants intermingle with native shrub species along linear disturbed areas such as the edge of the U.S. 41 road shoulder, but do not extend into adjacent natural vegetation communities. Exotic invasive plants such as water hyacinth and hydrilla occur in a number of waterways within the ROGG Study Area, ranging from small floating clumps of plants to dense stands that clog the surface of the water body.

Exotic invasive animals also occur within the ROGG Study Area. Some species, such as Burmese pythons, occur as solitary individuals that range through the region, and are anticipated to have a regional effect on other native wildlife populations. These solitary species are difficult to control since finding individuals within the region can be problematic. Other species, such as fire ants, can occur in large groups where the species occurs. These species can have significant effects on sedentary individuals such as nestling birds, but may not range throughout the region to gather prey. Other exotic species carry diseases that can significantly effect or eradicate important vegetation or wildlife species. A notable example is the ambrosia beetle that carries a fungus that kills members of the laurel family, including redbay and swamp bay. Exotic animals also displace native populations of similar species or directly prey on desirable native species. A notable example of the former is the island apple snail that can displace the native apple snail, the historical prey for the Everglade snail kite, while a notable example of the latter is the bromeliad weevil that attacks and kills bromeliads, including many of the air plants characteristic to the region. Feral pigs and armadillos alter vegetation communities through rooting in search of tubers and other underground plant materials, digging burrows, or depredating on ground nesting birds and reptiles. Secondary effects from rooting can include disturbing soils sufficiently for exotic plants to be established and changes to micro-topography that effect sheetflow characteristics. Although negative effects are significant, feral pigs and armadillos also provide food sources for Florida panthers.

Management activities to control exotic invasive species are ongoing within the ROGG Study Area. Big Cypress National Preserve, ENP, Fakahatchee Strand State Preserve, and the Picayune Strand State Preserve have developed management programs aimed at reducing exotic invasive species from native natural communities, which has greatly reduced the occurrences of exotic invasive species. Restoration of areas that were historically disturbed such as the removal of fill piles or filling of excavated water bodies also has reduced the substrate available for exotic plant infestation. Management activities vary depending on the target species, but typically include mechanical removal, herbicide application, prescribed fire, hunts for exotic animals, or introduction of biological control methods.

## Exotic Species Summary

Exotic invasive species are a cause of extensive environmental damage to natural systems throughout south Florida. Exotic invasive species can displace or alter the composition of natural vegetation communities, change physical or ecological processes and nutrient availability, cause the death of native plant or animal species, and change conditions for the growth and reproduction of native plant or animal species. Management efforts can be both costly to implement and can cause unintended negative local effects on cultural resources or non-target species. The amount and density of exotic invasive plants varies based on disturbance and management history, with the larger monocultures occurring on vacant parcels, along the banks of the Old Tamiami Trail, and in areas with significant hydrological alteration.

Exotic invasive animals also occur within the ROGG Study Area, which can prey on native wildlife species, carry diseases that affect native species, displace native species, or alter vegetation communities through rooting or other soil disturbances. Some exotic invasive animals, including feral pigs and armadillos, serve as prey for Florida panthers. Management activities to control exotic invasive species are ongoing within the ROGG Study Area. Management activities vary depending on the target species, but typically include mechanical removal, herbicide application, prescribed fire, hunts for exotic animals, or introduction of biological control methods. Exotic invasive species influenced the analysis for the ROGG through evaluations of opportunities to route the trail through exotic invasive vegetation areas to remove those species and limit impacts to higher quality natural systems, the use of exotic species removal to mitigation for other natural resource impacts, and design options to minimize the introduction of exotic species as a result of ROGG through design, implementation, and long-term operations.

**Exotic Species - Relevance to ROGG:** The presence of exotic invasive species within the ROGG Study Area affected feasibility assessments for routing options, design of trail and trailhead facilities, and post-construction operation options. Specific influences on analysis for the ROGG included:

- **Trail Location** – Monocultures of exotic invasive plants occur on both previously filled areas and highly altered areas, such as the melaleuca stands south of U.S 41 near Krome Avenue. The presence of these monocultures does not limit trail routes for ROGG. In fact, trail routes that are extended through monocultures of exotic invasive plants may serve as a catalyst for removal and long-term management. Trail locations near high quality landscape features such as a bird rookery can serve as a corridor for exotic invasive animals to obtain access to those features. The feasibility study for ROGG incorporated a review of potential effects on desirable landscape features for use by exotic invasive species.
- **Mitigation** – The management plans for parks along the corridor place exotic invasive species control as a goal, which is often limited by sufficient funding to fully address the exotic invasive species. Exotic invasive plants occurring within road ROWs, other disturbed lands, or wetlands are a seed source for exotic plant invasion into adjacent natural areas. Control of exotic invasive plants in areas adjacent to high quality natural systems would remove seed sources. Similarly, control of exotic invasive plants within wetlands and/or other disturbed lands, especially when done in conjunction with a restoration plan to restore native biodiversity, would both enhance the function of the target systems as well as remove seed sources for adjacent lands. Both of these actions may serve as mitigation for natural resource impacts resulting from ROGG.
- **Facility Design and Implementation** – Disturbances in the landscape that result in exposed soils or new or expanded fill provide a substrate vulnerable to exotic plant invasion. Design options that minimize the establishment of these conditions during or after construction can limit the establishment of exotic invasive plants on the new trail facility. Boardwalks or other elevated structures that minimize ground disturbance or lessen the need for filled causeways limit the area available for exotic plant establishment. The use of appropriate landscape material, including native species, as a strategy for reducing the potential impacts from exotic invasive species was evaluated as elements affecting feasibility of the ROGG. Landscape materials of non-native plants will not be acceptable for ROGG. Similarly, species used in the landscape palette susceptible to exotic animals in the region such as plants in the laurel family should not be incorporated into the palette until issues associated with laurel wilt can be better understood and controlled. Incorporation of design elements that limit the effects from the use by exotic invasive animals were considered as part of the feasibility assessment.
- **Operations** – Exotic invasive plant species occur throughout the landscape and can invade areas that are disturbed for construction projects, such as a future ROGG segment. Maintenance activities to treat populations of exotic invasive species that arise within the ROGG corridor will be required for long-term operation of the system. Costs for this maintenance have been considered as part of the feasibility assessment. Management activities to control exotic invasive animal species will depend on actions in the adjacent natural lands and was not considered as a contributing factor for the feasibility of operation of the ROGG.

