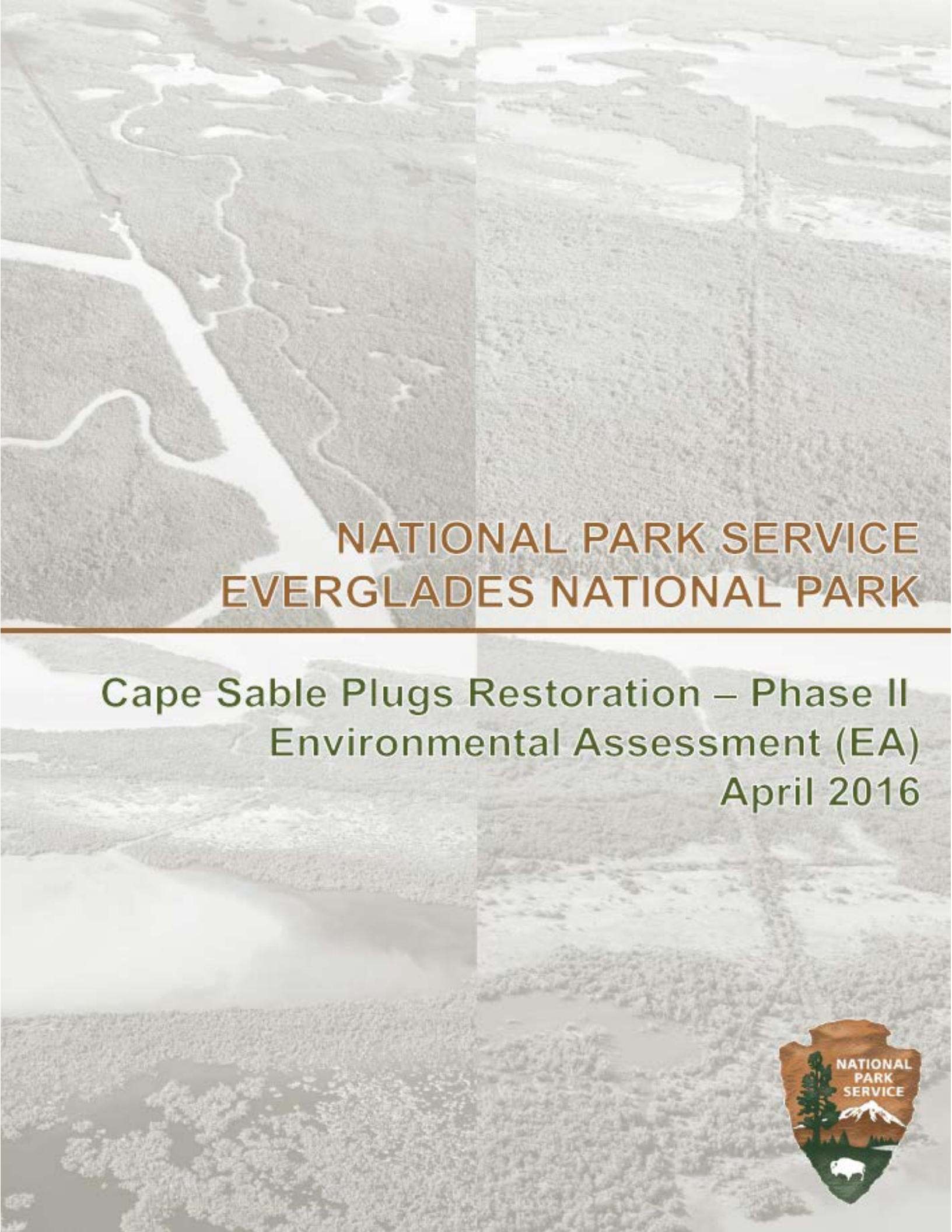

NATIONAL PARK SERVICE
EVERGLADES NATIONAL PARK

Cape Sable Plugs Restoration – Phase II
Environmental Assessment (EA)
April 2016

EXECUTIVE SUMMARY

The National Park Service (NPS) proposes to repair the plugs on House and Slagle Ditches and replace the failed Raulerson Canal plug within the Cape Sable area of Everglades National Park (EVER). This project is intended to reestablish the natural function of the marl ridge and restore natural ecological processes to the Cape Sable region by eliminating the unnatural exchange of salt and freshwater through man-made canals.

The Cape Sable region extends from the southwestern tip of Florida, into the Gulf of Mexico and Florida Bay. The cape contains stretches of shell beaches fringed by a mix of mangrove trees and marsh. Beyond the mangroves lies Lake Ingraham, the largest of the cape's lakes. The lake is backed by a narrow marl ridge that shelters the cape's numerous interior wetlands.

In the early 20th century, a network of canals was dredged through the marl ridge to drain the cape's interior wetlands for use in agriculture and cattle grazing. These man-made canals have triggered substantial changes in the ecology of the area. Incoming tides now push marine waters and sediments inland, increasing salinity and transporting sediments to lakes and wetlands. Outgoing tides flush freshwater from wetlands north of the marl ridge and transport sediments toward Lake Ingraham and Florida Bay.

As a result, the previously freshwater and brackish ecosystems of Cape Sable have experienced substantial change from exposure to the saltwater. The incursion of saltwater into formally freshwater marsh systems as the result of man-made connections between fresh and saltwater habitats led to an ecological collapse of these wetlands (Wanless and Vlaswinkel 2005). Soil has been lost from the interior wetlands communities of Cape Sable and has been replaced by open water and more saline communities. The unnatural exchange of water through the canals has altered vegetation communities, reduced the quality of wildlife habitat, and lowered the productivity of forage fishes, potentially impacting the survival of various wading birds. These changes are compromising the function of coastal habitats that are important to recreational fish, and other plants and animals dependent on the cape for survival.

The NPS has long recognized the importance of addressing impacts from the Cape Sable canals. During the late 1950s and early 1960s, the NPS plugged the canals at the marl ridge with earthen plugs. However, over time all of the earthen plugs have either been breached or severely compromised by the forces of weathering and/or erosion. The constant movement of water through man-made canals on the cape has led to their rapid widening. The expansion of these canals has exacerbated sediment deposition in the cape's open waters and is converting Lake Ingraham into a tidal mud flat. As the canals on Cape Sable continue to widen, it is believed the rate of change will continue to accelerate, emphasizing the need for timely corrective action. The Homestead and East Cape Canals were re-plugged in 2010-2011 with 100-foot earthen plugs, which are intended to have structural longevity for at least 50 years.

Stopping the unnatural exchange of water through the man-made waterways is key to stabilizing the natural function of the interior wetlands. While this landscape is naturally dynamic, slowing the rate of human-induced change on this landscape may also bring about greater resilience to the cape in the face of predicted sea level rise and the possibility of more frequent and intense hurricanes.

Thus, based on preliminary analysis, internal scoping, and public input, the NPS developed a range of new design alternatives to either repair or replace the existing plugs at the House and Slagle Ditches and the failed plug at Raulerson Canal. Each alternative design also considers the need for structural longevity (at least 50 years). Two action alternatives for the House and Slagle

ditches and two action alternatives for the Raulerson canal were carried forward for analysis in this EA along with the no action alternatives for both plug sites:

House and Slagle Ditches Plugs Restoration Alternatives

Alternative 1: No Action
The No Action Alternative involves leaving House and Slagle Ditches in their current conditions and would allow the existing plugs to continue to be exposed to the current and potential future erosional processes. Eventually, the plugs would become breached and tidal flows would be capable of propagating north past the Old Ingraham Highway (also known as the Coastal Prairie Trail or the Coastal Prairie Highway) to EVER's interior wetlands. Currently, erosion is evident at the House and Slagle Ditches plug sites on the north side and is expected to continue.

Action Alternative 2: Re-Backfill Eroded Plug Areas
Alternative 2 involves re-backfilling the eroded plug areas with a course grade limestone and rock fill containing silty binder-type fines. Alternative 2 would essentially restore the plugs at the existing locations on House and Slagle Ditches. This alternative would minimize the amount of backfill material needed to conduct the restoration work and would consequently minimize costs as well.

It is anticipated that locally available limerock fill, typical of that used for roadway base material in South Florida, would be used as backfill in the eroded areas of the plugs. The backfill would be placed in sufficient quantities to re-construct the original plugs' cross-section, keeping them consistent with the adjacent slopes and elevation/ grades.

It is estimated that the width of the ditch/plug was initially approximately 18 feet and it was adequate to initially function as a narrow inland roadway. The roadway served the movement of vehicles and equipment deep into the backcountry and inland Cape Sable wetlands along what is now termed as the Old Ingraham Trail. Based on field observations, it appears that a coarser well-graded sand and gravel mixture was used to initially construct the plug. The current surface of the plug is dense, hard, and likely well compacted due to its early use as a roadway.

Action Alternatives 3: Re-Backfill Eroded Plug Areas, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection
Alternative 3 is an expanded variation of Alternative 2, which re-establishes the plug sections at their existing locations, and includes slope and erosion protection measures as well as a geotextile fabric-wrapped sand drain for seepage protection. Sand drains consist of a boring through the silt that is filled with sand (or gravel) to allow the soil to drain; sand drains are helpful to accelerate the process of consolidation settlement of the plugs.

In addition to backfilling the eroded plug areas, the slopes of the repaired plug and a few feet each side thereof would be covered with a geotextile fabric, and would include a geotextile fabric-wrapped sand drain. In order to mitigate against future erosion at the existing plug locations, the geotextile slopes and drain would be covered with erosion protection. A gravel-filled geoweb system would allow for future re-growth of vegetation through the geoweb matrix. A slotted PVC drainpipe would be inserted into the sand drain material to collect and discharge any seepage water that would pass through the plug fill and enter the drain.

Such an application could potentially be expanded to a larger slope area along each plug face in the immediate ditch and adjacent areas. However, given the apparent long-term stable conditions of the adjacent slope areas and considering that such an enlargement would require

more material be delivered to the remote site, it appears that the cost benefit of expanding this alternative may not be warranted at this time. Therefore, the enlargement aspect of this alternative will not be carried forward for further analysis.

Raulerson Canal Plug Replacement Alternatives

Alternative 1: No Action
The No Action Alternative involves taking no action and allowing Raulerson Canal to continue to function in its current state. Leaving the failed plug in its existing condition would allow the canal to continue to erode, widen, and transport suspended sediment to the interior wetlands as well as to Florida Bay and the Gulf of Mexico.

Action Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection
This alternative involves constructing a canal plug cut off comprised of cross-canal steel sheet piling with sheet pile-protected canal banks that considers a safety factor. The design would use parallel back-to-back cross-tied sheet pile cross walls and a riprap system to protect the side slopes and perimeter area from erosion relating to flanking tidal flows. This design has proven to be effective and stable at East Cape Canal. This plug would be constructed starting at the western edge of the canal (where it turns south) and extend 100 feet inland, in an easterly direction.

This alternative includes the construction of an earthen plug by installing two sheetpile walls - one upstream and one downstream within the canal. In order to reduce the erosional energy forces associated with the seasonal overtopping events, the sheetpile wall design includes placement 25 feet from the edge of the canal bank as a safety factor. Therefore, the sheetpile walls would have a 25-foot margin of error on either side of the canal. These walls would be placed approximately 100 feet apart.

The area between the two walls would be filled with sand that would be pumped in. The top of the plug surface would be covered by geotextile fabric and then a hard surface (or similar) to minimize potential erosion. The exact design of surface cover material would be determined during the final design phase of the project; it will consider surfaces that would promote and support vegetation across the entire structure while still providing sufficient erosion protection.

The fill material would likely originate from a permitted fill source outside the park and would be transported from a barge located in Lake Ingraham or from a location within the canal, closer to the plug site. The sheetpile would be installed in all four quadrants of the plug to form flow deflector wingwalls. This design would also promote surface sheetflow away from the plug structures and thus prevent seepage and tunneling through the marl ridge. Additionally, fill material would be placed adjacent to each sheetpile wall (2.5:1 slope from the sheetpile to the ground on the north side) to substantially increase the lateral support for the plugs. Graded riprap (or similar material) would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion protection.

The design of this alternative has been tested and proven functional at two nearby waterways, also located in the Cape Sable region. The failed plugs on the Homestead and East Cape Canals were recently replaced in 2010 through 2011. These structures were designed to last 50 years under normal overtopping events. Since construction has been completed, the unnatural exchange of salt and freshwater through the canals has been substantially reduced allowing

more natural influences on the interior wetlands of Cape Sable while also addressing safety and illegal access issues (URS 2012).

Action Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
This alternative is similar to Alternative 4A with an additional option of constructing a safe passage over the restored plug for non-motorized boaters (i.e., canoeists and kayakers). All other construction features would be similar to Alternative 4A.

The plug would include an engineering component to provide safe passage over the restored plug for non-motorized boaters. To provide safe portage, a floating dock structure (approximately 10-feet by 10-feet) would be constructed in the center of each plug entrance. The dock would be constructed using a wood-plastic composite lumber composed of wood and recycled plastics. The dock structure would be constructed so that a portion of the structure would extend over the water. A ladder would be placed on each dock to allow for access. A hardened path would be installed across the proposed plug using articulated block riprap (i.e., interlocking mats or equivalent) to provide safe and sustainable passage across the plug.

Environmental Preferable Alternatives and NPS Preferred Alternatives

Alternative 2, Re-backfill Eroded Plug Area, is the environmentally preferable alternative and the NPS preferred alternative at Slagle and House Ditches. At Slagle Ditch, the NPS would repair the eroded plug which is currently leaking and considered to be near failure. At House Ditch, the NPS would monitor the condition of the plug, and should it begin leaking, repair it with the same means and methods used at Slagle Ditch.

Alternative 4A, Construct a New Sheet Pile and Fill Plug with Erosion Protection, is the environmentally preferable alternative and the NPS preferred alternative at the Raulerson Canal.

Environmental Consequences

The following table presents some of the main conclusions of the environmental consequences of the alternatives, focusing on the most important long-term adverse and beneficial effects. This table does not address short-term or temporary impacts; please see the full impact analysis in "Chapter 3: Affected Environment and Environmental Consequences," for a complete representation of the environmental impacts. Table 2.6 in Chapter 2 presents a Summary of the Impacts of the Alternatives.

Table E.1 – Long-Term Environmental Impact Intensity Summary

Impact Topic	**Alternative 1:** No Action Alternative	**Alternative 2:** Re-Backfill Eroded Plug Areas at House and Slagle Ditches	**Alternative 3:** Re-Backfill Eroded Plug Areas, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection at House and Slagle Ditches	**Alternatives 4A and 4B:** Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection at Raulerson Canal (4A) with an Option for a Canoe Ramp (4B)
Geology, Topography, and Soils	Moderate to major adverse to soils Negligible to geology and topography	Beneficial	Beneficial	Beneficial
Hydrology	Moderate to major adverse	Beneficial	Beneficial	Beneficial
Water Quality	Moderate to major adverse	Beneficial	Beneficial	Beneficial
Vegetation and Wetlands	Moderate to major adverse	Beneficial	Beneficial	Beneficial
Wildlife and Habitat	Minor to moderate adverse	Beneficial	Beneficial	Beneficial
Marine Resources and Essential Fish Habitat	Minor to moderate adverse	Beneficial	Beneficial	Beneficial
Special Status Species	Minor to moderate adverse	Beneficial	Beneficial	Beneficial

Impact Topic	**Alternative 1:** No Action Alternative	**Alternative 2:** Re-Backfill Eroded Plug Areas at House and Slagle Ditches	**Alternative 3:** Re-Backfill Eroded Plug Areas, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection at House and Slagle Ditches	**Alternatives 4A and 4B:** Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection at Raulerson Canal (4A) with an Option for a Canoe Ramp (4B)
Wilderness	Negligible to untrammeled and undeveloped Minor adverse to the solitude or primitive recreation quality Moderate to major adverse to natural quality	Minor adverse to untrammeled, undeveloped, and solitude or primitive and unconfined recreation quality Beneficial to the natural quality	Minor adverse to untrammeled and solitude or primitive and unconfined recreation quality Highly localized minor to moderate adverse impacts to the undeveloped quality Beneficial to the natural quality	Minor adverse to untrammeled, Beneficial to the natural quality Alt4A –Localized moderate adverse to undeveloped and minor adverse to the solitude or primitive and unconfined recreation quality Alt 4B – Localized moderate impacts to undeveloped and minor to moderate to solitude or primitive and unconfined recreation quality Beneficial to the natural quality
Cultural Resources	Minor to moderate adverse	Beneficial	Beneficial	Beneficial
Visitor Use and Experience	Moderate adverse	Beneficial	Beneficial	Beneficial
Park Management and Operations	Minor adverse	Beneficial	Beneficial	Beneficial

Public Review and Comment

This EA will be available for public review for 30 days. If you wish to comment, you are encouraged to submit your comments directly through the NPS Planning, Environment, and Public Comment (PEPC) website: http://parkplanning.nps.gov. Select "Everglades National Park" from the drop down box, and follow the links for the Cape Sable Canals Plug Restoration Project – Phase II/EA. The "Open for Public Comment" link on the left column provides access to the EA.

Alternatively, you may also contact the park at (305) 242-7700 to request a CD of the EA. Another option is to mail comments to the name and address provided below:

Please mail your written comments to:
South Florida Natural Resources Center
Everglades National Park
Attn: Amy Renshaw, Cape Sable Phase II EA
950 N. Krome Ave,
Homestead, FL 33030

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment — including your personal identifying information — may be made publicly available at any time. Although you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

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Chapter 1

Purpose Of and Need for Action

CHAPTER 1: PURPOSE AND NEED FOR ACTION

1.1 INTRODUCTION

Everglades National Park (EVER) is one of 410 units of the National Park System administered by the National Park Service (NPS), US Department of the Interior. Established in 1947, the park currently consists of 1,542,000 acres (2,410 square miles) of land and water in Miami-Dade, Monroe, and Collier Counties, including most of Florida Bay (EVER 2015). EVER is recognized as a wetland of international importance. It is the largest subtropical wetland in the United States and contains important habitat for numerous species of birds, fish, and other wildlife.

Within EVER, the Cape Sable peninsula extends from the southwestern tip of Florida, into the Gulf of Mexico and Florida Bay. The cape contains stretches of shell beaches fringed by a mix of mangrove trees and wetlands (**Figure 1.1**). Beyond the mangroves lies Lake Ingraham, the largest of the cape's lakes. Lake Ingraham is backed by a narrow marl ridge that shelters the cape's numerous interior wetlands.

Historically, the interior wetlands of Cape Sable region were isolated from both Florida Bay and the Gulf of Mexico by a marl ridge known as the Flamingo Embankment. (The terms Flamingo Embankment and marl ridge refer to the same topographic high ridge located in the Cape Sable Region of EVER. This ridge is referred to as the marl ridge hereafter in this document.) Early in the 20th century, at least seven canals were dredged through the marl ridge in attempts to drain the cape's interior wetland areas and reclaim the land for development, agriculture, and cattle grazing. The network of canals opened up the cape's interior wetlands to the tidal influence and inflow of saltwater from Florida Bay and the Gulf of Mexico, increasing salinity and triggering substantial change in the ecology of the area.

The open canals and at least one natural tributary, East Side Creek, connect the Gulf of Mexico and Florida Bay to interior wetlands through the historically continuous marl ridge. Outgoing tides flush freshwater from wetlands north of the marl ridge releasing nutrients stored in the soil and transporting sediments toward Lake Ingraham and Florida Bay, incoming tides bring marine sediments that are deposited in the interior lakes and wetlands of Cape Sable. Soil has been lost from the interior wetlands communities of Cape Sable and has been replaced by open water and more saline communities.

Canal construction appears to have had a dramatic effect on the southern portion of the interior of Cape Sable. By 1953, mangroves and other salt tolerant plant communities had colonized the higher marl areas. The reported ecological collapse of the southern interior wetlands was a direct result of the drainage of the freshwater wetlands from canal construction through the marl ridge; large storm events/hurricanes; and saline intrusion through the constructed canals (Wanless and Vlaswinkel 2005). Presently, the central and northern interior wetland communities of Cape Sable are interspersed with mangroves and other marine community vegetation.

Higher salinity in the interior wetlands has altered vegetation patterns, reduced the quality of wildlife habitat (including that of juvenile crocodiles), and decreased the productivity of forage fishes; thereby, potentially affecting the ability for wading birds and other fauna to forage efficiently. The greater exchange of water and sediments through the canals have brought about changes in the function of coastal habitats important to crocodiles, wading birds, recreational fish, and other species dependent on the cape for survival. Environmental degradation in Cape Sable contributes to ecosystem damage in Florida Bay and the Florida Keys. Part of the remedy is plugging the canals to prevent the inflow of salt water and the outflow of freshwater.

The NPS has long recognized the importance of addressing impacts from the Cape Sable canals. During the late 1950s and early 1960s, the NPS plugged several of the canals at the marl ridge with earthen plugs. However, over time all of the earthen plugs have either been breached or severely compromised by the forces of weathering and/or erosion. The constant movement of water through man-made canals on the cape has led to the widening of several canals. The expansion of these canals has exacerbated sediment deposition in the cape's open waters and is converting Lake Ingraham into a tidal mud flat. As the canals on Cape Sable continue to widen, it is believed the rate of change will continue to accelerate, emphasizing the need for timely corrective action. The Homestead and East Cape Canals were re-plugged in 2010-2011 with 100-foot earthen plugs, which are intended to have structural longevity for at least 50 years.

Stopping the unnatural exchange of fresh and salt water through the man-made canals and waterways is key to stabilizing the natural function of the interior Cape Sable wetlands. While this landscape is naturally dynamic, slowing the rate of human-induced change on this landscape may also bring about greater resilience to the Cape in the face of predicted sea level rise and the possibility of more frequent and intense hurricanes and other high-water events.

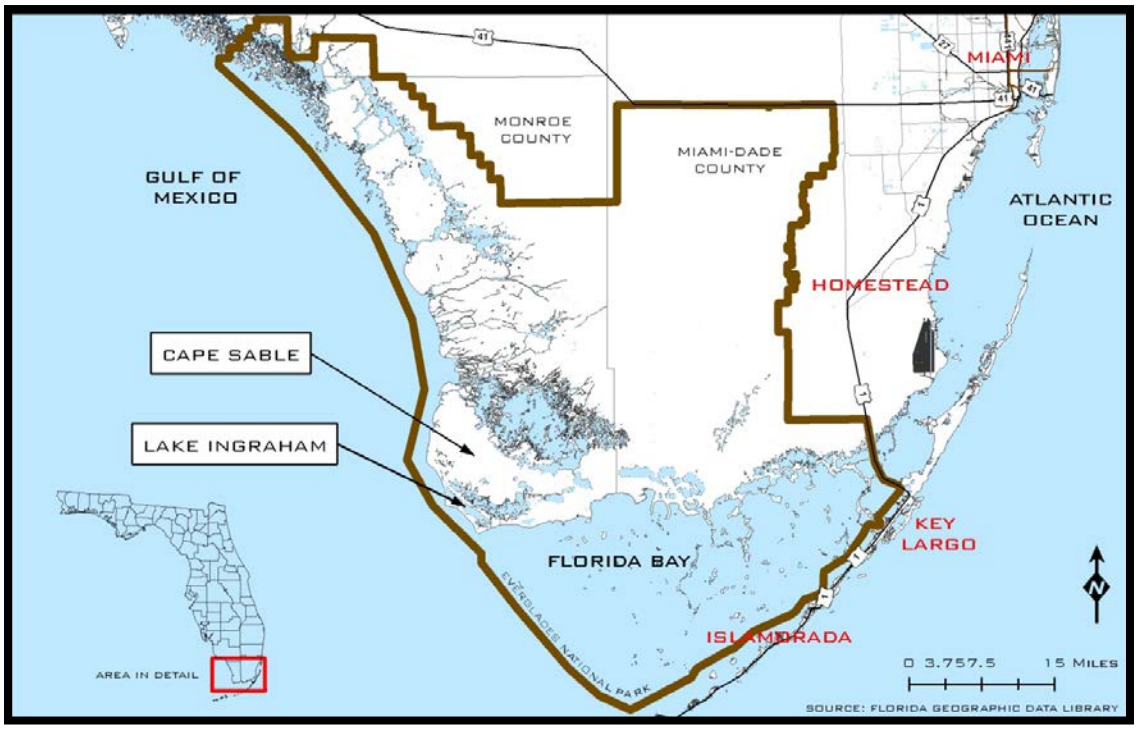


FIGURE 1.1 - CAPE SABLE LOCATION MAP

This Environmental Assessment (EA) has been prepared in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; the Council on Environmental Quality (CEQ) Regulations for Implementation of NEPA (40 Code of Federal Regulations [CFR] Parts 1500 to 1508); NPS' regulations for NEPA compliance (43 CFR Part 46); NPS DO #12 and NEPA Handbook (NPS 2015b); and Section 106 of the National Historic Preservation Act of 1966, as amended, and its implementing regulations (36 CFR Part 800). A discussion of applicable laws, regulations, and policies follows in Section 1.3.

Federal agencies are required, during the decision making process, to fully evaluate and consider the environmental consequences of federal actions. The purpose of the EA is to analyze the potential environmental impacts of the EVER Cape Sable Plugs Restoration – Phase II Project

and its alternatives, including a No Action alternative, and to determine whether to prepare an Environmental Impact Statement (EIS) or a Finding of No Significant Impact (FONSI).

1.1.1 Purpose and Need for the Proposed Action

1.1.1.1 Purpose of the Project.

The "purpose" of the project is a broad statement of goals that the NPS intends to fulfill through taking action and should be stated in terms of desired outcome (43 CFR 46.420(a)). The purpose of this project is to reestablish the natural function of the marl ridge and restore natural ecological processes to the Cape Sable region by eliminating the unnatural exchange of salt and freshwater through man-made canals.

1.1.1.2 Need for Action.

The "need for action" is the underlying problem or opportunity to which the NPS is responding and may include factors such as existing conditions that need to be changed, problems that need to be remedied, decisions that need to be made, and/or policies or mandates that need to be implemented. The needs of this project are to:

- Reestablish the natural function of the marl ridge in the Cape Sable region
- Reduce the impacts of the canal-induced breaching of the marl ridge, which is allowing unnatural intrusion of saltwater into wetland communities north of the marl ridge
- Reduce the erosional processes currently occurring in House Ditch, Slagle Ditch, and Raulerson Canal
- Reduce the unnatural movement of sediment and nutrients through the canals on Cape Sable
- Eliminate the unnatural exchange of salt and freshwater through the canals and eliminate the impacts this unnatural exchange has on fish and wildlife communities north of the marl ridge
- Improve the wilderness character in the Marjory Stoneman Douglas Wilderness Area

1.1.2 Objectives in Taking Action

Purpose and need statements articulate broad goals that an action is meant to achieve. "Objectives" are more specific statements of purpose. They provide additional bases for comparing the effectiveness of alternatives in achieving the desired outcomes of the action.

Objectives must be grounded in the park's enabling legislation, purpose, significance, and mission goals. They must also be compatible with the direction and guidance provided by the park's general management plan, and/or other management guidance. The following are the project's objectives (grouped by subject):

1.1.2.1 Natural Resource Objectives.

- Reduce the unnatural exchange of salt and freshwater into the Cape Sable region north of the marl ridge through Raulerson Canal thereby restoring a more natural hydrology to the region
- Prevent the unnatural exchange of saltwater into and loss of freshwater out of wetland communities north of the marl ridge in Cape Sable through House and Slagle Ditches
- Promote ecological resilience to climate change and sea level rise in the interior wetland communities of the Cape Sable region
- Reduce unnatural impacts to habitat quality for juvenile crocodiles, wading birds, forage fish, and other wildlife within the interior wetlands of the Cape Sable region
- Reduce the unnatural movement of sediment and nutrients through the Raulerson Canal
- Prevent the unnatural movement of sediment and nutrients through House and Slagle Ditches
- Reduce/eliminate adverse impacts to marine resources in the Cape Sable region

1.1.2.2 Wilderness Objectives.

- Improve the natural quality of wilderness character in the Marjory Stoneman Douglas Wilderness Area
- Design the project features and ensure that project implementation, monitoring, and maintenance maximize compatibility with the qualities of wilderness character

1.1.2.3 Cultural Resources Objectives.

- Avoid adverse impacts to cultural and archeological resources and historic features through project design or mitigation measures

1.1.2.4 Engineered Features Objectives.

- Design engineered features, when necessary, to last at least 50 years (barring severe damage by catastrophic hurricane events) with annual/bi-annual maintenance

1.1.2.5 Visitor Use and Experience Objectives.

- Provide safe passage into the Marjory Stoneman Douglas Wilderness Area for canoeists/kayakers at the Raulerson Dam location
- Improve the wilderness visitor experience by reducing the opportunity for illegal motorized access into the Marjory Stoneman Douglas Wilderness Area

1.1.3 Project Site Locations and Scope of the Analysis

The focus of this analysis is to evaluate alternatives for restoring or replacing plugs on three man-made canals at Cape Sable in EVER - House Ditch, Slagle Ditch, and Raulerson Canal. The

primary study area includes the area along the marl ridge of Cape Sable in EVER in the immediate vicinity of the existing canals (**Figure 1.2**).

FIGURE 1.2 - STUDY AREA

At present, five major ditch/canal plugs are known to exist in the Cape Sable region:

- **Homestead Canal Plug** – a 100-foot long earthen plug bounded by sheet pile on each end and reinforced with rip-rap armoring; reconstructed in 2011; structurally stable for an anticipated life of at least 50 years
- **East Cape Extension Canal Plug** – a 100-foot long earthen plug bounded by sheet pile on each end and reinforced with rip-rap armoring; reconstructed in 2011; structurally stable for an anticipated life of at least 50 years
- **House Ditch Plug** – an earthen plug constructed in the 1950s; erosion is presently occurring on the north and south sides of the plug
- **Slagle Ditch Plug** – an earthen plug constructed in the 1950s; erosion is presently occurring on the north side of the plug and potential exists for erosion on the south side of the plug
- **Raulerson Canal Plug** – a former earthen plug that has completely failed; erosion is presently occurring along both banks of the canal; some remaining debris from the previous plug still exists at the former plug site

Additionally, East Side Creek, a natural waterway in the Cape Sable region, is currently experiencing similar tidal influence and erosional processes as the canals and ditches in the area. Based on the available historical evidence, EVER believes that these processes occurring in the waterway may be due, at least in part, to the presence and widening of the human-created

canals in the region. Therefore, a plug along this waterway was considered for inclusion as part of this project during scoping. However, after careful consideration of public and internal scoping comments, a decision was made to dismiss a plug at East Side Creek from further evaluation (see Section 2.2, Alternatives Considered but Dismissed).

Depending on the resource being assessed, the study area may also include areas that would receive indirect or secondary impacts as a result of the proposed action. The area of potential effect is defined for each resource in Chapter 3.

1.2 PURPOSE AND SIGNIFICANCE OF EVERGLADES NATIONAL PARK

The NPS preserves outstanding representatives of the best of America's natural, cultural, and recreational resources of national significance. These resources constitute a significant part of the American heritage, its character, and future. EVER is a vital part of America's system of parks and other preserved resources. The NPS not only directly and indirectly preserves these irreplaceable national treasures, it also makes them available annually to millions of visitors from throughout this country and the world.

1.2.1 Enabling Legislation

Congress authorized the formation of EVER on May 10, 1934 to be "…wilderness where no development…or plan for the entertainment of visitors shall be undertaken which would interfere with the preservation of the unique flora and fauna of the essential primitive natural conditions now prevailing in the area." The legislation stalled during the Great Depression and World War II but 13 years later, President Harry S. Truman dedicated the park at Everglades City on December 6, 1947. At that time, EVER was comprised of 460,000 acres. Over time, park lands were acquired via public and private donations. By 1958, the boundaries of EVER had expanded to approximately 1.4 million acres. In 1989, the EVER Protection and Expansion Act added another 109,500 acres in East Everglades. Currently, the park includes more than 1.5 million acres (NPCA 2005, NPS 2013a).

The General Management Plan / East Everglades Wilderness Study / Environmental Impact Statement (GMP/EEWS/EIS) for the park was approved on October 23, 2015. The plan is designed to better protect and restore critical natural, cultural, and wilderness resources and provide improved visitor experiences (see Section 1.5.5.1, NPS Plans, Policies, and Actions).

1.2.2 Purpose and Significance of Everglades National Park

The following purpose and significance must be taken into account in any park planning.

Purpose – EVER is a public park for the benefit of the people. It is set aside as a permanent wilderness preserving essential primitive conditions including the natural abundance, diversity, behavior, and ecological integrity of its flora and fauna.

Park Significance – Significance statements capture the essence of the park's importance to the nation's natural and cultural heritage. They represent the park's distinctiveness and describe why an area is important within regional, national, and global contexts. Significance statements

help focus on the protection and enjoyment of attributes that are directly related to the purpose of the park.

EVER is nationally and internationally significant because:

- It is a unique subtropical wetland that is the hydrologic connection between central Florida's freshwater ecosystem and the marine systems of Florida Bay and the Gulf of Mexico. It is the only place in the US jointly designated an International Biosphere Reserve (designated October 26, 1976), a World Heritage Site (designated October 26, 1979), and a Wetland of International Importance (designated June 4, 1987).
- It comprises the largest subtropical wilderness reserve in North America. The park contains vast ecosystems, including freshwater wetlands, tropical hardwood, pine rockland, extensive mangrove estuaries, and seagrasses, which support a diverse mix of tropical and temperate plants and animals.
- It serves as sanctuary for the protection of more than 20 federally listed and 70 state-listed threatened and endangered animal species, as well as numerous species of special concern. Many of these species face tremendous pressure from natural forces and human influences in the south Florida ecosystem.
- It provides important foraging and breeding habitat for more than 400 species of birds (including homeland to world-renowned wading bird populations), and functions as a primary corridor and refuge for migratory and wintering wildlife populations.
- It includes archeological and historical resources spanning approximately 6,000 years of human history, revealing adaptation to and exploitation of its unique environment.
- It preserves natural and cultural resources associated with the homeland of American Indian tribes of Florida (including the Miccosukee Tribe of Indians of Florida, the Seminole Tribe of Florida, the Seminole Nation of Oklahoma, and other American Indian groups such as the Council of the Original Miccosukee Simanolee Nation Aboriginal People).
- It preserves the remnants of a nationally significant hydrologic resource that sustains south Florida's human population and serves as a global experiment in restoration.
- It provides the public with the opportunity to experience the Everglades wilderness for recreation, reflection, and solitude in proximity to a major metropolitan area.

1.2.3 General Park Background

Spanning the southern tip of the Florida peninsula and most of Florida Bay, EVER is only a portion of the fragile Everglades ecosystem. EVER provides a prime example of the systemic linkages between national parks, the larger ecosystem, and surrounding communities. The park stretches more than 60 miles north-to-south and 40 miles east-to-west. The park has a relatively low elevation, ranging from 0 to 8 feet (average 6 feet). Average rainfall in the park is about 60 inches per year with the rainy season running from May through September (mosquito season coincides with the rainy season). With the wilderness area named after her, Marjorie Stoneman Douglas was a conservation pioneer who brought the beauty and fragility of the Everglades to public attention in her 1947 book *The Everglades, River of Grass*.

EVER is located at the interface of temperate and subtropical environments for the northern and southern limits for many species creating a unique mingling of diverse temperate and subtropical species. Average highs in winter are 77°F, lows 53°F and in summer is 87°F, lows 80°F (NPS 2015a); EVER has a great diversity of resources (NPS 2015a). These include more than 400 species of birds, 800 species of land and water vertebrates, 1,600 species of vascular plants, 125 species of fish, and 24 varieties of orchids, and over 220 significant archeological and

historic sites. Its rich diversity and unique landscape attract more than 1 million visitors each year. Popular activities include canoeing, kayaking, camping, boating, wildlife observation, and fishing.

1.3 LAWS, REGULATIONS, AND POLICIES

Numerous laws, regulations, and policies at the federal, state, and local levels guide the decisions and actions regarding the project. Some examples that shape the project's legal and regulatory framework follow.

1.3.1 NPS Laws and Management Policies

1.3.1.1 National Park Service Organic Act.

In order to manage and preserve the nation's national park lands, Congress passed the National Park Service Organic Act in 1916 to establish the NPS. Specifically, the Act declares that the NPS has a dual mission, both to conserve park resources and to provide for their use and enjoyment "in such a manner and by such means as will leave them unimpaired" for future generations (16 U.S.C. [United States Code] § 1-4).

The two most significant amendments to the Organic Act come from the National Park System General Authorities Act of 1970 and the Redwoods National Park Expansion Act of 1978. The General Authorities Act amendment (16 U.S.C. § 1a-1 to 1a-7) declares that though distinct in character, all of the nation's parks are united in one National Park System through their interrelated purposes and resources under the mission, purpose, and protection of the Organic Act.

The Redwoods Act amendments, which expanded Redwood National Park, also amended the Organic Act. This amendment reaffirms the mandate set forth in the Organic Act and directs the NPS to manage park lands in a manner that would not degrade park values (16 U.S.C. § 1 a-1). All National Park System units are to be managed and protected as parks, whether established as a recreation area, historic site, or any other designation.

The Organic Act and its amendments afford the NPS latitude when making resource decisions that balance visitor recreation and resource preservation. Although the Organic Act directs the NPS to regulate park lands, it does not speak to the specifics of park management. Thus, as noted in the often-cited 1996 case interpreting the Organic Act (Bicycle Trails Council of Marin v. Babbitt, 82 F.3d 1445, 1454 [9th Cir. 1996]) "the National Park Service has broad discretion in determining which avenues best achieve the Organic Act's mandate." In line with this broad discretion, the Organic Act also provides the NPS with the authority to make regulations as it deems "necessary or proper for the use and management of the parks" (16 U.S.C. § 3). The NPS interprets the Organic Act through the development of NPS Management Policies (See Section 1.3.1.4, NPS 2006).

The purposes for establishing national park units vary based on their enabling legislation, natural resources, cultural resources, and missions, therefore the appropriate management activities vary as well. Thus, this EA analyzes the context, duration, and intensity of impacts related to the Cape Sable Canals Plug Restoration – Phase II Project on park resources (NPS 2015b).

1.3.1.2 National Parks Omnibus Management Act of 1998.

This act (16 U.S.C. § 5901, et seq.) underscores NEPA in that both are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting the ultimate resource management decision to the analysis of impacts, using appropriate technical and scientific information. Both also recognize that such data may not be readily available and provide options for resource impact analysis in this case.

1.3.1.3 NPS Management Policies.

NPS has several sources of detailed guidance to help managers make day-to-day decisions. The primary source of guidance is the 2006 edition of Management Policies, which is also the foremost element of the Service's directives system. Other elements include Director's Orders (DO), Handbooks, and Reference Manuals.

NPS Management Policies (NPS 2006) establishes service-wide policies for the preservation, management, and use of park resources and facilities. These policies provide guidelines and direction for management of resources within the park. The alternatives considered in the EA would incorporate and comply with the provisions of these mandates and policies. NPS Management Policies (2006) also directs park staff to integrate wilderness concerns into all planning documents to guide the preservation, management, and use of the park's wilderness area and ensure that wilderness is unimpaired for the use and enjoyment of future generations.