## Ecological Processes

Natural ecological processes interact with the physical environment to shape the landscape and the ecology of the species within that landscape. Processes such as the seasonal variation in freshwater inundation or tidal fluctuations cycle every year and may periodically drastically exceed normal conditions such as during a flood or storm surge. These periodic events can result in vegetation community alterations. Other processes such as tropical storms occur infrequently or irregularly and can have significant effects on ecosystem composition and function based on a one-time event. Others occur regularly such as fire, but may vary in intensity based on the conditions present (i.e. drought, high moisture levels). The process of succession interacts with each of these to modify the condition and composition of vegetation and wildlife communities over time. In south Florida, ecological processes with the strongest influences on the ecology of the region include fire, hydrology, wind, tidal influences, sea level rise, and succession.

### Fire

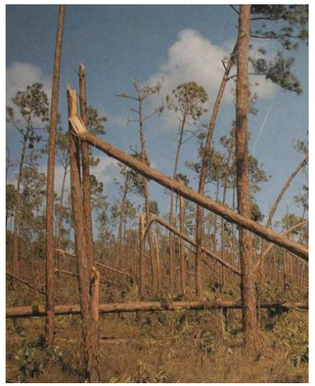
Fire is a defining ecological process for the composition and structure of vegetation communities of south Florida. Many of the vegetation communities within south Florida depend on frequent, generally low-intensity fires to sustain a diverse native herbaceous community, convert plant material to nutrients, or to stimulate renewed growth or reproduction. Other vegetation communities such as rockland hammock persist because of the preclusion of fire by natural or constructed barriers. Conversely, infrequent fires may affect the nature of the habitat because they allow the build-up of high fuel loads that can be vulnerable to a devastating fire, particularly during drought conditions. Periodic fires also prevent the encroachment of hardwoods into open systems. This encroachment can adversely affect habitat for a variety of wildlife species, including listed species such as the red-cochaded woodpecker and Cape Sable seaside sparrow.

Like other ecological processes affecting south Florida such as hydrology, the characteristics and patterns of fires have changed since drainage and development activities in the region expanded in the 20th century. Prior to the 1900s, fires ignited by lightning strikes or indigenous peoples burned across the wide areas of the landscape until the fires ran into natural barriers such as rivers, large near-permanently inundated strands or swamp forests, or areas with fuel loads insufficient to carry another fire.

Typically occurring during the summers when lightning from frequent thunderstorms was most common, fires would occur when soil moisture was generally high. This prevented fires from burning organic soils and confined fires to above-water vegetation. Fires during this time were generally frequent in marshes, wet prairies, and pinelands and low in intensity due to limited fuel accumulation, although periodically fires in drought periods could be substantially more intense. The construction of roads, levees, canals, and other structures added firebreaks to the region, lessening the scale at which fires typically burned. Hydrological changes exposed some areas of the Everglades to longer dry periods and/or reduced water levels, which led to increased occurrences of fires that consumed organic soils and damaged or killed the roots of plants.

Management practices in the early part of the century often focused on fire suppression, which resulted in the buildup of fuel loads within pyrogenic vegetation communities. When fire did occur, the additional fuel loads resulted in a more intense fire that killed otherwise fire-adapted plants leading to changes in community structure and succession. In recent decades, fire management programs have been adopted by the public landowners in the ROGG Study Area that have worked to reduce fuel loads and returned frequent fires to the landscape.

Big Cypress Natural Preserve Fire
Photo Credit: nps.gov



Pinelands after Hurricane Andrew
(NPS photo)

Water flow through an
Old Tamiami Trail breach

Tidally influenced wetlands
in Ten Thousand Islands NWR

Control structure between WCA3
and the L-29

Successionary growth of shrubs on the
banks of the Old Tamiami Trail



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## Hydrology

Hydrology as an ecological process is embedded within the description of the region's hydrology noted in Section 2.4 – Hydrology. This section provides both a history of hydrological alterations and a projection of the expected results of proposed restoration. The historical boundaries of vegetation communities were defined by the dynamic, but consistent sheetflow of water across the landscape. On a regional scale, this sheetflow of freshwater interacting with tidal pulses of saltwater or brackish water defined the boundary of coastal marshes and mangrove swamps. Locally, the boundaries of vegetation communities were strongly influenced by water depth, hydroperiod, and duration of drought. Individual plant species adapted to variation in water levels through a variety of mechanisms, including morphological adaptions such as cypress knees or mangrove prop roots, and reproduction cycles tied to seasonal water level fluctuations.

Similarly, native wildlife species adapted to the dynamic nature of hydrology in the region. For example, white ibis are highly nomadic and will fly en masse dozens of miles to take advantage of available prey exposed to precise conditions of inundation or saturation. The foraging behavior of white ibis and of all the other wading birds in south Florida are tied to the dynamic patterns of drought and inundation that drive community assemblages including invertebrate and vertebrate prey.

Although normal variation in hydrology was a primary influence on vegetation and wildlife of the region prior to regional alterations, extreme events such as floods or droughts also shaped the distribution of vegetation communities and wildlife behavior. While the wetland systems within south Florida generally accommodate freshwater flooding events where water levels exceed normal seasonal high levels, upland systems can experience modifications to understory vegetation composition and/or canopy tree survival depending on the length of time the flooding occurs. Flooding events that result from storm surges bring a combination of high water levels, exposure to salinity, and/or debris deposition that can kill species intolerant to those effects, including freshwater wetland species otherwise tolerant of high water levels alone. On the other end of the hydrological spectrum, drought conditions increase the potential for fires to burn through standing vegetation, leaf litter, and/or organic soils. Long-term drought conditions can result in transitions from wetter to drier vegetation communities as well as changes in plant physiology that make vegetation more susceptible to negative impacts of higher water levels when the water levels return.