Section 4.8 of NPS' Management Policies (NPS 2006) directs NPS to protect geologic features (i.e., products and physical components of geologic processes) from the unacceptable impacts of human activity, while allowing natural processes to continue. Examples of geologic features include: rocks, soils, and minerals; geysers and hot springs; cave and karst systems; canyons and arches; sand dunes, moraines, and terraces; dramatic or unusual rock outcrops and formations; and paleontological and paleoecological resources such as fossilized plants or animals, or their traces. For the purposes of analysis in this document, geologic features also include soil erosion, effects on soil productivity, and the ability of the soil to support native vegetation.

Sections 4.6.3, 4.6.4, and 4.6.5 of NPS Management Policies 2006 specifically address water quality, wetlands, and floodplains, respectively (NPS 2006). The policies state that NPS would "take all necessary actions to maintain or restore the quality of surface waters and ground waters within parks consistent with the Clean Water Act and all other applicable and federal, state, and local laws and regulations" and provide similar protective provisions for wetlands and floodplains that reiterate the Director's Orders discussed above.

Section 4.4.2.3 of the NPS Management Policies 2006 provides specific guidance for management of threatened or endangered plants and animals (NPS 2006). These policies dictate that the NPS would survey for, protect, and strive to recover all species native to national park system units that are listed under the ESA. The NPS would fully meet its obligations to both proactively conserve listed species and prevent detrimental effects on these species. NPS would inventory, monitor, and manage state and locally listed species in a manner similar to its treatment of federally listed species to the greatest extent possible. In addition, the Service would inventory other native species that are of special management concern to parks (such as rare, declining, sensitive, or unique species and their habitats) and would manage them to maintain their natural distribution and abundance.

Chapter 5, Section 5.3.1 Protection and Preservation of Cultural Resources states that the NPS would employ the most effective concepts, techniques, and equipment to protect cultural resources against theft, fire, vandalism, overuse, deterioration, environmental impacts, and other threats without compromising the integrity of the resources (NPS 2006). If inadvertent discoveries of human remains are made during the projects, the protocols outlined in the May 2008 Park Native American Graves Protection and (NAGPRA) Plan of Action for Inadvertent Discoveries, Everglades National Park, and Associated Tribes would be followed.

Chapter 8, Section 8.2, Visitor Use, addresses "enjoyment of park resources and values by the people of the United States" as "part of the fundamental purpose of all parks." The NPS is committed to "providing appropriate, high-quality opportunities for visitors to enjoy the parks," by maintaining "an atmosphere that is open, inviting, and accessible" (NPS 2006). Section 8.2.2 of the NPS Management Policies 2006 discusses recreational activities within the parks, with multiple sections – Management of Recreational Use (8.2.2.1), Backcountry Use (8.2.2.4), and Fishing (8.2.2.5) – specifically applicable to use of the Cape Sable area by park visitors.

Section 8.2.5.1 discusses visitor safety in the parks, stating that while "park visitors must assume a substantial degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments … The saving of human life would take precedence over all other management actions as the [NPS] strives to protect human life and provide for injury-free visits" (NPS 2006). This concern is limited by the constraints of the 1916 Organic Act, which only allows discretionary management activities to be undertaken to the extent that they would not impair park resources and values (NPS 2006). While the NPS acknowledges that there are limitations on its ability to protect park employees and visitors from all hazards, the Service would strive to "provide a safe and healthful environment" (NPS 2006). "When practicable and consistent with congressionally designated purposes and mandates, the Service would reduce or remove known hazards and apply other appropriate measures" (NPS 2006). The NPS would conduct such actions to have the least possible impact on park resources and values (NPS 2006).

1.3.1.3.1 DO #12 and Handbook: Conservation Planning, Environmental Impact Analysis, and Decision-Making

In addition to NPS implementing regulations (43 CFR Part 46), DO #12 (2011) and the accompanying NEPA handbook (NPS 2015b) lay the groundwork for how the NPS complies with NEPA. DO #12 and the handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects.

DO #12 requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision-makers to understand implications of those impacts in the short and long-term, cumulatively, and in context, based on an understanding and interpretation by resource professionals and specialists.

1.3.1.3.2 DO #28: Cultural Resource Management

DO #28 (1998) sets forth the guidelines for management of cultural resources, including cultural landscapes, archaeological resources, historic and prehistoric structures, museum objects, and ethnographic resources. This order calls for the NPS to protect and manage cultural

resources in its custody through effective research, planning, and stewardship in accordance with the policies and principles contained in the NPS Management Policies (NPS 2006).

1.3.1.3.3 DO #41: Wilderness Stewardship

The purpose of DO #41 (2013) is to help bring additional accountability, consistency, and continuity to the NPS wilderness management stewardship program, and to guide Service-wide efforts in meeting the letter and spirit of the Wilderness Act of 1964 (16 U.S.C. § 1131-1136) (see Section 1.3.2.7). This DO clarifies specific provisions of NPS Management Policies and establishes specific instructions and requirements concerning the management of all NPS wilderness areas. DO #41 requires a minimum requirements analysis be prepared for actions proposed in wilderness.

1.3.1.3.4 DO #77: Natural Resource Protection

DO #77 addresses Natural Resource Protection, with specific guidance provided in Reference Manual #77: Natural Resource Management. This DO includes DO #77-1: Wetland Protection and DO #77-2: Floodplain Management, both of which would be applicable since the proposed project is located within wetland resources and a designated floodplain.

DO #77-1, issued in 2002, establishes policies, requirements, and standards for implementing Executive Order (EO) 11990: Protection of Wetlands. Under this EO, the NPS adopts a goal of "no net loss of wetlands." In addition, the NPS strives to achieve a long-term goal of net gain of wetlands service wide. For proposed development or other activities, plans, or programs that either are located in or have the potential for direct or indirect impacts on wetlands, the NPS employs a sequence of avoidance, minimization, and mitigation. They conduct the following: (1) avoiding adverse wetland impacts to the maximum extent practicable; (2) minimizing impacts that could not be avoided; and (3) compensating for remaining unavoidable adverse wetland impacts by restoring degraded wetlands.

DO #77-2, approved in 2003, applies to all NPS proposed actions, including the direct and indirect support of floodplain development that would adversely affect the natural resources and functions of floodplains, including coastal floodplains, or increase flood risks. This DO also applies to existing actions when they are the subjects of regularly occurring updates of NPS planning documents. Under DO #77-2, it is NPS policy to preserve floodplain values and minimize potentially hazardous conditions associated with flooding. For floodplain management on park lands, the NPS (1) manages for the preservation of floodplain values; (2) minimizes potentially hazardous conditions associated with flooding; and (3) complies with the Organic Act and all other federal laws and EOs related to the management of activities in flood-prone areas (e.g., EO 11988, Floodplain Management, applicable provisions of the Clean Water Act, the Rivers and Harbors Appropriation Act of 1899). Specifically, the NPS would protect and preserve the natural resources and functions of floodplains; avoid the long- and short-term effects associated with the modification of floodplains; and avoid direct and indirect support of floodplain development and actions that would adversely affect the natural resources and functions of floodplains or increase flood risks. When it is not practicable to locate or relocate development or inappropriate human activities to a site outside and not affecting the floodplain, the NPS would prepare and approve a SOF, in accordance with procedures described in Procedural Manual #77-2: Floodplain Management, and take all reasonable actions to minimize the impact to the natural resources of floodplains.

1.3.1.3.5 NPS Management Policies 2006: The Prohibition on Impairment of Park Resources and Values

By enacting the NPS Organic Act of 1916 (Organic Act), Congress directed the U.S. Department of Interior and the NPS to manage units "to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 USC § 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC 1a-1).

NPS Management Policies 2006, Section 1.4.4, explains the prohibition on impairment of park resources and values:

> *While Congress has given the Service the management discretion to allow impacts within parks, that discretion is limited by the statutory requirement (generally enforceable by the federal courts) that the Park Service must leave park resources and values unimpaired unless a particular law directly and specifically provides otherwise. This, the cornerstone of the Organic Act, establishes the primary responsibility of the Nation Park Service. It ensures that park resources and values will continue to exist in a condition that will allow the American people to have present and future opportunities for enjoyment of them.*

The NPS has discretion to allow impacts on park resources and values when necessary and appropriate to fulfill the purposes of a park (NPS 2006 sec. 1.4.3). However, the NPS cannot allow an adverse impact that would constitute impairment of the affected resources and values (NPS 2006 sec 1.4.3). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2006 sec 1.4.5). To determine impairment, the NPS must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS 2006 sec 1.4.5). A determination on impairment for the selected alternative will be provided for in the decision document if applicable.

1.3.1.3.6 Climate Change

Various Executive Orders, Departmental guidance, and NPS authorities establish the legal and policy foundation for management approaches that the NPS uses to address current and future effects of climate change. These authorities include:

- NPS Management Policies (2006)
- NPS Climate Change Response Strategy (2010)
- NPS Climate Change Action Plan (2012-2014)
- Policy Memorandum 12-02, Applying National Park Service Management Policies in the Context of Climate Change
- Policy Memorandum 14-02 Climate Change and Stewardship of Cultural Resources
- Policy Memorandum 15-01 Addressing Climate Change and Natural Hazards for Facilities

The intent of this guidance is to ensure that decisions affecting stewardship of natural and cultural resources and the design of facilities will be informed by and responsive to the existing and projected climate change and other natural hazards.

1.3.2 Other Federal Laws and Executive Orders

The NPS is also required to comply with the following laws, EOs, regulations, and policies in developing this project.

1.3.2.1 National Environmental Policy Act of 1969, as Amended.

The National Environmental Policy Act of 1969 (NEPA), as amended applies to a broad range of federal actions; Section 102(2) mandates that before federal agencies make decisions, they must consider the effects of their actions and its alternatives on the quality of the human environment. NEPA created and assigned the Council on Environmental Quality (CEQ) the task of ensuring that federal agencies meet their obligations under NEPA. CEQ implemented NEPA through regulations 40 CFR 1500-1508. The NPS has, in turn, adopted procedures to comply with the act and the CEQ regulations, as found in Department of Interior's NEPA Regulations (43 CFR Subtitle A Part 46), DO #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making, and its accompanying NEPA Handbook, collectively DO #12 (NPS 2015b).

The NEPA process is intended to, "help public officials make decisions that are based on understanding of environmental consequences, and take actions that protect, restore, and enhance the environment" (40 CFR 1500.1). The purposes of NEPA and the mission of the NPS express very similar goals. Both contain language designed to result in the conservation and protection of our nation's resources for the benefit of future generations. NEPA establishes a national policy:

> *". . . which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation . . ."*

An EA, while still analytical and explanatory, is meant to be a "brief" and "concise" document at a level of detail limited to that necessary to demonstrate that the proposal would not result in significant environmental impacts (40 CFR 1508.9; 46.310(e)). It should be kept brief by carefully developing the scope to identify pivotal issues; focusing discussions and analysis on the relevant issues and dismissing issues that are not meaningful to the decision and discussing impacts in proportion to their importance. Section 102(2)(c) of NEPA requires that an EIS be prepared for proposed major federal actions that may significantly affect the quality of the human environment.

NEPA reviews that follow both the letter and spirit of the law display several key characteristics: part of planning and decision-making, part of a public process, based on an interdisciplinary approach, inclusive, focused and concise, objective and science-informed, and ultimately site specific.

1.3.2.2 Endangered Species Act of 1973.

The Endangered Species Act (ESA) of 1973, as amended (16 USC § 1531-1544) requires all federal agencies to consult with the Secretary of the Interior on all projects and proposals with the potential to impact federally endangered or threatened plants and animals. It also requires federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. A federal agency must ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any threatened or endangered species nor destroy or adversely modify any designated critical habitats.

The ESA is administered by the US Fish and Wildlife Service (USFWS) for terrestrial and freshwater species and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) (NOAA Fisheries) for marine and anadromous species. A noted exception is the West Indian manatee (*Trichechus manatus*) which is managed by USFWS. Sea turtles are under the regulatory authority of both agencies, depending on the situation (i.e., USFWS for sea turtles nesting on shore, NOAA Fisheries for sea turtles in the marine environment). The smalltooth sawfish (*Pristis pectinata*) is under the regulatory authority of the NOAA Fisheries. A distinct population segment may also be listed for vertebrate species. The American crocodile (*Crocodylus acutus*), for example, is listed worldwide as endangered, except in Florida where it is listed as threatened due to population recovery (70 FR 15052). In other cases, a species may not be designated as endangered or threatened under the ESA, but receives federal protection under other federal regulations such as the Marine Mammal Protection Act of 1972 (see Section 1.3.2.5), the Migratory Bird Treaty Act of 1918, or the Bald Eagle Protection Act of 1940.

In compliance with Section 7 of the ESA, this EA will serve as the proposed project's Biological Assessment (BA) and will be completed in accordance with consultation requirements for the USFWS and NOAA Fisheries.

1.3.2.3 Coastal Zone Management Act of 1966.

The Coastal Zone Management Act (CZMA) (16 U.S.C. §§1451 et. seq.) seeks to preserve and protect coastal resources. The CZMA provides financial and technical incentives for coastal states to develop coastal zone management programs (CZMPs). These plans manage coastal zones consistent with the CZMA's standards and goals to balance economic growth with the protection of natural resources, the reduction of coastal hazards, the improvement of water quality, and sensible coastal development. CZMA Section 307 requires that federal activities that have the potential to affect the coastal zone's natural resources must be consistent to the maximum extent practicable with the state's CZMP. Federal agencies must consult with state CZMPs and must provide the CZMP with a determination or certification that the activity is consistent with the CZMP's policies, where those policies would have a possible effect on state coastal resources, as defined by the CZMP and local land use plans.

The Florida Coastal Management Program (FCMP), the State of Florida's federally approved management program, was approved by the NOAA in 1981. The FCMP consists of a network of 23 Florida Statutes administered by 11 state agencies and four of the five water management districts. The program is designed to ensure the wise use and protection of the state's water, cultural, historic, and biological resources; to minimize the state's vulnerability to coastal hazards; to ensure compliance with the state's growth management laws; to protect the state's

transportation system; and to protect the state's proprietary interest as the owner of sovereign submerged lands.

The State of Florida's coastal zone includes the state's 67 counties and its territorial seas. Therefore, federal actions occurring throughout Florida are reviewed for consistency with the FCMP. However, the state has limited its federal consistency review of federally licensed and permitted activities to the federal licenses or permits specified in Section 380.23(3)c, F.S.

1.3.2.4 Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended.

The Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSA) is the principal law governing marine fisheries in the US. It was originally adopted to extend control of U.S. waters to 200 nautical miles in the ocean; to prevent overfishing, especially by foreign fleets; to allow overfished stocks to recover; and to conserve and manage fishery resources to ensure a safe and sustainable supply of seafood. No changes were made to the EFH mandate during the 2006 Magnuson-Stevens Act Reauthorization (NOAA 2009b).

The Sustainable Fisheries Act of 1996 (Public Law 104-267) made significant revisions to the MSA. It requires all federal agencies to consult with NOAA Fisheries on all actions, or proposed actions, permitted, funded, or undertaken by the agency that may adversely affect Essential Fish Habitat (EFH). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." "Waters" include aquatic areas and their associated physical, chemical, and biological properties. "Substrate" includes sediment underlying the waters. "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem. Spawning, breeding, feeding, or growth to maturity covers all habitat types utilized by a species throughout its life cycle. NOAA Fisheries would provide recommendations on conserving essential fish habitat to federal or state agencies for activities that would adversely affect essential fish habitat.

1.3.2.5 Marine Mammal Protection Act of 1972.

The Marine Mammal Protection Act of 1972 (MMPA) prohibits the "take" (i.e., hunting, killing, capture, or harassment) of marine mammals, and enacts a moratorium on the import, export, and sale of marine mammal parts and products. The MMPA established federal responsibility to conserve marine mammals with management vested in the US Department of the Interior for sea otters, walruses, polar bears, dugongs, and manatees. Authority to manage marine mammals was divided between the Department of the Interior (delegated to USFWS) and the US Department of Commerce (delegated to NOAA Fisheries). A third federal agency, the Marine Mammal Commission, was later established to review and make recommendations on the policies and actions of the USFWS and NOAA Fisheries related to their implementation of the MMPA.

In compliance with MMPA, this EA will serve as the proposed project's BA and will be completed in accordance with consultation requirements for the USFWS and the NOAA Fisheries. The bottlenose dolphin (*Tursiops truncatus*) is protected under this act.

1.3.2.6 Clean Water Act of 1972.

The Federal Pollution Control and Prevention Act of 1972 as amended, commonly known as the Clean Water Act (CWA), is the primary federal law governing water pollution. The objective of the Clean Water Act is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The act supports establishment and enforcement of water quality standards. Florida has delegated all waters of EVER as OFWs. The FDEP established "rules which provide for a special category of water bodies within the state, to be referred as "Outstanding Florida Waters," which shall be worthy of special protection because of their natural attributes" (Section 403.061 (27), F.S.). The state has an anti-degradation standard for such waters (Section 62-302 of Florida's Administrative Code [F.A.C.]). These include the anti-degradation standard mentioned above as well as minimum criteria related to the presence of debris, oils, scum, color, odor, taste, and turbidity. Section 62-302.700 addresses the special protection afforded to OFWs.

The principal body of law currently in effect is based on the Federal Water Pollution Control Amendments of 1972, which substantially expanded and strengthened earlier legislation. Major amendments were made to the Clean Water Act of 1977 enacted by the 95th US Congress and the Water Quality Act of 1987 enacted by the 100th US Congress.

1.3.2.7 Wilderness Act of 1964.

The Wilderness Act of 1964 (16 U.S.C. § 1131-1136) marked the first time Congress called for helping to *"secure for the American people of present and future generations the benefits of an enduring resource of wilderness."* The act established a National Wilderness Preservation System and laid the groundwork for establishing the Marjory Stoneman Douglas Wilderness area. Today, the Marjory Stoneman Douglas Wilderness is part of the 109 million acre National Wilderness Preservation System that provides clean air, water, and habitat critical for rare and endangered plants and animals. Lands identified as suitable for wilderness designation, wilderness study areas, proposed wilderness, and recommended wilderness (including potential wilderness) must also be managed to preserve their wilderness character and values in the same manner as "designated wilderness" until Congress has acted on the recommendations. Wilderness areas within the National Park System are afforded the highest possible standard by US land conservation laws, for they have the protection of both the Organic Act and the Wilderness Act.

1.3.2.8 Architectural Barriers Act Accessibility Standards (ABAAS).

As outlined in the NPS Management Policies 2006 and DO #42: Accessibility for Visitors with Disabilities in NPS Programs and Services, as of May 8, 2006, the ABAAS requires that buildings and facilities covered by the law meet standards for accessibility by disabled persons. Such access "would be provided consistent with preserving park resources and providing visitor safety and high quality visitor experiences" (NPS 2006).

1.3.2.9 Historic Preservation Laws.

1.3.2.9.1 National Historic Preservation Act of 1966, as Amended

Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA) requires federal agencies to consider the effects of their proposals on historic properties, and to provide state historic preservation officers, tribal historic preservation officers, and, as necessary, the Advisory Council on Historic Preservation a reasonable opportunity to review and comment on these actions. Section 106 review and NEPA are two separate, distinct processes. They can and should occur simultaneously, and documents can be combined, but one is not a substitute for the other. They should, however, be coordinated to avoid duplication of public involvement or other requirements. The information and mitigation gathered as part of the 106 review must be included in the NEPA document, and the 106 process must be completed before a FONSI or an ROD can be signed on a proposal that affects historic properties. All actions affecting the parks' cultural resources must comply with this legislation (16 U.S.C. § 470 et seq.).

In addition, pursuant to 36 CFR 800.8, the NEPA process will be used to coordinate and adhere to the requirements for Section 106 of the NHPA and the procedures required by 36 CFR Part 800. Where appropriate, this would include public participation, analysis, and/or reviews that meet the purposes and requirements of both statutes in a timely and efficient manner.