The magnitude of alterations to hydrology in south Florida resulting from the extensive civil works program summarized in Sections 2.1 and 2.4 have changed unmistakably the patterns of flood and drought across the region, particularly in ENP. Regional hydrological alterations resulted in drought-like conditions in some portions of south Florida and longer, deeper inundation in others. These conditions became the new baseline condition upon which hydrologic processes affected the ecology of the region. Inundation levels continue to affect vegetative communities, prey availability, salinity levels and patterns of fire. Alterations to flow direction, duration and depth have substantially altered the juxtaposition and structure of natural communities across south Florida.

In some instances, hydrologic alterations have been exacerbated by other ecosystem drivers, such as concentration of nutrients. Increased inundation combined with elevated nutrient levels have changed vegetation and wildlife communities across the southern extent of the Everglades through modifications to periphyton and vascular plant composition across thousands of acres (e.g. sawgrass to cattail monocultures). Restoration activities to return water levels and inundation duration to conditions more consistent with historical hydrology are intended to redress much of the vegetation and wildlife changes that resulted from the regional hydrological alterations of the 20th century.

## Wind

While coastal breezes are common on a daily basis in south Florida, the effect of wind as a process affecting ecological resources is primarily from irregular events associated with tropical storms. Daily coastal breezes generally are mild in intensity, although these breezes can carry salt spray a short distance inland, thereby affecting growth forms and species composition for vegetation communities near brackish or salt waters. However, most south Florida systems are adapted to these periodic breezes. Strong winds associated with tropical storms occur over a relatively short period of time with high intensity. These strong winds have little effect on wet prairies and marshes, but can topple trees and shrubs within forested upland and wetland systems. Loss of canopy trees removes surfaces on which the abundant epiphytes of the region occur and/or as creates openings that can be occupied by exotic invasive species.

Downed material from tropical storm winds can also serve as fuel for more intensive fires, which can ultimately result in changes to community composition. The effects of strong winds can be magnified within linear corridors where the narrow openings in the canopy to accommodate the corridor channel wind energy into an area that exposes canopy trees in the central portions of forest stands to destructive winds that would have historically passed over a non-fragmented forest stand.

## Tidal Fluctuations

Daily tidal fluctuations coupled with levels of salinity are significant drivers in the type of coastal systems occurring within south Florida. The distinct zonation found within tidal marsh vegetation communities depends on the length and depth of daily tides and salinity levels. Mangroves occur on the margins of creeks and other open water bodies, including canals, within the ROGG Study Area. Historically, the broad sheetflow of water through the Everglades and Big Cypress intergraded with the tidal waters of bays of south Florida and established a wide area of brackish conditions. Channelization of this sheetflow into canals allowed more saline tidal waters to extend farther inland. Mangroves began to migrate up the margins of the canals subject to tidal influences to take up residence in areas that were generally freshwater systems prior to channelization. The construction of U.S. 41 changed the connection of tidal marshes north and south of U.S. 41 by limiting tidal waters to a few limited canals.

## Sea Level Rise

Due to flat topography, sea level rise has the potential to significantly affect the composition and distribution of many of the vegetation communities of south Florida. Since the formation of the Everglades more than 5,000 years ago, vegetation communities of south Florida have experienced rising sea levels, although the pace of the rise has varied over time. Slowly rising sea levels introduce tidal influences farther inland, which translates to broad areas in the flat topography of south Florida. As the tidal influences increase, transitions from freshwater systems to coastal systems to open estuarine systems occur. Slow increases in sea level historically allowed for vegetation communities to gradually shift across the landscape. The predicted rapid changes in sea level rise will likely devastate established communities as a result of alterations to tidal influences that occur more quickly than vegetation systems can adapt.

In recent years, the rate of sea level rise has increased. In December 2010, the Florida Oceans and Coastal Council produced a report entitled Climate Change and Sea-Level Rise in Florida. The opening paragraph of the Executive Summary states:

> "Sea level has risen slowly during the period of Florida's modern settlement. Over the course of centuries when sea level was stable by geologic standards, natural systems developed an intimate relationship with the land–sea boundary. Marshes and mangroves expanded to the very limit of their abilities; intertidal oyster reefs became closely calibrated to tides, and seagrass beds grew as deeply as light penetration allowed."

Based upon the most recent literature at the time of publication, the report documents the accelerated rate of sea-level rise in the past 20 years, and the ecological consequences of increased saltwater intrusion, higher storm surges, and vegetative community changes. Data from the Intergovernmental Panel on Climate Change (IPCC) were cited in the Report that project sea-level rise by 2100 to range from 1.5 feet to more than 3 feet. Under either scenario, the projections of heightened storm activity are pervasive. Various sources predict landward expansion of tidal communities, establishment of new areas of mangrove forests, and replacement of coastal communities with open water. These variations in the responses to sea-level rise depend on the physical conditions, tidal fluctuations and existing vegetative communities at particular locations along the south Florida coast.

## Succession

Ecological succession is an ongoing process whereby vegetation and wildlife communities change over time in response to both the presence and lack of disturbances. Ecological processes such as fire, hydrology, and tropical storm winds disturb the growth of or kill some or all of the species within a community, leaving open spaces or altered conditions favorable for species tolerant of those disturbances to occur. The lack of those disturbances allows more disturbance-intolerant species to grow and thrive, potentially displacing the disturbance-tolerant species over time. Some communities, such as the rockland hammock, are intolerant of fire and/or tropical storm wind events and revert to pine rocklands or other early successional communities when the rare disturbance occurs. Others, like hydric pine flatwoods or wet prairies, are maintained through frequent disturbance that allows the characteristic diversity of the system to be maintained. Disturbances caused by human action such as timber removal, agricultural conversion of land, or fill placement also cause changes to communities, although the resulting successional trajectories may differ from those of the native community that was displaced. These may result from introduction of exotic invasive species or through changes



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in the natural ecological processes. For example, fill of a roadway creates both a fire break and drier conditions that allow shrubs to grow more densely than in the adjacent communities.