1.3.2.9.2 Antiquities Act of 1906

This act (16 U.S.C. § 431-433) protects all historic and prehistoric sites on federal lands and prohibits excavation or destruction of such antiquities unless a permit (Antiquities Permit) is obtained from the Secretary of the department which has the jurisdiction over those lands. It also authorizes the President to declare areas of public lands as National Monuments and to reserve or accept private lands for that purpose.

1.3.2.9.3 American Indian Religious Freedom Act of 1978

The American Indian religious Freedom Act (AIRFA) affirms the right of Native Americans to have access to their sacred places. If a place of religious importance to American Indians may be affected by an undertaking, AIRFA promotes consultation with Indian religious practitioners, which may be coordinated with Section 106 consultation. Amendments to Section 101 of NHPA in 1992 strengthened the interface between AIRFA and NHPA by clarifying that:

> *Properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined to be eligible for inclusion on the National Register of Historic Places (NRHP).*

In carrying out its responsibilities under Section 106, a federal agency shall consult with any Indian tribe or Native Hawaiian organization that attaches religious and cultural significance to properties described in subparagraph (A) [16 U.S.C. § 470a (a)(6)(A) and (B)].

1.3.2.9.4 Archaeological Resources Protection Act of 1979

This act (16 U.S.C. § 470aa-mm) requires federal agencies to provide notice to the Secretary of the Interior if any archeological resources are found, for recovery or salvage of them. The law applies to any agency whenever it received information that a federal activity would cause irreparable harm to prehistoric, historic, or archaeological data. The penalty for stealing or vandalizing any archeological resources is $500,000 and up to five years in prison.

1.3.2.9.5 Native American Graves Protection and Repatriation Act of 1990

The NAGPRA (25 U.S.C. § 3001) assigns ownership and control of Native American cultural items, human remains, and associated funerary objects to Native Americans. It also establishes requirements for the treatment of Native American human remains and sacred or cultural objects found on federal land. This act further provides for the protection, inventory, and repatriation of Native American cultural items, human remains, and associated funerary objects. NAGPRA requires museums that receive public funds to consult with Native Americans. Native Americans have the power to decide what happens to museum collections of human remains, grave goods, and sacred items. When these items are inadvertently discovered, cease activity, make a reasonable effort to protect the items, and notify the appropriate Indian tribe(s) and/or Native Hawaiian organization(s).

1.3.2.10 Executive Order 11593 – Protection and Enhancement of the Cultural Environment.

This EO directs federal agencies to support the preservation of cultural properties and to identify and nominate to the NRHP-listed cultural properties in the park and to "exercise caution... to assure that any NPS-owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

1.3.2.11 Executive Order 11988 – Floodplain Management.

This EO directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct or indirect support of floodplain development wherever there is a practicable alternative.

1.3.2.12 Executive Order 11990 – Protection of Wetlands.

This EO directs federal agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

1.3.2.13 Executive Order 13007 – Indian Sacred Sites.

Federal agencies shall, to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, (1) accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites on federal lands.

1.3.2.14 Executive Order 13112 – Invasive Species.

This EO requires federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species may cause.

1.3.3 Florida State Laws: Water Quality Criteria

All waters that are a part of EVER are defined as Outstanding Florida Waters (OFW). Section 403.061 (27), F.S., grants the Florida Department of Environmental Protection (FDEP) power to establish rules that provide for a special category of water bodies within the state, to be referred as "Outstanding Florida Waters," which shall be worthy of special protection because of their natural attributes (FDEP 2015b). OFW standards apply to overall water quality. In general, the FDEP does not permit direct pollutant discharges to OFWs that would lower ambient (existing) water quality or indirect discharges that would significantly degrade the waters, including turbidity.

Chapter 62-302 (F.A.C.) sets limits for water quality standards including those for *Estuary-Specific Numeric Interpretations of the Narrative Nutrient Criterion* (62-302.532, effective 2016) which identifies limits for total Nitrogen, total Phosphorous, and chlorophyll; and sets *Classification of Surface Waters, Usage, Reclassification, Classified Waters* (62-302.400, effective 2016). These criteria are not discussed in detail here as the OFW water quality standards for national parks discussed above are more stringent.

Permits from state and/or federal regulatory agencies to implement any of the proposed action alternatives would be required to ensure that water quality will not be degraded as a result of project implementation. There are no dredging activated proposed under any of the alternatives (see Section 2.0).

1.4 PROJECT BACKGROUND

1.4.1 History of Cape Sable Canals

Early in the 20th century, several canals were constructed in the Cape Sable area, prior to the establishment of EVER. The canals were dug through the marl ridge in attempts to drain and reclaim the interior wetland areas for development, agriculture, and cattle grazing. These canals opened up the interior Cape Sable wetlands to tidal influence and the inflow of saltwater from the Gulf of Mexico and the Florida Bay.

Since the completion of the canals, natural forces such as tides and runoff have continually widened the canals and exposed Lake Ingraham to tidal flows resulting in a change in the

ecosystem of the Cape Sable region. Tidal flushing has also widened several canals, including the Middle Cape, East Cape, and Lake Ingraham canals, approximately two to four feet per year and deposited sediment in Lake Ingraham converting it into a mud flat at low tide (Wanless and Vlaswinkel 2005).

The Middle Cape Canal, the largest canal in the Cape Sable region, is located between the north end of Lake Ingraham and Florida Bay. This canal did not widen appreciably until after the 1935 Labor Day Hurricane, but today the opening is more than 300 hundred feet wide. The East Cape Canal connection to the southern end of Lake Ingraham was completed in the 1920s and the lower portion of the canal, between Florida Bay and the Ingraham Canal, is currently more than 200 hundred feet wide. The canals were subsequently plugged with earthen plugs at the marl ridge during the 1950s, but over time, most of the earthen plugs have either been breached or severely compromised by the forces of weathering and erosion.

The failed earthen plugs on the Homestead Canal and East Cape Canal Extension were replaced in 1997 with sheet pile plugs but these plugs also failed after a few years by erosional breaching. In 2010-2011, the failed sheet pile plugs were replaced with 100-foot long earthen structures bounded at each end by sheet pile bulkheads and riprap armoring. These plugs are structurally intact.

In 2005, the earthen plug on Raulerson Canal was weakened by storm surges from Hurricanes Katrina and Wilma. By November 2007 the plug had been breached completely and water began to flow in and out of the interior wetlands through the canal. Two separate repair efforts were made on the Raulerson Canal since the initial breach occurred. The first repair was in December 2007 and the second repair was in March 2008. By the fall of 2009, the repair had failed catastrophically and salt water was flowing freely through the canal. Raulerson Canal has widened from 8’ to 40’ since 2009

House Ditch and Slagle Ditch were dammed with earthen plugs in 1956 where the canals cross the old Cape Sable Road, which is now referred to as the Old Ingraham Highway (also Coastal Prairie Trail). Both plugs are currently functional but have eroded from the north side. Erosion of the plug at Slagle Ditch is significant - seepage through the plug is occurring, and the structure is in danger of failing catastrophically if impacted by a storm or because of erosion accelerated by seepage through the structure.

Detailed information about the plugs and conditions at House and Slagle Ditches and Raulerson Canal is presented in the *2012 Engineering Analysis and Feasibility of Repairing or Replacing Failed Dams* report discussed in Sec. 1.4.3 below (URS 2012). It may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

1.4.2 Factors Influencing the Cape Sable System

1.4.2.1 Climate Change – Sea Level Rise.

Cape Sable evolved following a rapid rise in sea level 2,500 to 2,400 years ago (Wanless and Vlaswinkel 2005). The rate of relative sea level rise was only three to five centimeters (cm) per century up until the beginning of last century. The relative sea level rise since 1930 has increased six-fold due to regional changes in the density and circulation of North Atlantic shallow and deep waters. The 9-inch rise in sea level since 1930 has destabilized all of Cape Sable’s coastal and wetland environments, greatly increasing the area and volume of water that incoming tides cover (Wanless and Vlaswinkel 2005).

The Miami-Dade County Climate Change Advisory Task Force (CCATF) published the Second Report and Initial Recommendations which was based on published recommendations from the Intergovernmental Panel on Climate Change (IPCC). The document states that global warming will result in many changes to the natural environment "including changing atmospheric circulation and temperature patterns, changes in rainfall and severe weather, changes in biologic community distribution, increased extinction rates, changes in disease and pest distribution, and changes in sea level" (CCATF 2008). While all of these environmental impacts will affect south Florida and EVER within the next century, the key concern for the low-lying Cape Sable area will be rising sea level. There is "a very high likelihood" that the sea level will rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF 2008).

1.4.2.2 Weather.

"Four major hurricanes crossed the Mangrove Coast between Cape Sable and Everglades City during the past century (1926, 1935, 1960, and 1992). The Category 5 and 4 storms of 1935 and 1960 [Hurricane Donna] passed directly across Cape Sable and devastated the tall mangrove forests, both at the coast and in the interior. Rapid post-storm peat decay and substrate subsidence, combined with rapidly rising sea level, has made recovery difficult, and portions of these wetland mangrove forests have evolved to open water" (Wanless and Vlaswinkel 2005). More recently, the Cape Sable area experienced storm surge and rain effects from Hurricanes Katrina, Rita, and Wilma in 2005 (e.g., 19.9 inches during Katrina). It is also important to note that in addition to the impacts from hurricanes, strong winter storm events have had an impact on the environmental dynamics of the Cape Sable area (Wanless and Vlaswinkel 2005).

1.4.2.3 Human Effects.

Human modifications mostly occurred prior to 1935 and included a road that extended from Flamingo along the marl ridge to northern Lake Ingraham. The construction of a number of narrow drainage canals had considerable influence over the environmental dynamics of southern Cape Sable.

1.4.3 Previous Studies and Planning

Recent studies have been completed for the Cape Sable area of EVER. In 2005, Wanless and Vlaswinkel at the University of Miami conducted a study of *Coastal Landscape and Channel Evolution Affecting Critical Habitats at Cape Sable, Everglades National Park, Florida*, which was funded by the NPS. The study documented "significant landscape changes" to Cape Sable as a result of saline intrusion, ecological collapse of the formally freshwater wetland community, enlarged tidal prism, rapid sedimentation, and shore and interior erosion (Wanless and Vlaswinkel 2005). The report may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

In 2007, URS Corporation (now AECOM) was contracted by the NPS to conduct a Preliminary Engineering Analysis to identify and develop preliminary engineering design concepts for the restoration of the failed plugs on the East Cape Extension and Homestead Canals. URS engineered six alternative solutions for plug restoration and analyzed each alternative using a

matrix rating direct impacts, indirect impacts, constructability, dredging, cost, stability, and safety (URS 2007).

In 2011, the NPS retained URS Corporation to develop preliminary alternatives for the mitigation of eroding plugs on the House and Slagle ditches, restoration of the failed plug on the Raulerson Canal and the potential construction of a new plug on East Side Creek. The April 2012 final report, entitled *Engineering Analysis and Feasibility of Repairing or Replacing Failed Dams and Limiting Saltwater Intrusion in Cape Sable, Everglades National Park*, presented site condition assessments, preliminary engineering analysis, cost estimates, preliminary designs for plugs along each waterway, and analysis of potential impacts of the alternatives (URS 2012).

The assessment of House Ditch determined that erosion conditions are manageable into the foreseeable near future, but left unchecked, this plug will eventually fail allowing tidal flows into the interior marshes (pp 8-9):

> *The observed existing erosion conditions are considered manageable at the present time and for the foreseeable near future. However, over the longer term with anticipated sea level rise over the next several decades, such overtopping events may become more frequent and problematic and the potential for accelerated erosion at this dam site as well as other low-lying areas in the region will increase in future decades. Without remediation, the erosion will eventually propagate through the dam plug therein providing direct communication of the enlarged ditch north of the dam with the smaller southern, tidally influenced ditch. Left unchecked, this ditch will eventually become re-opened to tidal flushing and become an unrestricted flow way for tidal saltwater propagation to the Cape Sable interior will occur.*

The assessment of Slagle Ditch determined that water is seeping through the eroded plug posing a risk of imminent failure (p. 10):

> *Now that seepage water is observed to be potentially propagating through the Slagle earthen dam plug, concern is expressed that the remaining portion of the dam plug could become quickly eroded and the ditch dam structure could potentially fail in a few years, if not sooner. Of the two, House and Slagle Ditch dams, the Slagle dam plug is in the worst erosional condition, is of imminent pending breach failure and in need of the most immediate attention and remediation of the eroded conditions.*

The range of plug alternatives developed in the 2012 study has been carried forward into the alternatives developed for and considered in this EA (see Section 2.0). The 2012 Feasibility Study is incorporated by reference into this EA and may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

1.5 PROJECT SCOPING AND PUBLIC PARTICIPATION

1.5.1 Scoping

Scoping is "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR 1501.7). The scoping process should continue throughout the early planning stages and includes both internal and external (other agency and public) elements and should be focused on determining the extent and nature of issues and alternatives that should be considered during a NEPA review.

1.5.1.1 Internal Scoping.

Internal scoping refers to the process an interdisciplinary team of NPS staff that is familiar with the issues and affected resources uses to define issues, alternatives, and data needs. Internal scoping generally results in the completion of an Environmental Screening Form (ESF). Scoping with interested federal, state, and local agencies and Indian tribes is also part of the internal scoping process. Internal scoping ensures that all relevant issues and alternatives are considered early in the NEPA process integrating a variety of expertise in natural resources, cultural resources, planning, and other disciplines.

An Internal Scoping Meeting was held on October 21, 2014 to further analyze and refine the design alternatives for the four plug locations. Follow-up meetings were held on November 6, 2014 to discuss the inclusion or exclusion of a plug along East Side Creek, a natural waterway, in the NEPA document, and on December 3, 2014 to discuss Climate Change and Sea Level Rise in reference to this project. These meetings resulted in a clarification in purpose, needs, and objectives, and development of potential project alternatives including the proposed No Action alternative for each waterway, five Action Alternatives each for House Ditch and Slagle Ditch, and five Action Alternatives for Raulerson Canal.

1.5.1.2 Public Scoping.

Public scoping (or external scoping) is the process used to gather public input and may include scoping sessions, direct mailings, newsletters, ads, and open houses. The engagement of the interested and affected public is important to incorporate early in the process on matters related to the proposed action, environmental issues that should be addressed, potential alternatives, and sources of data that should be considered. It is an important requirement of the NEPA process, especially in determining the appropriate scope of the analysis. The CEQ guidelines for implementing NEPA and the NPS guidelines require that the NPS "make a 'diligent' effort to involve the interested and affected public on a proposal for which an EA is prepared" (NPS 2015b).

In accordance with *DO #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making* (NPS 2011) and NPS Management Policies (NPS 2006), the NPS conducted public scoping to ensure the project received input from all interested parties. The Public Scoping Report documents the result of the public scoping was finalized in June 2015. The report may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

The project was announced to the public on September 2, 2014 in a joint NPS/Everglades Foundation press release that was posted on the EVER website and distributed to media outlets. The release stated that the NPS would be moving forward with a project to address the damage to the ecosystem caused by the canals. The public scoping period for this project spanned from February 4 through March 8, 2015.

To ensure input was gathered from all interested parties, the public, agencies, and tribes were invited to provide input on and recommendations for the draft project purpose, need, objectives, and preliminary alternatives. Several questions were posted on NPS' Planning, Environment, and Public Comment (PEPC) website and the public were invited to participate in the scoping portion of the project. Correspondence from respondents ranged from strong support for the

project to strong opposition to the project. Some of the correspondence also supported some elements of the proposed action, while opposing other elements.

The general public, organizations, and agencies provided comments. The most common comments received were in reference to general project support or opposition, climate change and sea level rise, wildlife and threatened/endangered species, wilderness, backcountry recreation (non-motorized boating and fishing), new alternatives or elements of design, construction methodology, and monitoring and mitigation. This input was used by NPS to help refine the purpose, need, objectives, and alternatives and issues to be considered in this document. The public scoping report may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

1.5.2 Derivation of Issues and Impact Topics

Issues describe problems or concerns associated with current impacts from environmental conditions as well as problems that may arise from the potential future management of the Cape Sable plugs. The development of issue statements often sheds light on previously unrealized management opportunities that, if enacted, would bring about a greater beneficial change. Issues and concerns related to the restoration of the Cape Sable plugs were identified by EVER staff with input from the public, partners, and tribal organizations. Issues were grouped into areas of similar concerns, which are now being addressed as specific impact topics in this EA. Specific impact topics were identified based on the following: issues raised during scoping, federal laws, regulations, EOs, NPS Management Policies (NPS 2006), and NPS knowledge of limited or easily impacted resources.

1.5.3 Impact Topics Analyzed in this Environmental Assessment

The following impact topics are discussed and analyzed in Chapter 3. These topics are resources of concern that would be beneficially or adversely affected by the actions proposed under each alternative and are developed to ensure that the alternatives are evaluated and compared based on the most relevant topics. A brief rationale for the selection of each impact topic is given below as an issue statement. For those topics that were dismissed from further consideration, an explanation is provided.

1.5.3.1 Geology, Topography, and Soils.

Substantial soil erosion has occurred around the edges of the waterways potentially due to strong current. Restoration activities would serve to eliminate or reduce erosion along the banks. However, temporary impacts to soils that would occur because of construction activities will be considered.

Issue Statement: Restoration activities would eliminate or minimize bank erosion at each of the waterways, thus protecting the geologic resources at the plug sites and throughout the entire length of each waterway as the rate of canal widening due to erosion is expected to decrease when flow velocity is reduced. Temporary disturbance from construction activities such as the placement of earthen fill and erosion control measures such as riprap would temporarily alter geologic resources in the project area.

1.5.3.2 Water Resources.

1.5.3.2.1 Hydrology

The plug at Raulerson Canal failed in 2007, and flow through the canal continues to impact the hydrology of Cape Sable. The plugs at House and Slagle Ditch remain in place, although seepage through the plug on Slagle indicates imminent failure. Replacing the failed plug at Raulerson Canal would affect the hydrology of the Cape Sable system by permanently blocking flow through the canal except for times when tidal flow overtops the marl ridge. Reinforcing the plugs on Slagle and House Ditch will prevent the hydrologic changes that would occur when the current plugs are breached. Flow through East Side Creek may increase following restoration activities on Raulerson Canal.

Issue Statement: Restoration activities would impact the hydrology of the Cape Sable system. The flow of water through other nearby waterways would continue and may increase.

1.5.3.2.2 Water Quality

Waters throughout the park are designated as an Outstanding Florida Water (OFW) (designated in 1978); these waters provide the predominate water recharge for the Biscayne Aquifer, which serves as a drinking water source for most of south Florida . Therefore, no degradation of surface water quality is permitted. Currently, the water quality of the interior Cape Sable wetlands is being degraded by tidal saltwater intrusion and loss of freshwater. Restoration activities would reduce the unnatural exchange of water through the canals decreasing unnatural saltwater intrusion and increasing the retention of rainwater in the interior wetlands. Potential concerns for water quality also include short-term temporary increased turbidity from construction activities, as well as potential minor impacts from oil or gas release from construction equipment.

Issue Statement: Restoration activities would reduce the unnatural exchange of water through the canals, decreasing unnatural saltwater intrusion and increasing the retention rainwater in the interior wetlands, beneficially affecting water quality in the area. However, restoration activities have the potential to cause short-term temporary negative impacts to water quality from construction-related activities.

1.5.3.2.3 Vegetation and Wetlands

The majority of the project area is classified as wetland, an integral component of the EVER landscape. Since much of the Cape Sable area consists of wetlands, any new construction outside the existing footprint of the existing plugs has the distinct potential to impact wetlands (see **Figure 1.3**). The quality of the interior wetlands is currently being degraded by tidal saltwater intrusion and loss of freshwater caused by the waterways that were dredged through the marl ridge in the 1920s. The restoration activities would benefit the wetlands by decreasing saltwater intrusion and increasing freshwater retention. Potential construction-related impacts to wetlands include mangrove trimming required to transport construction equipment and materials to the project sites and increased turbidity related to construction.