**Ecological Processes - Relevance to ROGG:** The ecological processes along the ROGG Study Area affected feasibility assessments for routing options, configuration and materials for trail and trailhead facilities, and long-term maintenance requirements. Specific influences on analysis for the ROGG included:

- **Fire** – Fire management within the ROGG Study Area consists primarily of the application of prescribed fire and wildfire control. Prescribed fire is planned to occur in certain appropriate weather and moisture conditions, to minimize effects on structures, and with control personnel and equipment able to access the areas to be burned. Similar to prescribed fire, wildfire control efforts require access to the areas that are being burned, but that access may require additional or different types of equipment due to more variable fire and fuel conditions. Trail routes for ROGG through fire dependent habitats needed to limit or avoid the fragmentation of habitat that removed capacity to apply prescribed fire or control wildfire with typical fire control equipment. The materials for the trail also must be fire resistant when occurring within or adjacent to fire dependent habitats. To accommodate fire control efforts, the design of trails that occur within natural areas should provide suitable clearance or non-railed sections to allow for fire crews to access or evacuate over or under the trail. Trail maintenance should be conducted to limit the growth of shrubs or other aggregations of fuels that could burn over the trail facility.

- **Hydrology** – Extensive efforts to restore the hydrology of the Everglades and Big Cypress systems are underway. As part of the feasibility assessment, the effects of ROGG trail locations and design on regional efforts to restore hydrology was evaluated. All route locations and trail designs for ROGG that would compromise ongoing programs and projects to restore hydrology were determined to be infeasible. Post-restoration trail locations identified for CERP, CEPP, or other projects were identified as potential ROGG options, while options to use the design of ROGG to restore sheetflow downstream of U.S. 41 were also considered for feasibility. The design for the trail and trailhead facilities included provisions to address flooding from rainfall events and storm surge. The likelihood of water levels from higher elevation flood events covering the trail was assessed, although this option would require maintenance of the trail to remove mud or other flood debris following a flood event and/or access control measures during the flood event.

- **Wind** – Although trail locations under canopy trees are desirable for trail user comfort, the removal of trees to accommodate a trail corridor can cause gaps in the canopy that then become even more susceptible to tropical storm wind events. Locating the trail under canopy that does not require canopy tree removal was considered as part of the ROGG feasibility study. The future design of trail structures and trailhead facilities must meet appropriate codes for hurricane wind loads. Additional anchoring of boardwalks or other trail features that occur adjacent to canals was considered as part of the study to limit potential impacts to the loss of the structure control structures.

- **Sea Level Rise** – In addition to accommodating current and post-restoration hydrology, the design of trail facilities incorporated evaluations for the inundation levels, flood elevations, and tidal influences associated with the sea level under anticipated sea level rise models. This included evaluations for trail and trailhead base elevations, requirements to maintain positive drainage for stormwater systems, and higher storm surge and flood elevations.

- **Succession** – Elements to address management for succession included a management program to mow grassed banks and/or control shrub growth along fill sections following construction of the trail, use of previously altered sites that could benefit from planting to reset the succession trajectory and accommodation of fire management for adjacent fire dependent communities.

## Ecological Process Summary

Natural ecological processes interact with the physical environment to shape the landscape and the ecology of the species within that landscape. Processes such as the seasonal variation in freshwater inundation or tidal fluctuations cycle every year and may periodically drastically exceed normal conditions such as during a flood or storm surge. These periodic events can result in vegetation community alterations. Other processes such as tropical storms occur infrequently or irregularly, but can have significant effects on ecosystem composition and function as a result of catastrophic one-time events. Others occur regularly such as fire, but may vary in intensity based on the conditions present (i.e. drought, high moisture levels). The process of succession interacts with each of these to modify the condition and composition of vegetation and wildlife communities over time. In south Florida, ecological processes with the strongest influences on the ecology of the region include fire, hydrology, wind, tidal influences, sea level rise, and succession.

Specific influences on analysis for the ROGG relative to ecological processes included accommodating fire management through incorporation of fire-resistant materials and maintenance of access by appropriate trail design, reviewing ROGG compatibility with regional hydrological restoration projects, incorporating design options to address wind effects, assessing effects of sea level rise, and managing succession.

## Ecology Summary

The ecological resources of the ROGG Study Area provide both the impetus for establishing a regional greenway and the challenge of managing human access. These resources are uniquely adapted to the region's subtropical climate, geology and soils, and the overriding influence of water, but also extremely sensitive to perturbations caused by the presence and activity of humans who live, recreate, or visit within the systems. While the regional ecosystem provides a uniquely recognizable setting, a full appreciation for the ecological setting for the ROGG Study Area requires a more detailed review of specific elements, including vegetation communities, listed wildlife species, exotic species, wetlands, and ecological processes.

The ecological resources of the Everglades have experienced significant changes over the last century, yet are proving resilient after implementation of restoration efforts. Much of the Everglades is a near monotonous expanse of wet prairies dominated by sawgrass and dotted with tree islands, although ridge and slough landscapes add subtle diversity to the system. Regional drainage alterations have led to habitat changes and exotic/ invasive species encroachment, but restoration efforts targeted to restore appropriate hydrology promise possibilities of improved ecological function over time. Comprising the western 2/3 of the ROGG Study Area, the Big Cypress watershed exhibits similar ecological processes as the Everglades, but contrasts in ecological character and relative degree of alterations. The forested strands, sloughs, and prairies of the Big Cypress comprise one of the largest stands of interconnected cypress wetlands in Florida, and provide a home for rare and endangered species unique to North America. Although alterations in the hydrology of the Big Cypress occurred, the degree and intensity of these changes across the watershed were less concentrated than the levee and canal system through the Everglades.

### Natural Resource Regulatory Context

Impacts to natural resources in the study area would require authorization from several agencies having jurisdiction over wetlands and water bodies and protected wildlife and plant species. The review and authorization for proposed impacts would be coordinated through a variety of regulatory mechanisms, ranging from NEPA coordination to application and approval of various environmental permits. Construction of the ROGG may require coordination with the USACE, USFWS, EPA, SHPO, SFWMD, FDEP, FFWCC and MDRER to address natural resource issues.