Issue Statement: Restoration activities have the potential for construction-related negative impacts to wetlands. There is also the potential for beneficial impacts to wetland water quality

in the interior wetlands once these areas are governed by natural processes rather than the unnatural exchange of fresh and saltwater though the canals."

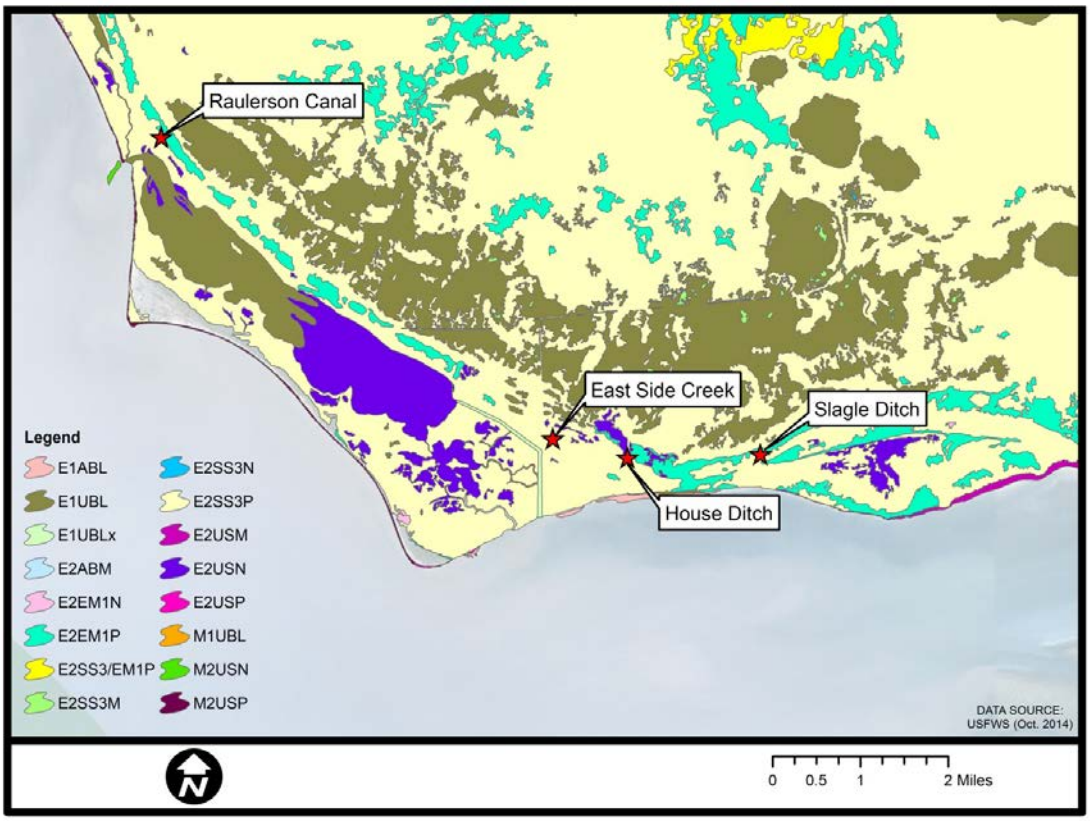


FIGURE 1.3 - CAPE SABLE AREA WETLANDS MAP

1.5.3.3 Wildlife and Habitat.

The Cape Sable area provides important habitat for a number of common and protected species. The mangroves provide feeding and nesting habitat for fish and wading birds. The terrestrial habitats and vegetation at the project area support various wildlife species. Restoration activities would cause both positive and negative impacts to the wildlife in the Cape Sable area. Plugging the man-made canals would decrease saltwater intrusion and increase freshwater retention in the interior Cape Sable wetlands; juvenile crocodile habitat, wading bird foraging habitat, and fish habitat may all be improved. Potential negative impacts to wildlife habitat would be caused by construction-related activities such as the placement of fill material, soil disturbance, and mangrove trimming. Short-term and temporary noise and vibration impacts from construction could also occur.

Issue Statement: The Cape Sable area of EVER contains important habitat for a number of species. Restoration activities have the potential to temporarily impact these species through habitat modification and/or loss and increased levels of disturbance. In addition, beneficial effects may occur from a decrease in disturbance from motorized boaters and wildlife habitat may improve when the water quality of interior wetlands are governed by natural processes.

1.5.3.4 Marine Resources and Essential Fish Habitat.

The marine and estuarine resources of the Cape Sable area include important park elements such as submerged aquatic vegetation (seagrass communities), mangroves, wading birds, crocodiles, manatees, and wetlands. These elements collectively form a valuable entity to be considered in the assessment of alternatives for the Cape Sable plugs' restoration. Restoration activities would improve protection for marine resources by decreasing suspended sediment loads and nutrients transported from the interior wetlands of Cape Sable to habitats in the Gulf of Mexico, Florida Bay, and the Florida Reef Tract. Habitat conditions within the interior wetlands of Cape Sable may also improve when the canal is blocked. Salt and freshwater will no longer be exchanged through the Raulerson canal and marine sediments will not be deposited in interior wetlands." Potential negative impacts to marine resources would be caused by construction-related activities such as the placement of fill material, and increased turbidity. Fish stocks would also be partially isolated by the restored plugs, though other natural creek connections to the greater Cape Sable system exist.

EFH essential to the long-term survival and health of our nation's fisheries, exists in the Cape Sable area of EVER. EFH is highly dependent upon variables such as temperature, nutrients, and salinity. The proposed project would decrease saltwater intrusion and increase freshwater retention in the interior Cape Sable wetlands, which are designated as EFH, thus improving their quality. Potential negative impacts to EFH would occur from construction-related activities in the form of increased turbidity and the placement of fill material. Connectivity would also be partially blocked by the restoration of the plugs, though other natural creek connections to the greater Cape Sable system exist.

Issue Statement: The Cape Sable area of EVER contains important marine resources such as submerged aquatic vegetation (seagrass communities), hard bottoms, mangroves, and wetlands, most of which would be categorized as EFH. The proposed project has the potential to benefit these resources through decreased saltwater intrusion and increased freshwater retention in the interior Cape Sable wetlands. The potential for construction-related negative impacts also exists, including partial isolation of fish populations.

1.5.3.5 Protected Species.

EVER, including the Cape Sable area, is a unique ecosystem that is home to numerous federal- and state-listed threatened and endangered species and other protected species. The term "protected species" is used here to encompass any plant or animal that is legally protected because it is endangered, threatened to become endangered, or one of special concern. Legal protection may be at the federal, state, or local level. It is expected that the proposed projects would result in both positive and negative impacts to the special status species in the Cape Sable area. The restoration activities would decrease saltwater intrusion and increase freshwater retention in the interior wetland areas of Cape Sable. Juvenile crocodile habitat, smalltooth sawfish critical habitat, wading bird foraging habitat, and EFH may be improved. Potential negative impacts would be construction related. Increased turbidity during construction could potentially temporarily negatively impact the smalltooth sawfish and sea turtles.

1.5.3.5.1 Federally Listed Species

As discussed in Section 1.3.2.2, federal protection is designated via an endangered or threatened listing under the ESA. A species listed as "endangered" is considered to be in danger of extinction, while a "threatened" species is considered likely to become endangered within the foreseeable future unless the species and/or its habitat are protected and managed.

Federally listed **endangered** animals that have the potential to utilize the Cape Sable study area include:

- Atlantic hawksbill sea turtle (*Eretmochelys imbricata*);
- Atlantic leatherback sea turtle (*Dermochelys coriacea*);
- Atlantic Ridley sea turtle (*Lepidochelys kempii*);
- Florida panther (*Felis concolor coryi*);
- Green sea turtle (*Chelonia mydas*);
- Smalltooth sawfish (*Pristis pectinata*); and
- West Indian manatee (*Trichechus manatus*).

Federally listed **threatened** animals that have the potential to utilize the Cape Sable study area include:

- The Florida population of the American crocodile (*Crocodylus acutus*);
- Eastern indigo snake (*Drymarchon corais couperi*);
- Loggerhead sea turtle (*Caretta caretta*); and
- Wood stork (*Mycteria americana*).

In 2007, the bald eagle (*Haliaeetus leucocephalus*) was removed from the endangered species list; however, bald eagles are still protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Act. No known federally listed plant species occur within the Cape Sable study area. A discussion of federally listed species with the potential to occur in the Cape Sable study area is provided in Section 3.7.

The state of Florida also has regulations for the protection of threatened and endangered species. The Florida Endangered and Threatened Species Act (Title 28, F.S., Section 372.072) is the primary regulation and sets the policy to conserve and wisely manage these resources, as well as provide for research and management to conserve and protect these species as a natural resource. This act also emphasizes coordination with other state agencies, and outlines annual reporting requirements as well the development of specific biological goals for manatees. It prohibits the intentional wounding or killing of any fish or wildlife species designated by the FWC as "endangered," "threatened," or of "special concern". This prohibition also extends to the intentional destruction of the nests or eggs of any such species.

The protection of endangered, threatened, or "commercially exploited" plants is addressed in the Preservation of Native Flora of Florida Act (F.S. Section 581.185). Commercially exploited plants are defined as native species which are subject to being removed in substantial numbers and sold or transported for sale. This act sets Florida's policy relating to these species and includes several prohibitions covering the "willful destroying or harvesting" of such plants. It also contains an exemption for agricultural and silvicultural uses.

1.5.3.5.2 State-Listed Species

In addition to federally threatened and endangered species, the state of Florida lists "species of special concern," which are species undergoing consideration for state threatened or endangered listing which do not yet have a state management plan. F.A.C. Chapter 68A-27.005 states "No person shall take, possess, transport, or sell any species of special concern … or parts thereof or their nests or eggs except as authorized by permit from the [Florida Fish and Wildlife Conservation Commission (FWC)] executive director…"

Protected state-listed wildlife that has the potential to utilize the habitat resources of the Cape Sable study area includes:

- Brown pelican (*Pelecanus occidentalis*)
- Little blue heron (*Egretta caerula*)
- Osprey (*Pandion haliaetus*)
- Roseate spoonbill (*Ajaia ajaja*)
- White crowned pigeon (*Columba leucocephala*)

A discussion of state-listed species of special concern with the potential to occur in the Cape Sable study area is provided in Section 3.7, Special Status Species.

Issue Statement: The Cape Sable area of EVER contains federally protected animal species as well as state-listed plant and animal species. Restoration activities have the potential to impact these species through habitat modification and/or loss and increased levels of disturbance. In addition, beneficial effects may occur in the form of improved wildlife habitat.

1.5.3.6 Wilderness.

EVER is the largest designated wilderness area east of the Rocky Mountains (1,296,000 acres). The Cape Sable area includes both submerged and terrestrial wilderness. Many visitors experience the vast wilderness of Cape Sable, so maintaining and enhancing the park's wilderness values is critical to meeting park goals for protecting its wilderness resources and offering high-quality wilderness experiences. All federal land management agencies currently recognize several qualities of wilderness character - untrammeled, natural, undeveloped, and solitude or primitive and unconfined recreation. Analyzing the impacts that the proposed project would have on these four qualities will allow EVER to determine the effect of the project on wilderness character.

The natural quality of the wilderness area north of the marl ridge is currently being degraded by the unnatural exchange of salt and freshwater though the canals. Restoration activities have the potential to beneficially affect the natural quality of the wilderness by reestablishing the natural function of the marl ridge and restoring natural ecological processes to the Cape Sable region. However, these same activities would have short-term negative consequences to the undeveloped, the untrammeled, and the solitude or primitive and unconfined recreation qualities of wilderness character The wilderness areas immediately adjacent to the existing canals would be negatively impacted by motorized and mechanized construction equipment, these impacts are expected to be short-term and temporary. Noise is expected to affect the solitude of the area while the work is being performed. There would also be restrictions on public access, for safety reasons, to areas around the plugs while construction is ongoing. The plugs would also have a long-term impact to the wilderness character of Cape Sable. Once

construction is complete, the presence of manmade features in the wilderness would have a long-term effect on the undeveloped and untrammeled qualities as well as opportunities for solitude and primitive recreation. Visitors may use the plugs as picnic areas, giving the impression of an agency provided recreation area, which would be detrimental to the solitude and primitive recreation quality of wilderness.

Issue Statement: Restoration activities have the potential to produce long-term beneficial impacts to the natural quality of wilderness. Construction would have a short-term negative impact to the undeveloped, the untrammeled, and the solitude or primitive and unconfined recreation qualities. The plugs would have a long-term negative impact to the undeveloped, the untrammeled, and the solitude or primitive and unconfined recreation quality of wilderness character.

1.5.3.7 Cultural Resources.

New South Associates, Inc. completed the fieldwork for the archaeological survey, conducted following all permit conditions under ARPA Permit EVER 2015-001. Three historic properties were identified during the September 9-10, 2015 field survey. The Raulerson Brothers Canal (8MO2350; aka Raulerson Canal) is recommended as eligible for listing on NRHP. This is based on its possible association with the Raulerson brothers and early 20th century cattle grazing, and on its known association with the 20th century development of the Cape Sable region. House Ditch and plug (8MO2351) and Slagle Ditch and plug (8MO2352) are both recommended as eligible for listing on the NRHP. This is based on their association with the 20th century development of the Cape Sable region and with the mid-20th conservation efforts of EVER.

The proposed project would include changes to the physical integrity of these three properties, but would not affect their significance with regard to associations with the Raulerson brothers or cattle grazing, land development, and/or conservation efforts at Cape Sable. In contrast, the proposed restoration will protect these resources through continued protection and maintenance. NPS anticipated that the proposed undertaking will have no adverse effect on these three historic properties.

The NPS would coordinate with the Florida State Historic Preservation Officer (SHPO) to avoid or mitigate long-term adverse impacts to these structures due to construction activities. Prior to construction, archaeological surveys of all areas proposed for ground disturbance would be completed to ensure that significant archaeological resources (if identified within the areas of potential effect) are avoided and protected from construction activities. If avoidance is not feasible, appropriate data recovery or other mitigation measures would be carried out by the NPS in consultation with the SHPO and affiliated tribal preservation offices. Archaeological resources were dismissed from detailed analysis in this document (See Section 1.5.4.2).

Issue Statement: Minor to moderate adverse impacts to the canals, which are eligible historic structures, would be minimized through project design or mitigation measures. Long-term beneficial effects would result from slowing the widening of the canals from the current erosional processes. The cultural survey report may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

1.5.3.8 Visitor Use and Experience.

EVER draws visitors from around the globe, offering unique and spectacular wildlife, recreational opportunities, and solitude (NPCA 2005). The EVER keeps track of the total number of visitors that enter the park through its two entrance stations (Homestead and Shark Valley). While this doesn't include those who enter through the nearly 1/2 million acres of surrounding waters, it helps park managers identify the needs of visitors. Average visitation for the past few years has been about one million visitors annually (NPS 2015a).

The Cape Sable area experiences high visitor use within the EVER. Visitors use the Cape Sable area for fishing, canoeing/kayaking, motorized boating, camping, and exploration (i.e., hiking and birding). Short-term negative impacts would occur during construction from closing the construction area to visitors and increased noise in the general area.

Issue Statement: Visitor experience at Cape Sable has been both positively and negatively impacted by the canals. While the canals have had a negative impact to wildlife populations, and therefore the opportunity for visitors to view species such as crocodiles and roseate spoonbills, many visitors use the canals for fishing and enjoy the deepwater habitat they provide. Overall, restoration activities would improve visitor experience in the area. Short-term impacts to visitor use and experience would occur during construction.

1.5.3.9 Park Management and Operations.

The status of the failed plug on Raulerson Canal and the eroding plugs on House and Slagle Ditches require additional enforcement and research attention from park staff. Restoration of the plugs would negatively impact park management and operations. Education and interpretation, maintenance and monitoring, enforcement, and research and monitoring would all require current or increased effort from NPS personnel at the plug sites.

Issue Statement: Restoration of the eroded and failed plugs at Cape Sable would maintain or increase the current levels of education and interpretation, maintenance and monitoring, enforcement, and research needs.

1.5.4 Impact Topics Dismissed from Detailed Analysis

The following impact topics were dismissed from further consideration. The rationale for dismissal is provided below.

1.5.4.1 Air Quality.

EVER is located in a designated Class I air quality area under the Clean Air Act that is currently within a designated attainment area (i.e. concentrations below standards) for criteria pollutants. Lands with this designation are subject to the most stringent air quality regulations. Very limited increases in pollution are permitted in the vicinity. The air quality of the area is a valuable park resource, enhancing visitation by providing clean air and high visibility to match the unique ecosystem experience. The Clean Air Act of 1963 (42 U.S.C. § 7401) requires federal land managers to protect air quality, and the NPS Management Policies (NPS 2006) requires air quality to be analyzed when planning park projects and activities.

If restoration activities were conducted, emissions generated from transport and construction equipment would be mitigated. Further, they would not measurably contribute negatively to air quality conditions or adversely affect visitors or staff. Because of the high water table, it is unlikely that large quantities of dust would be generated, and any occurrence of fugitive dust would be localized and very transient. If dust were generated during construction, best management practices for dust suppression would be initiated. Emissions from construction equipment would be kept to a minimum by restricting idling time.

Based on an analysis of fuel used for construction of the project, the level of greenhouse gas emissions produced would range from 98 to 374 metric tons of carbon equivalent (MTCE). As stated above, best management practices and mitigation measures would be used to minimize the project's carbon footprint and its contribution to global climate change. When compared to the approximately 6.7 billion MTCE of greenhouse gas emissions produced in the nation in 2013 (EPA 2015), the emissions resulting from this project would be negligible and would not substantially contribute to air quality impacts.

Implementation of any of the alternatives described in the plan would have negligible effects on air quality, and the Class I air quality status of the park would be unaffected. Therefore, air quality was dismissed from detailed analysis in this EA.

1.5.4.2 Archaeological Resources.

No known archaeological resources or prehistoric/historic structures exist in the Cape Sable study area. Field surveys conducted in September 2015 did not identify any prehistoric resources. As a standard practice, if archaeological resources are discovered during construction, construction would be temporarily halted in the area of the discovery and the NPS would consult with the SHPO and affiliated tribes. The coordination would assess the significance of the resources and determine how to appropriately avoid, protect, and/or mitigate adverse impacts to the resources. Therefore, archaeological resources and prehistoric/historic structures were not analyzed in detail as a separate topic in this EA.

1.5.4.3 Conflicts with Land Use Plans, Controls, or Policies.

The proposed project seeks to allow natural processes to govern ecological processes and make recreational access in Cape Sable more compatible with park controls and policies. These actions are compatible with, and not in conflict with, local land use plans, controls, or policies. Therefore, this topic was not analyzed in detail in this EA.

1.5.4.4 Cultural Landscapes.

According to NPS DO #28: Cultural Resource Management Guideline, a cultural landscape is:

> *"a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of settlement, land use, systems of circulation, and the types of structures that are built. The character of a cultural landscape is defined both by the physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting cultural values and traditions."*

There are no designated cultural landscapes in the Cape Sable area of EVER. Therefore, there would be no impacts to cultural landscapes and this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.5 Ecologically Critical Areas.

EVER does not contain any designated ecologically critical areas, wild and scenic rivers, or other unique natural resources, as referenced in 40 CFR 1508.27. Therefore, this issue was not analyzed in detail as a separate impact topic in this EA.

1.5.4.6 Energy Requirements and Conservation Potential.

There would be no permanent energy requirements resulting from the proposed restoration activities. Energy requirements during construction would be negligible to minor, short term, and temporary. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.7 Environmental Justice.

EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (NPS 1994) directs all federal agencies to assess whether their actions have disproportionately high and adverse human health or environmental effects on minority and low-income populations and communities.

Federal agencies can incorporate environmental justice into their missions by analyzing and evaluating disproportionately high and/or adverse effects of their actions on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risk of the decision.

Guidelines for implementing this EO under NEPA are provided by the CEQ. According to the US Environmental Protection Agency, environmental justice is:

> *the fair treatment and meaningful involvement of all people, regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic group, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. The goal of "fair treatment" is not to shift risks among populations, but to identify potentially disproportionately high and adverse effects and identify alternatives that may mitigate these impacts.*

There are both minority and low-income populations in the general vicinity of EVER. However, based on the initial environmental screening for the project, environmental justice is dismissed as an impact topic because:

- Impacts associated with implementation of each alternative, including the Preferred Alternative, would not disproportionately adversely affect any minority or low-income

population or community or any other socially or economically disadvantaged populations.

- Implementation of each alternative, including the Preferred Alternative, would not result in any identified effects specific to any minority or low-income community.
- NPS staff actively solicited public participation as part of the planning process and gave equal consideration to input from all persons, regardless of age, race, income status, or other socioeconomic or demographic factors.
- The NPS staff does not anticipate that any adverse impacts on public health and/or the socioeconomic environment would appreciably alter the physical and social structure of the nearby minority or low-income populations or communities.

1.5.4.8 Ethnographic Resources.

As defined by the NPS Management Policies (NPS 2006), ethnographic resources are the cultural and natural features of the park that are of traditional significance to traditionally associated peoples. These peoples are the contemporary park neighbors and ethnic or occupational communities that have been associated with the park for two or more generations (40 years), and whose interests in the park's resources began before the park's establishment. Ethnographic resources can include sacred sites that have spiritual and religious significance to tribes and other traditionally associated groups, and may serve as the locations of ceremonial activities.

The history of EVER includes settlement and the use of waters for fishing for both sustenance and profit by both Native Americans and early settlers to the area. The Miccosukee and Seminole tribes claim the Everglades as a homeland and traditional use area before the park's establishment. Fishing for subsistence and profit has occurred at the park since the early 1900s and may be considered an ethnographic use. However, since the law prohibits commercial fishing, this ethnographic use has been terminated. Project alternatives would not interfere with any other ethnographic uses. Due to the location, minimal construction footprint of the project, and availability of alternative access routes during construction, impacts from construction, if any, to ethnographic resources would be negligible. Therefore, this issue was not analyzed in detail as a separate impact topic in this EA.

1.5.4.9 Floodplains.

In accordance with EO 11988, "Floodplain Management," and DO #77-2, "Floodplain Management," it is NPS policy to preserve floodplain values and minimize potentially hazardous conditions associated with flooding. If a proposed action is found to be in a regulatory floodplain and it is not practicable to relocate it to a site outside of the floodplain, NPS will prepare a SOF, in accordance with procedures described in Procedural Manual #77-2: Floodplain Management, and take all reasonable actions to minimize the impact to the natural resources of floodplains. The SOF quantifies the flood conditions and associated hazards as a basis for management decision-making.

However, Section V.B. Excepted Actions of DO #77-2: Floodplain Management states that "this procedure does not apply to certain park functions that are often located near water for the enjoyment of visitors but require little physical development and do not involve overnight occupation. Examples include… isolated backcountry sites, natural or undeveloped sites along trails or roads, survey and study sites, or other similar activities". Thus, due to the remote,

isolated, backcountry nature of the Cape Sable region this exception applies. In accordance with procedures described in Procedural Manual #77-2: Floodplain Management, this project meets the exception as listed in Section V.B. Therefore, this issue was not analyzed in detail as a separate impact topic in this EA.

1.5.4.10 Gateway Communities and Urban Quality.

Gateway communities are cities or towns adjacent to national parks and other protected areas. Visitors often use these communities as an entry point or "gateway" into the parks and enjoy their amenities – staying in their hotels, eating meals, purchasing supplies, and learning about the park's natural and cultural resources. Although Homestead, Florida City, and the Redland area of south Miami-Dade County are located adjacent to the park and provide food and lodging for a number of park visitors, these communities are not officially designated gateway communities for the park and would not be impacted by the proposed action alternatives. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.11 Indian Trust Resources.

Indian Trust Resources are owned by American Indians but held in trust by the United States. Requirements are included in the Secretary of the Interior's Secretarial Order 3206, *American Indian Tribal Rites, Federal – Tribal Trust Responsibilities,* and *the Endangered Species Act* and Secretarial Order 3175, *Departmental Responsibilities for Indian Trust Resources*. According to park staff, Indian Trust Resources do not occur within the park. There are no Indian Trust Resources downstream of the project area. Therefore, there would be no downstream effects on Indian Trust Resources from any of the proposed alternatives. Thus, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.12 Museum Collections.

EVER's museum collection consists of over 2.8 million objects, archival documents and photographs, and specimens. The collection preserves the history, culture, and research of the park. The museum collections are managed by the South Florida Collections Management Center located within EVER. There are no museum collections that would be affected by the implementation of the proposed project. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.13 Natural or Depletable Resource Requirements and Conservation Potential.

The NPS uses sustainable practices to minimize the short- and long-term environmental impacts of development and other activities through resource conservation, recycling, waste minimization, and the use of energy-efficient and ecologically responsible materials and techniques. Implementation of the proposed project would not compete with dominant park features or interfere with natural processes, such as the seasonal migration of wildlife or hydrologic activity associated with wetlands. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.14 Night Sky.

The Cape Sable area of EVER is located in a remote area of the park away from developed areas; therefore, the night sky is considered a resource. Since lighting is not a component of any of the action alternatives and construction activities are anticipated to occur only during daylight hours, no impacts to night sky would occur. Therefore, night sky was not analyzed in detail as a separate impact topic in this EA.

1.5.4.15 Prime and Unique Farmlands.

Prime farmland has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops. Unique agricultural land is land other than prime farmland that is used for production of specific high-value food and fiber crops. Both categories require that the land is available for farming uses. Lands within the park are not available for farming and therefore do not meet the definitions. Therefore, this issue was not analyzed in detail as a separate impact topic in this EA.

1.5.4.16 Socioeconomics.

The restoration activities are not anticipated to have an adverse or a beneficial effect on the local economy. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.17 Soundscapes.

The soundscape of the Cape Sable area would be temporarily impacted by construction-related activities. Temporary noise impacts to wildlife and visitor use will be addressed in Chapter 3. No long-term impacts to soundscapes are anticipated as a result of this project. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.4.18 Transportation.

Access to all park roads would not be impacted by any of the proposed action alternatives since construction staging areas will be located outside of the park. The exact location of the staging area will be the responsibility of the park. Therefore, this issue was not analyzed in detail as a separate topic in this EA. However, traffic impacts are assumed to be minor since the volume of construction equipment and materials will be limited to the capacity of the shallow draft transportation barge needed to access both work zones. Therefore, transportation of materials and equipment to upland staging area(s) can be phased to prevent adverse traffic congestion. Therefore, this issue was not analyzed in detail as a separate topic in this EA.

1.5.5 Relationship to Other Plans, Policies, and Actions

1.5.5.1 NPS Plans, Policies, and Actions.

NPS plans, policies, and actions beyond those listed previously that may influence the restoration of the Cape Sable plugs are provided below:

1.5.5.1.1 Cape Sable Canals Dam Restoration Project- Phase I

The FONSI for the Cape Sable Dam Restoration Project - Phase I was approved on February 17, 2010. The Phase I project was necessitated by two major issues: failed structures that created hazardous conditions for the boating public by allowing illegal entry of motor boats into the Marjory Stoneman Douglas Wilderness area, and twice-daily intrusion of salt water into the interior wetlands of Cape Sable, resulting in adverse impacts on the native habitat for the American crocodile. The man-made Cape Sable canals cut through a low ridge of marl soil along the edge of the cape, historically retaining freshwater, which enabled fresh water to drain from interior wetlands and salt water from the Gulf of Mexico to penetrate inland. Higher salinity in interior marshes reduced juvenile crocodile habitat suitability and lowered the productivity of forage fishes. This was affecting the ability for wading birds and other fauna to forage efficiently. In 2011, NPS replaced the two failed plugs at Homestead and East Cape Extension Canals with the aim of reducing saltwater intrusion and restoring the Cape Sable wetlands to a more natural state. The new plugs are having long-term beneficial effects on the natural qualities of the Cape Sable area.

1.5.5.1.2 EVER General Management Plan / East Everglades Wilderness Study / Environmental Impact Statement

The General Management Plan / East Everglades Wilderness Study / Environmental Impact Statement (GMP/EEWS/EIS) for Everglades National Park was approved on October 23, 2015. The GMP is a 20-year vision for the park's resource protection and management and is designed to support the restoration of natural systems and protection of cultural resources while providing improved opportunities for a quality visitor experience. During its development, NPS conducted extensive civic engagement to identify the issues and concerns to be addressed in the plan. More than 100 public, elected officials, agency, tribal, and stakeholder group meetings were held, and more than 15,000 comments were received. The GMP will employ management zoning and collaborative techniques such as adaptive management, user education, and a national park advisory committee focused on shallow-water marine resources and use.

1.5.5.1.3 EVER 2015 Fire Management Plan

NPS' updated Fire Management Plan and associated EA was approved on November 5, 2015. This plan improves management of wildland fire so that threats to humans and property are reduced while restoring and/or maintaining its function as a natural process. Fire is occasionally used in the Cape Sable area to help control non-native vegetation such as Old World climbing fern (*Lygodium microphyllum*). This plan continues to guide fire management in the Cape Sable area and throughout the park.

1.5.5.1.4 South Florida and Caribbean Parks Exotic Plant Management Plan

In 2010, the NPS completed an exotic vegetation management plan and environmental impact statement to control non-native plant species in the south Florida and Caribbean NPS units. The plan guides the control and reduction of non-native plant species in the project area and throughout the park.

1.5.5.1.5 EVER Hurricane Response Plan

In addition to the plans provided above, EVER has a Hurricane Response Plan that is currently followed at the park.

1.5.5.1.6 NPS Management Policies 2006

NPS Management Policies Section 4.7.2, regarding weather and climate, states that the NPS would "gather and maintain baseline climatological data for reference" for parks containing "significant natural resources" (NPS 2006). The NPS further states that "the Service would not conduct weather-modification activities" in an attempt to alter naturally occurring conditions in the park (NPS 2006). The NPS would conduct mitigation activities within the park in an attempt to mitigate the effects of climate change.

1.5.5.2 Other Federal Plans, Policies, and Actions.

1.5.5.2.1 Comprehensive Everglades Restoration Plan (CERP)

In December 2000, CERP was signed into law. This comprehensive plan seeks to restore the south Florida ecosystem while providing water for urban and agricultural uses and maintaining flood control. The CERP approach is to restore the "quantity, quality, timing, and distribution" of freshwater to the natural system. The comprehensive plan includes more than 65 projects designed to capture, store, and redistribute freshwater and encompasses 16 counties and 18,000 square miles of the Greater Everglades ecosystem, including Florida Bay. This is the largest hydrologic restoration project ever undertaken in the US; CERP implementation is anticipated to cost more than $10.5 billion and take 35+ years.

Three CERP projects are of particular importance to improving hydrologic conditions in EVER. The decompartmentalization of Water Conservation Area-3 includes filling canals and removing levees to restore natural sheetflow and ecological connectivity. ENP Seepage Management seeks to reduce water loss along the eastern park boundary. The C-111 Spreader Canal Project is designed to restore natural flows to Florida Bay and rehydrate the southeastern coastal marshes (South Florida Natural Resources Center 2015).

1.5.5.2.2 Central Everglades Planning Project (CEPP)

While CERP has been successful in restoring areas around the periphery of the Everglades, projects in the central and southern Everglades identified in the CEPP, including in and around

EVER, have not made as much progress. The CEPP combines a number of restoration projects, including several that were originally part of CERP, into one plan to ultimately allow more water to be directed south to the central Everglades, EVER, and Florida Bay.

The CEPP focuses restoration on more natural flows into and through the central and southern Everglades, restoring more natural water flow, depth, and durations into and within the central Everglades while reducing harmful flows from Lake Okeechobee to the northern estuaries. This project seeks to deliver approximately 25% more water to EVER via Shark Slough.

1.5.5.2.3 National Register of Historic Places (NHRP)

Several park facilities and/or structures are currently under consideration for nomination to the NRHP including several Mission 66 structures at Flamingo, and the potential nomination of areas to the Underground Railroad network, and the historic Ingraham Highway and associated canals. The Bear Lake mounds complex is listed as an Archeological District on the NRHP. The pre-historic Mud Lake Canal was designated a National Historic Landmark (NHL) on September 20, 2006.

1.5.5.2.4 Modified Water Deliveries (MWD) to Everglades National Park Project

The MWD Project was initiated by Congress as part of the 1989 Everglades Expansion and Protection Act and was designed to correct the unnatural spatial distribution of water in EVER. An ecological restoration project that precedes the CERP, the purpose of the MWD Project is to help reestablish natural hydrologic conditions in EVER and improve the connectivity for wildlife, which were altered by the construction of roads, levees, and canals. The MWD Project consists of structural modifications and additions to the Central and Southern Florida Project (C&SF Project) that improves the timing, distribution, and quantity of water flow to the Northeast Shark River Slough providing restoration benefits to EVER and Florida Bay.

1.5.5.2.5 Tamiami Trail 2

The Tamiami Trail 2 project is being conducted under a separate authority to MWD and is designed to augment the benefits of the MWD Tamiami Trail component. The purpose of the Tamiami Trail Modifications project (Tamiami Trail 2) is to improve water flow from north of Tamiami Trail to Northeast Shark River Slough within EVER. An EIS has been approved for this project and the NPS is currently positioning to contract with a design-build team for the preferred alternative.

1.5.5.3 Other State and Local Plans, Policies, and Actions.

Other state and local plans, policies, and actions that would need to be considered include the following:

1.5.5.3.1 Florida Circumnavigational Saltwater Paddling Trail

Beginning near Pensacola, extending around the Florida peninsula and Keys, and ending near the Georgia border, this sea kayak trail around Florida's entire coast is coordinated by the FDEP Office of Greenways and Trails. It brings paddlers to various areas along the 26 segments of the 1,515-mile sea kayaking trail that traverses the remote Big Bend Coast and Everglades/Florida Bay wilderness to the urbanized coastlines of Pinellas County and Fort Lauderdale. Each segment has reliable managers to coordinate with land managers, private businesses, and volunteers. The paddling trail assists in educating those who utilize the trail about Florida's fragile coastal environment; the 20 national parks, seashores, wildlife refuges, and marine sanctuaries; 37 Florida aquatic preserves; and 47 Florida state parks, along with numerous local parks and preserves. The trail incorporates several existing local and regional trails such as the Gulf and Wilderness waterways in EVER. Segment 14 of the trail extends from Everglades City to Long Key State Park and includes the 99-mile Wilderness Waterway and Florida Bay in EVER. The trail relies heavily on the involvement and cooperation of numerous other government agencies at the federal, state, regional, and local levels, along with private outfitters, businesses, paddling clubs, and individual volunteers (FDEP 2016).

Chapter 2

The Alternatives

CHAPTER 2: ALTERNATIVES

2.1 DEVELOPMENT OF THE ALTERNATIVES

NEPA implementing regulations require the decision maker to consider the environmental effects of the proposed action and a range of alternatives (40 CFR § 1502.14). The range of alternatives includes reasonable alternatives that must be rigorously and objectively explored, as well as other alternatives that are eliminated from detailed study. To be "reasonable," an alternative must meet the stated purpose of and need for action and be technically and economically feasible. Project alternatives may originate from the proponent agency, local government officials, or members of the public at public meetings, or during project development. Alternatives may also be developed in response to comments from coordinating or cooperating agencies. The alternatives analyzed in this document are the result of internal scoping and public scoping.

The project alternatives were originally developed in an April 2012 report prepared for NPS by URS Corporation entitled *Engineering Analysis and Feasibility of Repairing and Replacing Failed Dams and Limiting Salt Water Intrusion in Cape Sable Everglades National Park* (2012 Feasibility Study) and refined during the EA project scoping process. The 2012 Feasibility Study described a No Action alternative for all plug sites, three Action Alternatives for House and Slagle Ditches, and four Action Alternatives each for Raulerson Canal and East Side Creek and is incorporated into this EA by reference (URS 2012). The Feasibility Study may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.The locations of each alternative are shown on **Figure 2.1**.

An Internal Scoping Meeting was held on October 21, 2014 to further analyze and refine the design alternatives for the four plug locations. Follow-up meetings were held on November 6, 2014 to discuss the inclusion or exclusion of the proposed East Side Creek plug in the NEPA document, and on December 3, 2014 to discuss Climate Change and Sea Level Rise in reference to this project. These meetings resulted in a clarification in purpose, needs, objectives, the proposed No Action alternative for all four plug sites, five Action Alternatives each for House Ditch and Slagle Ditch, three Action Alternatives for Raulerson Canal, and two Action Alternatives for East Side Creek.

To ensure input was gathered from all interested parties, the public, agencies, and tribes were invited to provide input on and make recommendations for the draft project purpose, need, objectives, and preliminary alternatives. Several questions were posted on the NPS' PEPC website and the public were invited to participate in the scoping portion of the project. Correspondence from respondents ranged from strong support for the project to strong opposition to the project. Some of the correspondence also supported some elements of the proposed action, while opposing other elements. In general, comments were provided by the public, organizations, and agencies. The most common comments received were in reference to general project support or opposition, climate change and sea level rise, wildlife and threatened/endangered species, wilderness, backcountry recreation (non-motorized boating and fishing), new alternatives or elements of design, construction methodology, and monitoring and mitigation. This input was used by NPS to help refine the purpose, need, objectives, and alternatives and issues to be considered in this EA. The Public Scoping Report was finalized in June 2015; it may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

FIGURE 2.1 - PROJECT LOCATIONS

2.1.1 No Action Alternative

The purpose of including a No Action Alternative in the environmental analysis is to ensure that agencies compare the potential impacts of the proposed action to the impacts of maintaining the status quo. The No Action Alternative may be thought of in terms of continuing with the present course of action with the current conditions and expected future conditions if the proposed project was not implemented. By using the current conditions of the No Action Alternative as a benchmark, the impacts of the proposed alternatives can be directly compared to the existing baseline.

2.1.2 Action Alternatives

Action alternatives were further developed by the NPS and from public input obtained during project scoping. The collective efforts in documenting the requirements for the project formed the basis for development of the proposed action alternatives, including the Preferred Alternative.

NEPA regulations require that the agency evaluate ways to mitigate adverse environmental impacts associated with implementation of the proposed alternatives (40 CFR § 1502.16). Each alternative analyzed in this EA includes mitigation measures, such as best management practices (BMP) and standard operating procedures (SOP), intended to reduce the negative environmental effects of restoration activities (See Section 2.5, Mitigation Measures).

Environmental-related investigations were carried out to assist in the development of mitigation measures. These included topographic/bathymetric survey, wetland/mangrove assessments, protected species assessments, archaeological investigations, and marine benthic

assessments for each of the proposed plug sites, surrounding vicinities, and potential accessways required for construction.

NPS conducted a minimum requirements analysis (MRA) of the preliminary alternatives in accordance with DO #41 (see Section 1.3.1.3.3). This analysis determined that the restoration of plugs is necessary for the management of the Cape Sable area as wilderness, and also recommended a preferred alternative at each site that would minimize adverse impacts on wilderness character. This analysis informed the decisions to dismiss some of the initial action alternatives as discussed below. The MRA is incorporated by reference and may be reviewed on the project website at: http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

2.2 ALTERNATIVES CONSIDERED BUT DISMISSED

Based on the preliminary analysis, internal scoping with the NPS, and public scoping, the following alternatives were considered and dismissed from further analysis:

2.2.1 East Side Creek

The East Side Creek alternatives considered placing a plug in East Side Creek upstream of the confluence with East Cape Canal. Two plug types were considered - a sheet pile only plug, and a sheet pile plug with fill, identical to the plug currently in place on East Cape Canal. The NPS also considered including a flow discharge structure in the design of the plug, which would allow water to flow over the plug during high water events and would provide fish and other aquatic wildlife access to the interior wetlands of Cape Sable. After careful consideration of internal and public scoping comments, the East Side Creek alternatives were dismissed from further consideration.