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## 2.1.6 Public/Tribal Ownership

Landowners with large land holdings along the ROGG Study Area include the NPS, State of Florida through the Trustees of the Internal Improvement Trust Fund, SFWMD, Miccosukee Tribe of Indians of Florida, and USFWS. NPS owns and manages the ENP along the eastern end of the ROGG Study Area and the Big Cypress National Preserve in the central portion of the ROGG Study Area. The State of Florida ownership includes the Collier-Seminole State Park, Picayune Strand State Forest, and Fakahatchee Strand Preserve State Park that are managed through the FDEP Division of State Lands as well as the ROW for U.S. 41 that is managed through the FDOT. The SFWMD owns portions of WCA3 located on the eastern end of the alignment and the FFWCC manages portions of the WCA3 as the Frances S. Taylor Wildlife Management Area. The Miccosukee Tribe of Florida has a number of landholdings throughout the corridor. These holdings include trust lands such as the lands comprising the Miccosukee Indian Village as well as fee simple lands owned by the tribe, but not part of trust lands. The USFWS owns and manages the Ten Thousand Islands NWR located south of Fakahatchee Strand in the western portion of the ROGG Study Area as well as the Florida Panther NWR, which is located north of Fakahatchee Strand outside of the ROGG Study Area.

**Public/Tribal Ownership - Relevance to ROGG:** Public landholdings and their associated managing agencies within the ROGG Study Area maintain natural lands that could be accessible from ROGG, and they could serve as potential partners for the implementation of ROGG. On the other hand, routing ROGG through these landholdings will require extensive regulatory and public review. The lands held in public and tribal ownership within the ROGG Study Area affected feasibility assessments for routing options and regulatory review as well as opportunities for long-term partnerships for operation and maintenance. Specific influences on analyses for the ROGG included:

- **Potential Partnerships** – The public landholdings in the ROGG Study Area provide the landscapes, vistas, and facilities that are the reason for extensive visitation in the region. ROGG may serve as alternative facilities for the public to interact with the resources of the public landholdings, including potential pedestrian transportation corridors to reduce trips on U.S. 41. Public agencies are potential partners for the construction and maintenance of trail segments. These public agencies currently operate facilities such as the Shark Valley Visitor Center, Oasis Visitor Center, or the Collier-Seminole campground that could be incorporated into the trailhead and/or destination locations for the ROGG. Other facilities, such as the ORV trailheads for the Big Cypress National Preserve or the Fakahatchee Strand Preserve State Park visitor center, are planned for the corridor and these facilities would provide additional opportunities for shared amenities or trailheads at destinations for ROGG.

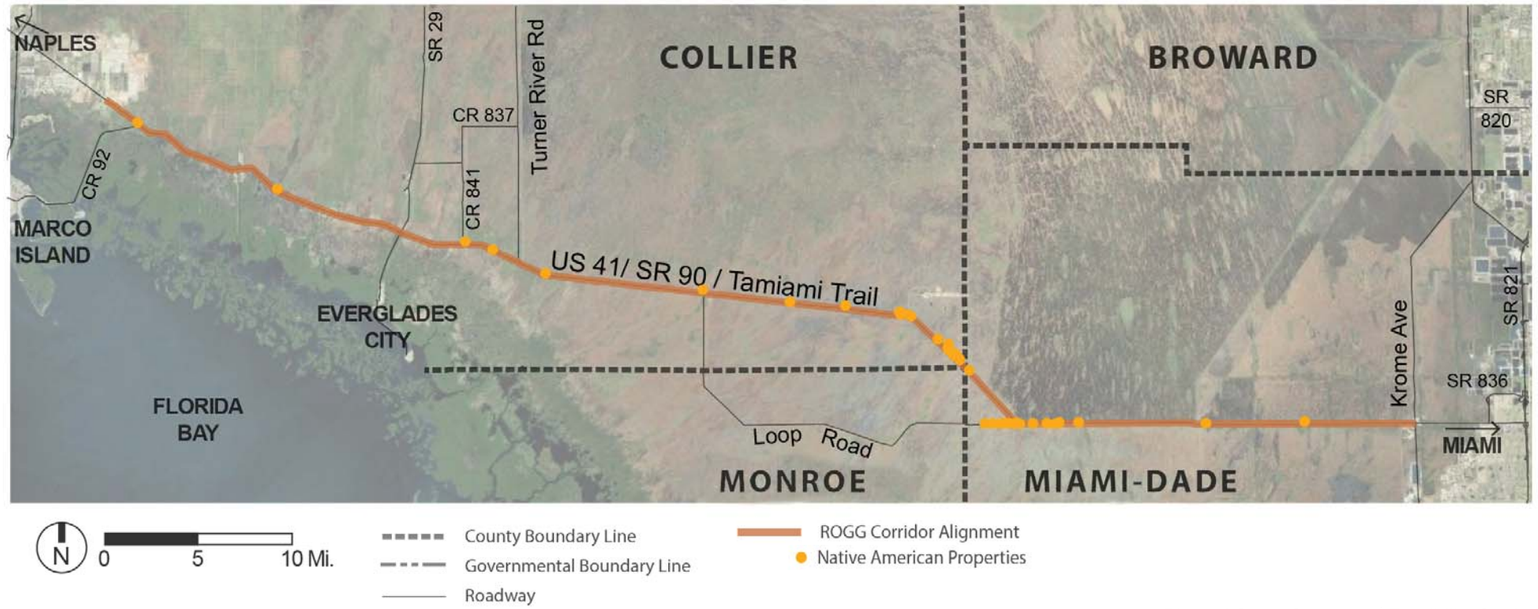
- **Regulatory Review** - Natural and cultural resources within public lands are both the attraction for visitors to the region and the primary responsibility of public landowners. Potential impacts to these resources will be subject to extensive public scrutiny due both to the aesthetic and natural resource values for which the land was initially acquired. In addition, potential impacts to these resources will be subject to extensive regulatory review, including NEPA coordination and permitting with local, state, and federal agencies for stormwater, wetlands, and listed species. These regulatory reviews will include extensive public involvement and comment on proposed activities, especially within federally owned lands. Proposed ROGG activities will also need to be incorporated into management plans for each of the public tracts as allowed uses over the management period covered by the plans.