As part of the first phase of the Cape Sable project, which restored the plugs on the Homestead and East Cape Canals, the NPS was required to consult with NOAA Fisheries on the smalltooth sawfish. The sawfish is a federally endangered species; juvenile sawfish rely on red mangrove shorelines and use creeks and canals as habitat. NOAA Fisheries agreed to allow the first phase of the Cape Sable project to proceed, as long as East Side Creek would remain open to provide a pathway for sawfish to access the interior wetlands. In 2009, NOAA Fisheries designated critical habitat for the smalltooth sawfish under the Endangered Species Act. The Cape Sable area is included under this designation.

Although connected to the East Cape Canal, East Side Creek is a natural feature, and implementing a hard, permanent, physical structure in a natural creek in designated wilderness is very challenging. Plugs existed at Raulerson Canal, Slagle Ditch, and House Ditch at the time of the Everglades Wilderness designation. No such feature has ever existed on East Side Creek. From a wilderness perspective, the benefits to the natural quality of wilderness character would need to outweigh the combined permanent negative effects on the untrammeled, undeveloped, and opportunities for solitude and primitive recreation qualities of wilderness character. While the exchange of water through East Side Creek has similar impacts as the canals on the interior wetlands of Cape Sable, such as the intrusion of seawater, loss of freshwater and sediment exchange, NPS determined that the role this creek played in the area was natural and not contrary with the purpose of the project which is to restore the preeminence of natural processes in the Cape Sable ecosystem. This determination is consistent also with the Everglades NP enabling legislation, which states: “The...area or areas shall be permanently reserved as a wilderness, and no development of the project or plan for the entertainment of

visitors shall be undertaken which will interfere with the preservation intact of the unique flora and fauna and the essential primitive natural conditions now prevailing in the area."

All East Side Creek alternatives were dismissed based on the clear negative impacts to wilderness character and previous consultation with NOAA Fisheries.

2.2.2 Using Mules to Transport Supplies and Equipment

The NPS considered using pack mule trains to transport supplies and equipment to House and Slagle Ditches. Mule trains were considered because using animals for transport would require no prohibited uses under the Wilderness Act. However, this alternative was dismissed from further consideration because of the long period of time that would be required for the mules to deliver supplies, the lack of a recognized park trail beyond Clubhouse Beach, and the environmental impacts of the mule train.

Under Alternative 2 for House and Slagle Ditches, it would take a train of 15 mules an estimated 17 days (20 trips) to deliver supplies and equipment to the proposed project area. Under Alternative 3, it would take the mule train 21 days (25 trips) to deliver supplies. These deliveries would occur during the time of year that Old Ingraham Highway (also known as Coastal Prairie Trail) is most heavily utilized by visitors. Old Ingraham Highway is a dirt trail, subject to regular wetting. The many trips required to deliver supplies would cause ruts, particularly if the work period was rainy. The extra traffic on the trail would likely require substantial trail repair once the deliveries were completed. The Old Ingraham Highway does not extend past Clubhouse Beach. An additional 1.6 miles of trail would have to be created and cleared to access House Ditch. A water tank would need to be placed at Slagle Ditch for the mules to use.

Mules are prone to ingesting seeds from their food, which would be deposited in their droppings in EVER. These seeds could lead to the growth of invasive plant species. Mules require 25% forage for their diet; even if forage is provided, it is likely that the mules would graze in their enclosure at the park which could pose adverse environmental impacts. Mule droppings could contaminate water supplies and could contain harmful trace chemicals that could affect the natural environment. Mule droppings and urine may be offensive to park visitors such as hikers and boaters. For these reasons, NPS dismissed this alternative from further analysis.

2.2.3 Complete Backfilling of Canals

This alternative proposes backfilling the entire length of the Raulerson Canal and House and Slagle Ditches. The extensive size and volume of fill required for this alternative makes it economically infeasible. Further, due to the scale, this alternative would not be implemented in a timely manner. In addition, the canal and two ditches are recommended as eligible for listing on the NRHP as they were part of Henry Flagler's 20th century land development plans for Cape Sable. Backfilling substantial portions of the canal and ditches would substantially affect the historic character of these resources. For these reasons, this alternative was dismissed from further consideration.

2.2.4 Re-Backfill Eroded Plug Areas, Include Slope and Erosion Protection at the Mouth of the Ditch

This alternative proposes backfilling the eroded areas of the existing earthen plug, placing erosion protection along the downslope areas of the existing plug, and constructing a new plug structure at the mouths of House and Slagle Ditches. The proposed location for the new plug at the mouth of both House and Slagle Ditches is topographically lower than the existing plug location and/or the marl ridge; therefore, a plug in this location would be more susceptible to overtopping from tidal influence and resulting erosional processes. Adding a second plug would also have short and long-term impacts to the untrammeled and undeveloped qualities of wilderness. The plugs that are currently located on House and Slagle Ditches have been in place for over 60 years. This alternative was dismissed from further consideration because the existing plugs have been effective for a long period of time, they meet the objectives of the project without additional wilderness impacts, and a new plug at a lower elevation would be more susceptible to overtopping.

2.2.5 Construct a New Plug the Width of the Marl Ridge

This alternative proposed to construct a new plug the width of the marl ridge at House and Slagle Ditches. Backfilling a large section of the ditches would be much more expensive; there would be increased fill and transport costs associated with filling longer reaches of the waterways. The deliveries would also be logistically difficult. The project would be relying on helicopter transport, so many more trips may be necessary to transport the fill to a remote location to create a wider plug. While they now require repair, the plugs on House and Slagle have been in place since the 1950s and have been successful at fulfilling the objectives of this project. It is unnecessary to create a larger plug which would have additional wilderness impacts, including negative impacts to the untrammeled and undeveloped qualities of wilderness. Areas of the proposed location are topographically lower than the existing plug location; therefore, a plug in this location would be more susceptible to overtopping from tidal influence and resulting erosional processes. For these reasons, this alternative was dismissed from further consideration.

2.2.6 Re-Backfill Eroded Plug Areas and Canal Approaching Plug, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection

This alternative involves extending the footprint of the plugs on House and Slagle Ditch to the width of the marl ridge. In addition to backfilling the eroded plug areas, the ditches approaching the plug would be backfilled to the prevailing adjacent ground level to a distance of ten feet from the toe of the plug slope with limerock fill. Erosion protection would be added to the slopes of the plugs and the sloped end of the refilled ditch area. The extensive size and volume of the fill and armoring necessary make this alternative more logistically difficult and much more expensive. The additional cost and difficulty in constructing this alternative seem unnecessary; particularly when past performance of the present plug seems to indicate that a heavily armored structure is not necessary. This alternative would impact the untrammeled and undeveloped quality of the Marjory Stoneman Douglas Wilderness by increasing the visibility of the plug, with very little benefit to the natural quality. For these reasons, this alternative was dismissed from further consideration.

2.2.7 Alternatives Using Hydraulic Pumping

This alternative proposed pumping fill material to the plug sites on House and/or Slagle Ditch from a barge positioned in Florida Bay. This alternative was determined to have greater impacts to the undeveloped and the solitude or primitive recreation qualities of wilderness character in the Marjory Stoneman Douglas Wilderness than the other alternatives being considered. The plugs are currently limestone fill. Other alternatives considered would also use limestone fill. It would be necessary to use sand as the fill for hydraulic pumping. Using sand would be more visually impacting, giving the perception of increased impacts to the undeveloped quality of wilderness character. Using hydraulic pumping would also increase the amount of time necessary for the transport of fill, increasing the impacts to the undeveloped and solitude or primitive recreation qualities of wilderness. For these reasons, this alternative was dismissed from further consideration.

2.2.8 Construct a New Sheet Pile Only Plug at the Former Failed Plug Location, Including Riprap Erosion Protection with/without Canoe Ramp

This alternative would construct a cross-canal steel sheet pile only plug cut off (without an earthen plug) at the former failed plug location on Raulerson Canal. The construction would include sheet-pile-protected canal side banks extending up to 200 feet up and down stream of the plug cutoff for both sides of the cross canal sheet pile section. This design would provide a cross canal cutoff which would not be subject to internal erosion and end around seepage failure. After further review this alternative was removed from consideration because there were structural deficiencies with the design. As riprap would only be placed on one side of the sheet pile at the former failed plug location, there would be the potential for the sheet pile to move thereby dramatically reducing its structural strength. Unstable sheet piling would pose a safety hazard to the human and natural environments, for park visitors and wildlife alike, particularly during a heavy storm or high water event. For these reasons, this alternative was dismissed from further consideration.

2.2.9 Flow Discharge Structure

This alternative proposed a flow discharge structure at Raulerson Canal that would allow water to flow over the plug during a high water events, thereby preventing damage to the top of the plug and allowing fish and other wildlife continue to access the interior regions of Cape Sable. A flow discharge structure would not conform with the purpose of the project to reduce the unnatural exchange of salt and freshwater through the canals of Cape Sable. Access for fish and wildlife to the interior wetlands of Cape Sable would be maintained through East Side Creek and the wetlands south of Whitewater Bay. The flow discharge structure could also be hazardous to wildlife and visitors - it would not be a controlled structure, and so it may open or close unexpectedly. There could be long-term maintenance issues and costs associated with the flow discharge structure. For these reasons, this alternative was dismissed from further consideration.

2.2.10 Construct a New Sheet Pile Only Plug at the Center of the Marl Ridge, Include Riprap Erosion Protection

This alternative involves constructing a cross-canal steel sheet pile only plug cut off (without an earthen plug) at the center of the marl ridge (Location 3). The construction would include sheet-pile-protected canal side banks extending up to 200 feet up and down stream of the plug cutoff for both sides of the cross canal sheet pile section. This design would provide a cross canal cutoff which would not be subject to internal erosion and end around seepage failure. In addition to the structural deficiencies and drawbacks with the flow discharge option (which has also been dismissed), the available topographic data indicates that proposed location for this alternative is at a topographically low elevation compared to the failed plug location, making it more susceptible to overtopping from tidal influence and resulting erosional processes. For these reasons, this alternative was dismissed from further consideration.

2.2.11 Construct a New Sheet Pile and Fill Plug the Width of the Marl Ridge

This alternative includes construction of an earthen plug by installing two sheetpile walls and filling the area between the two walls with sand on Raulerson Canal. Additional sheetpile would be installed in all four quadrants of the plugs to form flow deflector wingwalls to promote surface sheetflow away from the plug structures and thus prevent seepage and tunneling through the marl. Additionally, fill material would be placed adjacent to each sheetpile wall to substantially increase the lateral support for the plugs. Graded riprap would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion resistance. The available topographic data indicates that the proposed location for this alternative is at a topographically low elevation, making it more susceptible to overtopping from tidal influence and resulting erosional processes. For this reason, this alternative was dismissed from further consideration.

2.3 PROJECT ALTERNATIVES

In addition to the No Action Alternative, two action alternatives for the House and Slagle Ditches plug sites and two action alternatives for the Raulerson Canal plug site were carried forward to analyze the impacts that would potentially result from implementation. In accordance with all applicable laws and policies, based on the preliminary analysis, internal scoping with the NPS, and the public input related to the proposed project, the following alternatives were carried forward for analysis.

2.3.1 House and Slagle Ditches Plugs Restoration Alternatives

Discussion of the House and Slagle Ditch plugs are being combined under a common section as the nature of these two ditches and proposed plugs thereof are very similar. Four Alternatives, including a No Action Alternative for the restoration of House and Slagle Ditch Plugs were developed in the 2012 Feasibility Study and refined during the scoping process. The proposed project alternatives were further assessed for feasibility and consistency with NPS project needs and objectives. This assessment resulted in the modification of some alternatives and recommendations for dismissal for other alternatives, and the addition of two new alternatives.

For both House and Slagle Ditches, it appears as if the loosened plug fill has been eroded away by a combination of naturally occurring factors (see **Figures 2.2 - 2.5**). In addition to typical south Florida rainfall, several high water storm surge events since 2005 (i.e., Hurricanes Katrina, Rita, and Wilma) are believed to have accelerated erosion. Over the next several decades, with anticipated sea level rise estimated to be +19 to +30 inches, storm surge and overtopping events may become more frequent; the potential for accelerated erosion at the plug sites as well as other low-lying areas in the region will increase. It is expected that more than one significant (+6 foot) storm surge would occur during the lifetime of the proposed project. Without remediation, erosion would continue and eventually reopen the ditches allowing the unnatural exchange of water through the canals to influence the interior wetlands. **Figures 2.6** and **2.7** illustrate the locations and features of the viable action alternatives for the House Ditch and Slagle Ditch plugs, respectively.

In considering viable alternatives to remediate both House and Slagle Ditches, several logistical issues were considered. One of the primary restrictions to their effective long-term repair is the access limitations imposed as the sites are located in the designated Marjory Stoneman Douglas Wilderness Area – mandating minimal human disturbance in an effort to preserve the area's resources in their wild and primitive natural condition. The remote nature of the project area and restrictions in accessing the proposed sites present serious logistical challenges to moving personnel, materials, and equipment. The remote project locations, nature of the restoration activities, and wilderness access issues have provided important considerations and limitations that have helped shape the alternatives presented in the following sections. A comparison table of action alternatives for House and Slagle Ditches is presented at the end of this section (see **Table 2.1**).

FIGURE 2.2 - VIEW SOUTH OF HOUSE DITCH PLUG (SOURCE: AECOM, JULY 2015)

FIGURE 2.3 - VIEW NORTH OF HOUSE DITCH PLUG (SOURCE: AECOM, JULY 2015)

FIGURE 2.4 - VIEW NORTH OF SLAGLE DITCH PLUG (SOURCE: AECOM, JUNE 2015)

FIGURE 2.5 - VIEW SOUTH OF SLAGLE DITCH PLUG (SOURCE: AECOM, JUNE 2015)

2.3.1.1 Alternative 1: No Action Alternative.

The No Action Alternative involves leaving House and Slagle Ditches in their current conditions (see **Figure 2.2 – 2.5**) and would allow the existing plugs to continue to be exposed to the current and potential future erosional processes (see **Figure 2.8**). Eventually, the plugs would become breached and tidal flows would be capable of propagating north past the Old Ingraham Highway (also known as the Coastal Prairie Trail or the Coastal Prairie Highway) to EVER's inland wetlands. Currently, erosion is evident at the House and Slagle Ditches plug sites on the north side and is expected to continue.

2.3.1.2 Alternative 2: Re-Backfill Eroded Plug Areas.

Alternative 2 involves re-backfilling the eroded plug areas with a course grade limestone and rock fill containing silty binder-type fines Alternative 2 would essentially restore the plugs at the existing locations on House and Slagle Ditches (see **Figure 2.8**). **Figure 2.9** presents a conceptual plan view of the plug erosion repair plan to alleviate or minimize erosion that is currently occurring along both the north and south sides of the Old Ingraham Highway at House Ditch. **Figure 2.10** shows the conceptual plan view of the plug erosion plan to address erosion that is occurring at the north side of the trail at Slagle Ditch and the potential future erosion along the south side of the Old Ingraham Highway. This alternative would minimize the amount of backfill material needed to conduct the restoration work and would consequently minimize costs as well.