- **Tribal Landholdings** – Tribal landholdings within the ROGG Study Area include trust lands and fee-simple (or similar) non-trust landholdings by the Miccosukee Tribe of Indians of Florida and Seminole Tribe of Florida. Trust lands that are part of the reservation lands for the Miccosukee Tribe of Indians of Florida include: an approximately 33 acre area around the Miccosukee Indian Village, parcels on the north side of U.S. 41 used for commercial purposes, and parcels at Krome Avenue and U.S. 41 associated with the casino and tobacco shop. As part of their self-government powers as a sovereign nation, the tribe licenses and regulates activities within their trust lands. This includes the capacity to exclude persons from tribal lands. The Tribe and/or members of the Tribe own other non-trust landholdings through fee-simple title within the ROGG Study Area. These lands are similar to other privately owned property in the corridor as they are subject to state and local regulations, codes, and taxation. The location of any part of ROGG within trust lands would require approval from the Tribe and Bureau of Indian Affairs, and would require additional coordination efforts to implement if considered suitable by the Tribe. The presence of trust lands could provide opportunities for ROGG users to utilize commercial enterprises of the Tribe as well as to learn about the cultural heritage of the Miccosukees in south Florida.

### Public/Tribal Ownership Summary

Landowners with large land holdings along the ROGG Study Area include the NPS, State of Florida through the Trustees of the Internal Improvement Trust Fund, SFWMD, Miccosukee Tribe of Indians of Florida, and USFWS. Public landholdings and their associated managing agencies within the ROGG Study Area maintain natural lands that could be accessible from ROGG, and they could serve as potential partners for the implementation of ROGG. On the other hand, routing ROGG through these landholdings will require extensive regulatory and public review. The lands held in public and tribal ownership within the ROGG Study Area affected feasibility assessments for routing options and regulatory review as well as opportunities for long-term partnerships for operation and maintenance. Specific influences on analyses for the ROGG included an assessment of potential partnerships, regulatory review from facilities that would occur in these ownerships, and requirements associated with tribal holdings.

Native American Properties within 1 mile of U.S. 41 corridor



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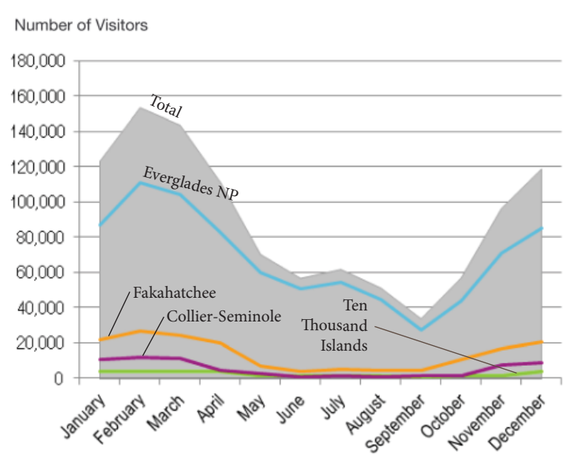
## 2.1.7 Transportation

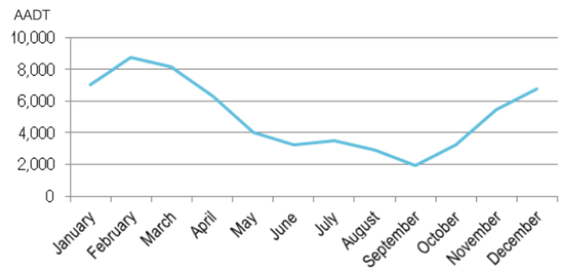
The U.S. 41 corridor is an important connection between the east and west coasts of South Florida. From the time of its initial construction until 1969, U.S. 41 was the only corridor for motorized vehicular traffic traversing the Everglades and Big Cypress. In 1969, I-75 was constructed through the northern portion of the Big Cypress and WCA3 to provide a limited access road between the east and west coasts of south Florida. While no longer used as the primary travel corridor between the urban areas of Naples and Miami, U.S. 41 is a significant corridor for access and scenic enjoyment parks, preserves, and other conservation lands of the region as well as access for tribal lands and individual parcel owners along the roadway.

Visitation rates for parks within the corridor vary seasonally, but are a significant component of the motorized vehicular traffic trips on U.S. 41. For four of the parks within the ROGG Study Area (ENP, Ten Thousand Islands NWR, Fakahatchee Strand Preserve State Park, and Collier-Seminole State Park) for which monthly visitation data is available. Total visitation per month averages approximately 90,000 per month with visitation to the ENP comprising a significant portion of this visitation **(Graph 1)**. This average varies greatly over the course of the year. Total visitation rates during the peak visitation period in February were more than 150,000 people per month while visitation rates in late summer (September) were fewer than 35,000 visitors per month. Visitation rates for the Big Cypress National Preserve are tracked on an annual basis, but observations from park staff indicates similar seasonal visitation patterns. Traffic counts for U.S. 41 exhibit similar seasonal fluctuations as the visitation rates, although generally the roadway meets a high level of service level under FDOT classifications. Measured by dividing the total annual volume of vehicle traffic by 365, the Annual Average Daily Traffic (AADT) metric is a relatively common measure for estimating how busy a roadway is. Based on data provided by FDOT for traffic in 2012, U.S. 41 within the ROGG Study Area averages approximately 5,000 vehicles per day. However, the utility of this measurement is limited in areas with extreme seasonal fluctuations in traffic.

**Graph1** : Estimated Visitors by Month, 2012




**Graph 2** : Estimated AADT by Month, 2012




Estimations of AADT on a month-by-month basis indicates that traffic averages approximately 9,000 vehicles per day during peak season, while traffic in the month with the lowest total visitation averages approximately 2,000 vehicles per day **(Graph 2)**. In addition, large motorized vehicle traffic, truck traffic, averages about 11.6% of total AADT which is higher than the 6-8% levels typically found on U.S. 41 each of SW 157th Ave./ Krome Ave. in Miami-Dade County. The average daily volume of vehicles for U.S. 41 is generally below the minimum service capacity of 7,800 vehicles per day for a two lane, undivided rural road facility. This would indicate the road is generally not congested on an average operating basis (Level of Service A). However, vehicle use during seasonal peaks reduces the Level of Service to a B level, indicating a slightly lower satisfaction level for travelers. Roadway Level of Service is a quantitative stratification of quality of service that measures by a scale of user satisfaction from A through F, with A being the best and F being the worst. Under most circumstances, the maximum service volume for Level of Service D equals the roadway's capacity.

In addition to traffic volume, other factors such as parking facilities and speed limits affect motorized vehicular traffic and access along U.S. 41. Defined parking facilities are limited in size at most destinations and non-existent outside of potential destination locations and can overflow into the ROW during heavy visitation periods. For instance, visitors park their cars in long lines along U.S. 41 outside of the access gate to Shark Valley Visitor Use Area in ENP during event days and/or high visitation seasons since the parking lots for the facility can rapidly fill up. Even when lots are not full, many visitors park along the edge of the road so they can access Shark Valley to walk, view wildlife, bicycle or take a tram tour on the 15-mile loop. Similarly, the use of the ROW for temporary parking to access fishing locations, hunting locations, or scenic views is common along U.S. 41 throughout the ROGG Study Area. Finally, the posted daytime speed limit varies through the corridor from 45 mph to 60 mph, with some areas limiting speeds during night-time to 45 mph, though anecdotal evidence indicates that many motorists exceed the posted speed limit throughout the corridor. High posted speed limits coupled with vehicles exceeding speed limits provides potential conflicts between vehicles and non-motorized use of the corridor by pedestrians and bicyclists.

The ROGG Study Area is currently not served by transit, although a new system that is being initiated by the City of Homestead to access ENP may serve as a model for future transit servicing park destinations in the future. The closest current transit routes within Miami-Dade County extend to SW 137th Avenue and U.S. 41, which is approximately four miles east of the eastern terminus of the ROGG Study Area at Krome Avenue. The closest current transit route within Collier County extends to the Big Cypress Flea Market, which is approximately one and half miles from the western terminus of the ROGG Study Area. A new transit service is currently being developed to provide transit access to portions of the ENP outside of the ROGG Study Area. Based on city approvals in August 2013, the City of Homestead is initiating a free trolley service that in anticipated to extend from downtown Homestead to the ENP Visitor Center and Anhinga Trail and the Biscayne National Park Visitor Center. The routes are currently being developed in coordination between the City of Homestead, National Parks Conservation Association, national parks staff, and community stakeholders.

Bicycling is an activity that occurs regularly within the ROGG Study Area, primarily as a shared-road facility, although there are some limited facilities to accommodate bicycling separate from the U.S. 41 roadway and vehicular traffic. Residents of communities and/or individual parcels in the ROGG Study Area bicycle along roads for recreation and access to jobs or other daily activities. Typically, this bicycle access occurs on the narrow shoulders of the roadways, although bridge crossings can restrict bicycle access to the roadway lanes due to narrow bridge widths. Separation between bicyclists and vehicles on these roads is limited due to the narrow width of road shoulders, typically 2 to 8 feet, and the lack of bicycle lanes or other separated facilities. Off-road bicycle access is available on the levees on the eastern side of the ROGG Study Area, the tram road within the Shark Valley Visitor Use Area, and other trails within parks and preserves in the corridor. The recently constructed one mile long bridge for U.S. 41 near Shark Valley did not include separated bike lanes but did include a ten foot wide paved curb lane or shoulder that cyclists could use. Long distance cycling through the corridor currently requires the use of the road lanes or shoulder as a shared-road facility where motorized vehicles share the road with cyclists.

Bicycle and pedestrian access within the corridor is common around destination locations, temporary stops for scenic views, and/or daily travel in the corridor. The majority of the ROGG Study Area has limited available facilities to separate pedestrians from motorized vehicular traffic. Destination locations such as Shark Valley Visitor Use Area and Oasis Visitor Center provide boardwalks, trails, or other locations for pedestrians to interact or view natural resources and scenery, but often also serve as origination points for pedestrians to walk along the shoulders of roads by the destination.

The Florida National Scenic Trail provides a north-south pedestrian trail in the vicinity of the Oasis Visitor Center. When travelers park on the shoulder of the roads, pedestrians move along the roads either on shoulders or on the margin of travel lanes as there are no sidewalks or other separated pedestrian facilities along the roads consistent with the rural nature of the area. Levees in the eastern portion of the ROGG Study Area are open for pedestrian travel, although these areas have limited shade or potable water availability. Long-distance pedestrian routes for hiking or travel from east to west within the ROGG Study Area currently occurs almost exclusively along the U.S. 41 road corridor.

**Transportation - Relevance to ROGG:** The transportation characteristics and options within the ROGG Study Area provide the context for standards and requirements for future ROGG facilities for safe pedestrian, bicyclist, transit, and motorized vehicular access. They affect feasibility assessments for routing options, design requirements, and coordinated uses that would benefit potential ROGG users. Specific influences on analysis for the ROGG included:

- **Motorized Vehicular Traffic** – Although U.S. 41 generally has a good level of service for vehicles, the speed of vehicles and variable traffic volumes pose



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a constraint to use of the existing narrow shoulder and maintained ROW by pedestrians and bicyclists. Generally, routes for ROGG that occur on or adjacent to the shoulder of the road increase potential conflict between ROGG users and motorized vehicular traffic versus routes that are separated from the road. The increased vigilance required by trail users for vehicles for trail routes that occur on or adjacent to the maintained ROW may also lessen the experience of trail use as opposed to the trail experience for separated facilities. Efforts to enhance compatibility of motorized vehicular traffic with bicycle and pedestrian use in the maintained ROW, such as lowering speed limits, would likely be subject to intense public scrutiny, while other safety features like audible and vibratory pavement markings have already been implemented by FDOT on portions of U.S. 41 and accepted by the general public.

- **ROW Parking** – Parking within the ROW of U.S. 41 throughout the corridor affects potential options for routing as well as the design of future ROGG facilities within the maintained ROW of U.S. 41. Pull-off parking along many stretches of the U.S. 41 corridor have occurred for many years and are part of the cultural appeal for travelers along the corridor. Pull-off parking within the maintained ROW provides potential conflict points with ROGG routes that occur on or adjacent to the road shoulder throughout the corridors. These conflict points include both traffic movements during the parking process that would require vehicles to cross the ROGG trail and potentially interact with pedestrians using ROGG or the physical blocking of the ROGG through the placement of a parked vehicle.

Within areas where the maintained ROW is constrained in size by bridges, guardrails, or other features, the physical impediment of a parked vehicle in the ROW may require bicycle and pedestrian users to route into the road travel lane or require crossing of a guardrail. Accommodations for vehicles crossing the ROGG trail should be incorporated in design of the future trail. Options to separate ROGG facilities from parking areas through either spatial or structural separation would decrease conflict points between ROGG and vehicles seeking to park on the U.S. 41 ROW. However, defined parking areas on or adjacent to the ROW and/or structural elements that would separate ROGG trail users from motorized vehicular traffic that also limit the ability to park in the ROW would likely be subject to intense public debate.

- **Bridges** – Existing short bridges for U.S. 41 constrain bicycle and pedestrian use along maintained ROW because of narrow pavement widths and reflector requirements leading to and from the bridge. The narrow pavement widths compress the space available for bicyclists and pedestrians to pass by bridges without moving into the travel lane. In addition, reflectors that enhance the striping pattern to provide visual cues to vehicles approaching these bridges can provide a rough surface for bicyclists. Solutions to address these constraints were incorporated into the feasibility assessment for ROGG. The recently constructed one-mile long bridge for U.S. 41 east of Shark Valley did not include a designated bike lane, but does include a paved shoulder for bicycle travel consistent with FDOT's Plans Preparation Manual (PPM) Chapter 8 for rural roadways. Options to add lanes or trail facilities to the new bridges would best be accomplished during planning and design of the facilities prior to construction, but could be added after construction of the bridge is complete. The effects of these different options for providing bicycle and pedestrian facilities over new bridges were considered as part of the feasibility assessment for ROGG.

- **Transit** – Although no transit currently occurs within the corridor, connections to points with the potential to be served by transit are important considerations for future ROGG facilities. ROGG facilities may serve as connections to increase access for pedestrians or bicyclists between transit stops and destination locations or as the main transit stop. Design considerations that accommodate transit access to trailheads were considered as part of the feasibility assessment.

The City of Homestead has initiated trolley service from the City's historic downtown district to ENP and in the future to Biscayne National Park. This service is offered free of charge and operates on weekends during the winter peak tourism season from November to May. Destinations within Everglades National Park include the Ernest Coe Visitor Center and Anhinga Trail. Neither of these destinations are within the ROGG Study Area but could serve as a potential model for the ROGG corridor. The origination point in downtown Homestead will be accessible via Miami-Dade County Public Transportation routes. Funding for this program includes federal grants for four trolleys and the Miami-Dade County People Transportation Plan half penny sales tax.

- **Design Considerations** - The design of trail systems on or in the vicinity of road ROWs are required to meet a variety of design and regulatory requirements, such as the FDOT Plans and Preparations Manual and the FDOT Design Standards. For ROGG, design of the future trail components would need to be consistent with FDOT and FHWA standards, such as the minimum five foot wide separation between the outside edge of a road shoulder and the inside edge of a shared use path. In addition, ROGG trail components would need to meet the requirements for bike routes set out in the American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities.

## Transportation Summary

The U.S. 41 corridor is an important connection between the east and west coasts of South Florida. While no longer used as the primary travel corridor between the dense urban areas of Naples and Miami, U.S. 41 is a significant corridor for access and scenic enjoyment of parks, preserves, and other conservation lands of the region as well as access for tribal lands and individual parcel owners along the roadway. Visitation rates for parks within the corridor vary seasonally, but are a significant component of the motorized vehicular traffic trips on U.S. 41. Traffic counts for U.S. 41 exhibit seasonal fluctuations similar to the visitation rates for the parks, although generally the roadway meets a high level of service level under FDOT classifications. Estimations of AADT on a month-by-month basis indicates that traffic averages approximately 9,000 vehicles per day during the busiest visitation month, while traffic in the month with the lowest total visitation averages approximately 2,000 vehicles per day. The average daily volume of vehicles for U.S. 41 is generally below the minimum service capacity of 7,800 vehicles per day for a two lane, undivided rural road facility (Level of Service A), although vehicle use during seasonal peaks meets the Level of Service B level for this type of roadway.

The posted daytime speed limit varies through the corridor, though anecdotal evidence indicates that many motorists exceed the posted speed limit throughout the corridor. Defined parking facilities are limited in size at most destinations and non-existent outside of potential destination locations and can overflow into the ROW during heavy visitation periods. Similarly, the use of the ROW for temporary parking to access fishing locations, hunting locations, or scenic views is common along U.S. 41. Considerations for motorized vehicular traffic relevant to ROGG include the influence of the volume of traffic using U.S. 41 as well as the speed of traffic for trail experience and safety, the potential location of the trail relative to traffic lanes, modifications to road design or speed limits that would be subject to intense public scrutiny, limited availability of defined parking facilities, and accommodations for temporary parking in the ROW on future ROGG uses.

Non-motorized transportation currently occurs along U.S. 41, although defined facilities to accommodate these users are limited to non-existent. The ROGG Study Area is currently not served by transit, although a new system that is being initiated by the City of Homestead to serve the ENP may serve as a model for future transit servicing park destinations in the future. The closest current transit routes occur approximately four miles from the eastern terminus of the ROGG Study Area and approximately one and half miles from the western terminus of the ROGG Study Area. Bicycling is an activity that occurs regularly within the ROGG Study Area, although there are limited facilities to accommodate bicycling separate from the U.S. 41 roadway and motorized vehicular traffic, especially for long distance cycling.

Pedestrian access within the corridor is common around destination locations, temporary stops for scenic views, and/or daily travel in the corridor, although the majority of the ROGG Study Area has limited available facilities to separate pedestrians from motorized vehicular traffic. Long-distance pedestrian routes for hiking or travel from east to west within the ROGG Study Area currently occurs almost exclusively along the U.S. 41 road corridor. Considerations for non-motorized vehicular transportation within the ROGG Study Area included evaluations of current and future facilities on existing and proposed bridges for U.S. 41, options for transit connections, and accommodations or facilities to separate motorized vehicular and non-motorized users.