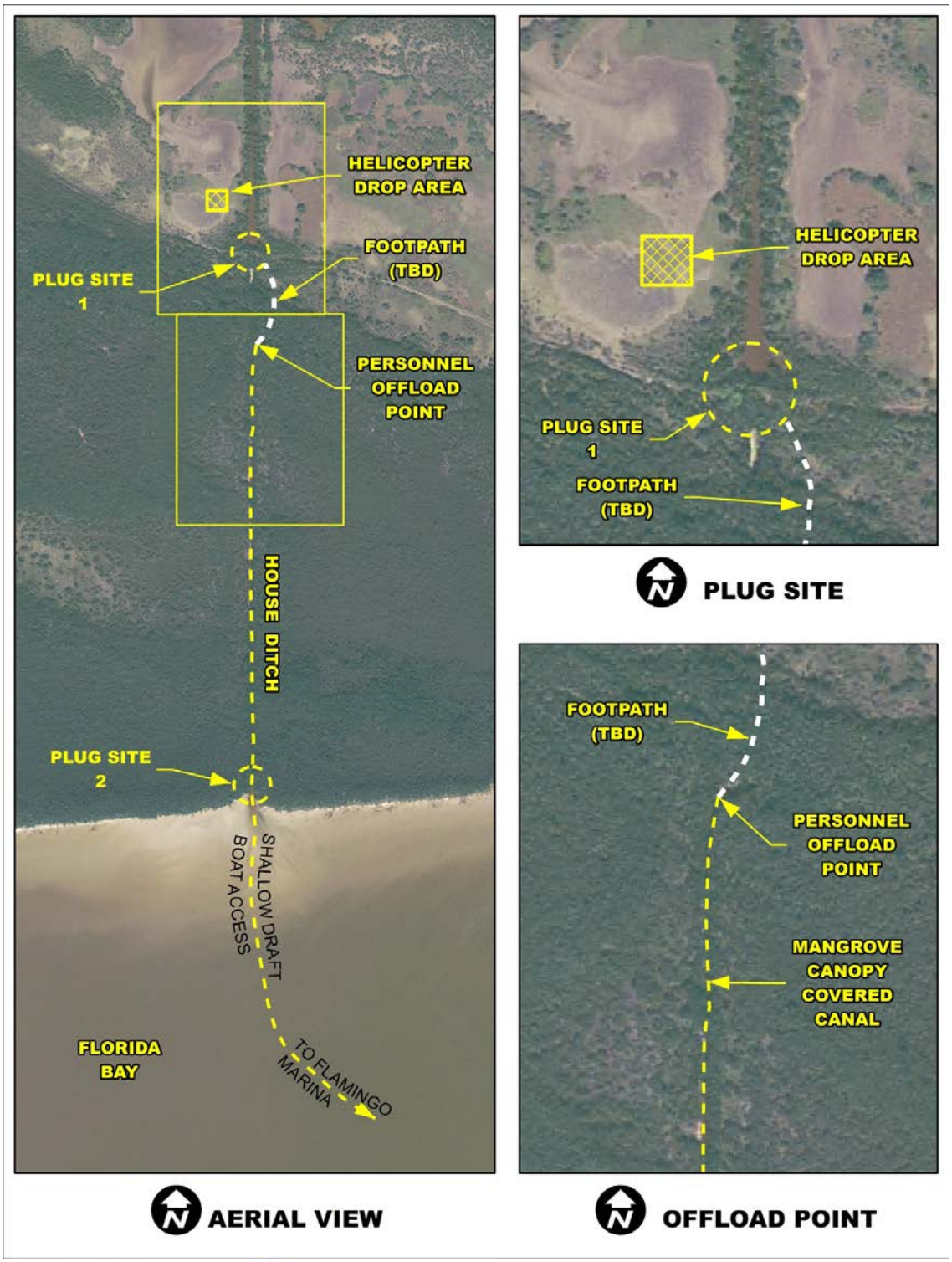


FIGURE 2.6 - HOUSE DITCH PROJECT SITE

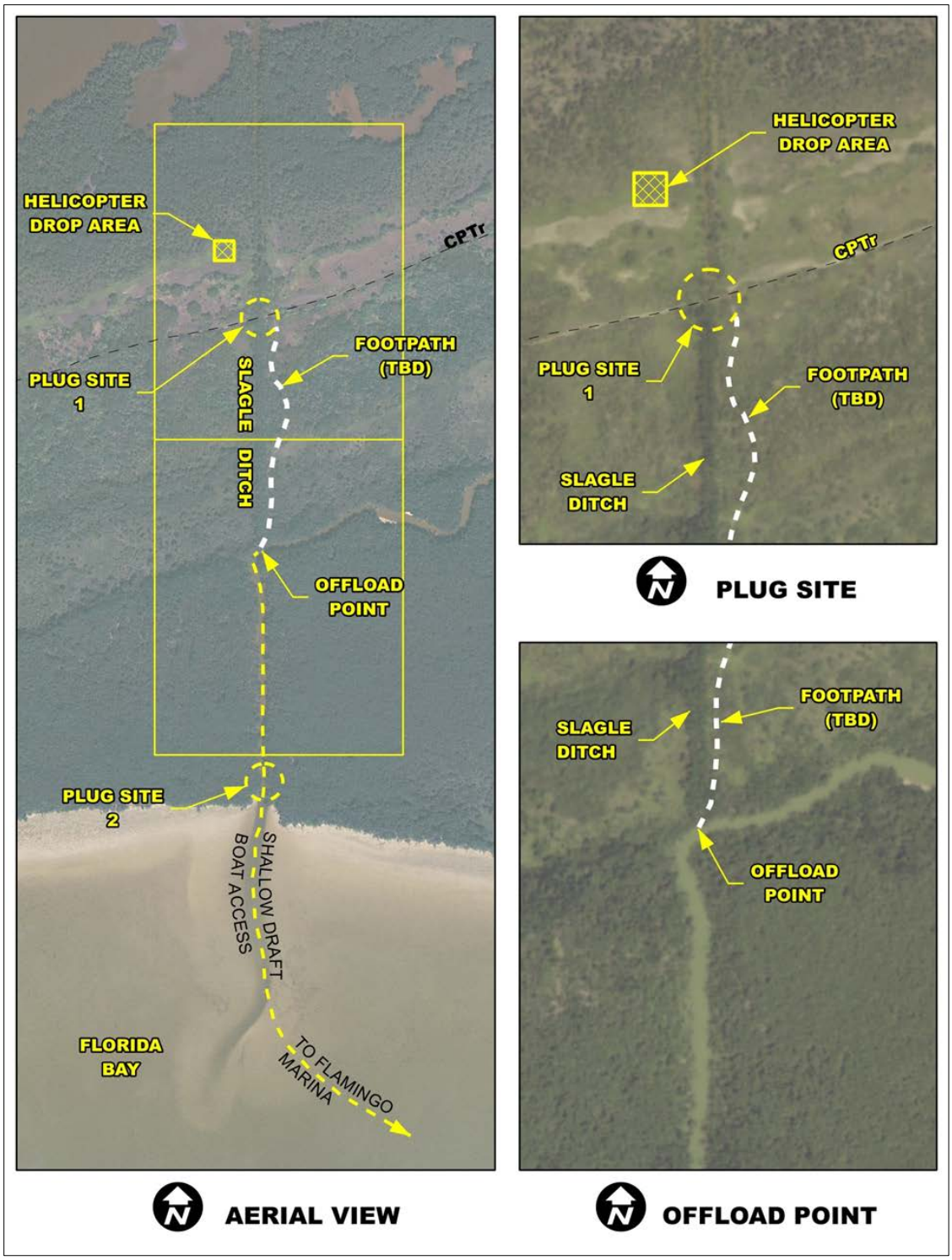


FIGURE 2.7 - SLAGLE DITCH PROJECT SITE

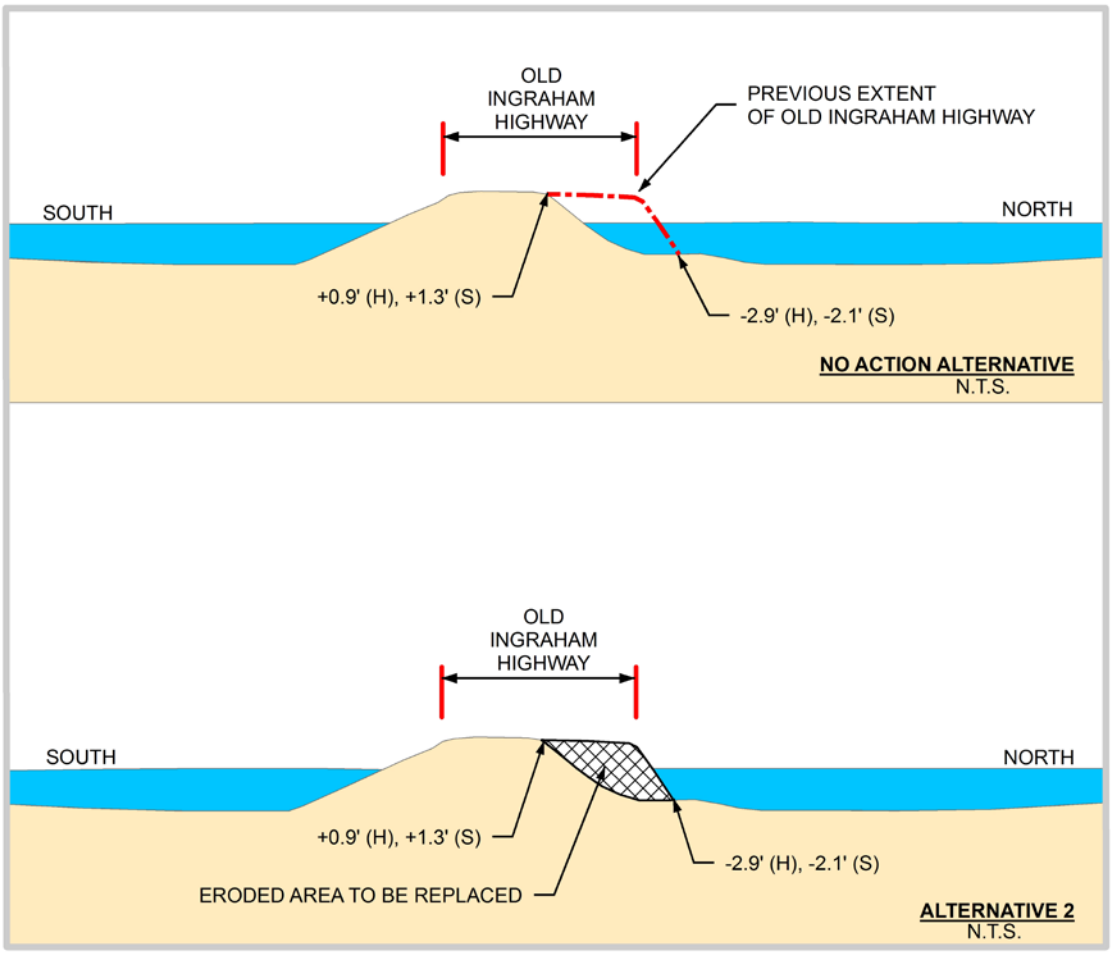


FIGURE 2.8 - HOUSE (H) AND SLAGLE (S) DITCHES: CONCEPTUAL PLUG REPAIR, ALTERNATIVES 1 AND 2

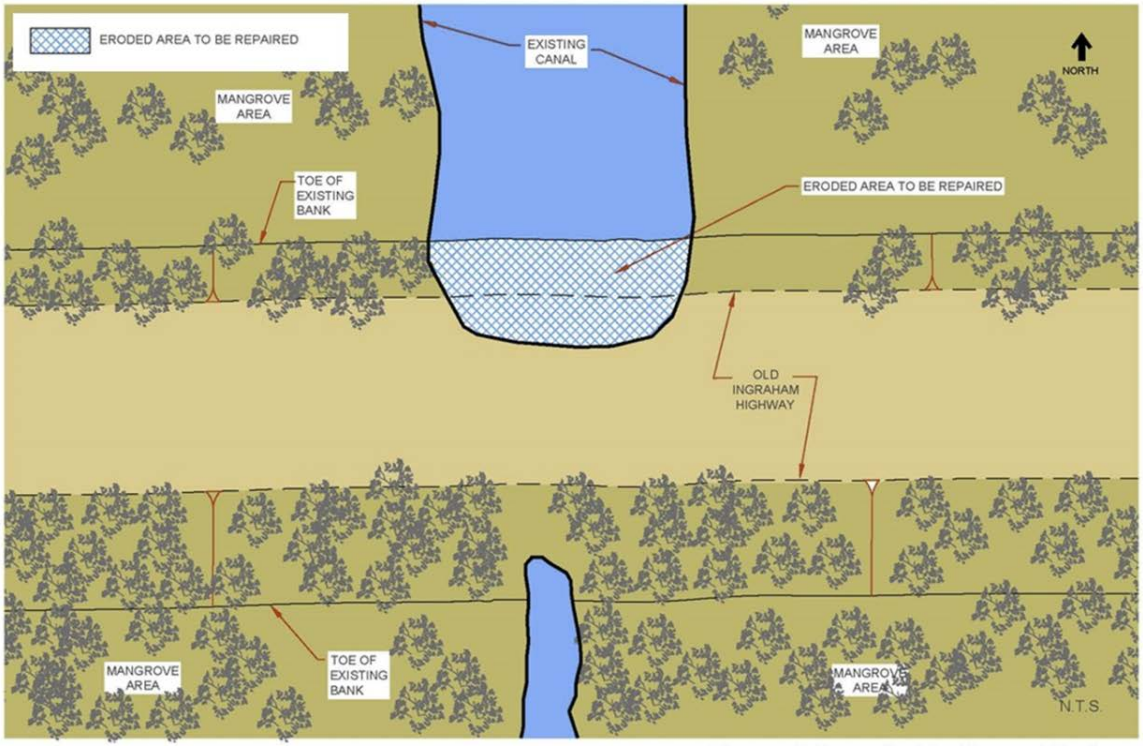


FIGURE 2.9 - HOUSE DITCH: PLUG EROSION REPAIR PLAN

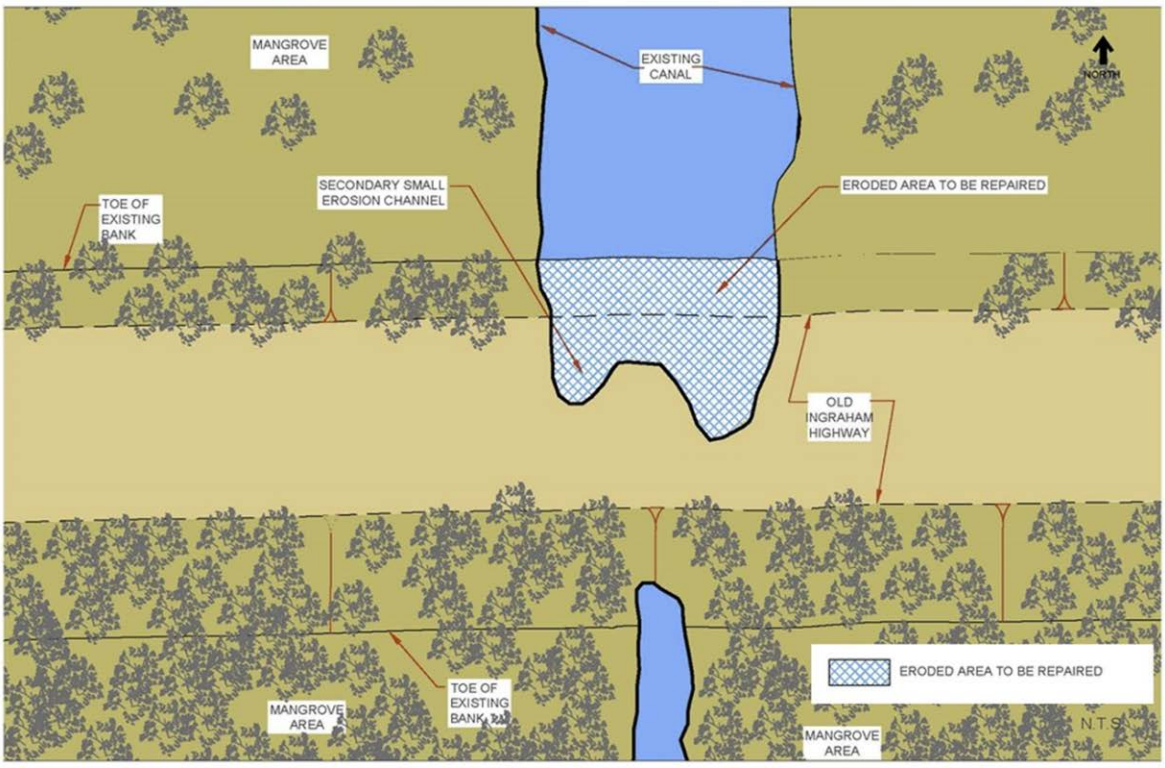


FIGURE 2.10 - SLAGLE DITCH, PLUG EROSION REPAIR PLAN

It is anticipated that locally available limerock fill, typical of that used for roadway base material in South Florida, would be used as backfill in the eroded area of the plug. The backfill would be placed in sufficient quantities to re-construct the original plug cross-section, keeping it consistent with the adjacent plug slopes and elevation/ grades.

It is estimated that the width of the ditch/plug was initially approximately 18 feet and it was adequate to initially function as a narrow inland roadway. The roadway served the movement of vehicles and equipment deep into the backcountry and inland wetlands along what is now termed as the Old Ingraham Highway. Based on field observations, it appears that a coarser well-graded sand and gravel mixture was used to initially construct the plug. The current surface of the plug is dense, hard, and likely well compacted due to its early use as a roadway.

2.3.1.3 Alternative 3: Re-Backfill Eroded Plug Areas, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection.

Alternative 3 (see **Figure 2.11**) is an expanded variation of Alternative 2, which re-establishes the plug section at its existing location, but includes slope and erosion protection measures as well as a geotextile fabric-wrapped sand drain for seepage protection. Sand drains consist of a boring through the silt that is filled with sand (or gravel) to allow the soil to drain and are helpful to accelerate the process of consolidation settlement of the plugs.

In addition to backfilling the eroded plug areas, the slopes of the repaired plug (and a few feet each side thereof) would be covered with a geotextile fabric. In order to mitigate against future erosion at the existing plug locations, the slopes would be covered with erosion protection. A gravel-filled geoweb system would allow for future re-growth of vegetation through the geoweb matrix. In addition, a geotextile fabric-wrapped sand drain would provide for seepage protection and would also be covered with erosion protection. The slotted PVC drainpipe would be inserted into the sand drain material to collect and discharge of any seepage water that would pass through the earthen plug fill and enter the drain.

Such an application could potentially be expanded to a larger slope area along each plug face in the immediate ditch and adjacent areas. However, given the apparent long-term stable condition of the adjacent slope areas and considering that such an enlargement would require more material be delivered to the remote site, it appears that the cost benefit of expanding this alternative may not be warranted at this time. Therefore, the enlargement aspect of this alternative will not be carried forward for further analysis.

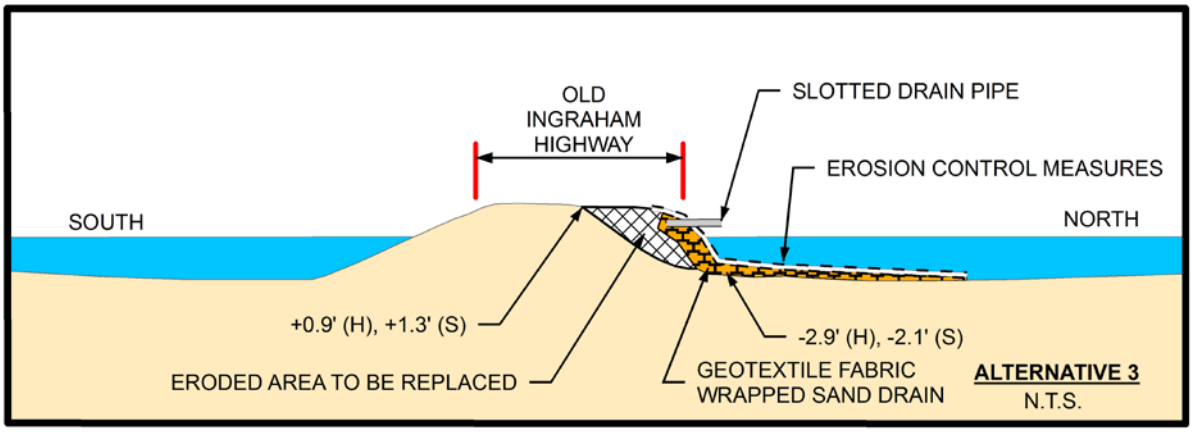


FIGURE 2.11 - HOUSE (H) AND SLAGLE (S) DITCHES: CONCEPTUAL PLUG REPAIR, ALTERNATIVE 3

TABLE 2.1 - ALTERNATIVES COMPARISON MATRIX FOR HOUSE AND SLAGLE DITCHES

ELEMENTS	ALTERNATIVE 2	ALTERNATIVE 3
Summary description of the alternative	Re-backfill Eroded Plug Area	Re-backfill Eroded Plug Areas, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection
Location of plug	At existing plug location along House and Slagle Ditches, respectively	At existing plug location along House and Slagle Ditches, respectively
Materials needed and transported	• Helicopter drop, then movement of a short distance to work site • 30 CY (House) & 40 CY limerock fill (Slagle)	• Helicopter drop, then movement of a short distance to work site • 30 CY (House) & 40 CY limerock fill (Slagle) • 36 LF (House) geotextile fabric wrapped sand drain • 40 LF (House) slotted PVC drain pipe in sand drain • 42 CY (House) erosion protection armoring • 42 (House) & 44 sq. yds. (Slagle) erosion control mat
Work zone and clearing	Common to all alternatives (See Section 2.4.6)	Common to all alternatives (See Section 2.4.6)
Construction crew requirements/logistics	Assumes 5 man crew and equipment	Assumes 5 man crew and equipment

ELEMENTS	ALTERNATIVE 2	ALTERNATIVE 3
Waste management	Common to all alternatives (See Section 2.4.8)	Common to all alternatives (See Section 2.4.8)
Estimated cost	$278,000	$321,000
Mitigation measures and BMPs	Common to all alternatives (See Section 2.5)	Common to all alternatives (See Section 2.5)

2.3.2 Raulerson Canal Plug Replacement Alternatives

Five alternatives for the Raulerson Canal plug replacement, including a No Action Alternative, were developed in the 2012 Feasibility Study and refined during the scoping process. Three suggested locations were also initially considered as potentially viable for the Raulerson Canal replacement plug (see **Figure 2.12**). A comparison table of action alternatives for Raulerson Canal is presented at the end of this section (see **Table 2.2**).

Location 1 is located west of the original failed plug location in the heavily vegetated and topographically lower (based on the topographic report) mangrove-dominated area west of the marl ridge. This location was deemed unsuitable due to the low elevations and the possibility of the waterway circumventing the plug through the adjacent coastal mangrove wetlands. A side creek also exists north and east of this proposed location, which could potentially facilitate flows around the plug location toward the eastern portion of Raulerson Canal from southern areas. Therefore, this location would not meet the stated project purpose, which is "to reestablish the natural function of the marl ridge and restore natural ecological processes to the Cape Sable region by eliminating the unnatural exchange of salt and freshwater through man-made canals." Therefore, this location was not considered for further analysis.

Location 2 is situated at the failed plug site. Some of the failed plug materials currently remain in place, downstream, and/or in the bottom of the canal. This debris material would have to be removed in order to allow for barge access (see **Figure 2.13**). Location 2 is located at the approximate topographic high point in the area. Therefore, this location would be most appropriate for the proposed plug location along this waterway.

Location 3 is at the center of the assumed marl ridge and is located to the east of the present failed plug section. This site also has the problematic consideration of removing existing debris in the canal in order to provide access east of the original failed plug location. The two alternatives proposed for Location 3 (as developed in the 2012 Feasibility Study) were dismissed from further consideration during the Internal Scoping Meeting for this project, as according to the recently collected 2015 topographic survey data, this location is not the topographic high point along this man-made waterway. Therefore, this location was not considered for further analysis.

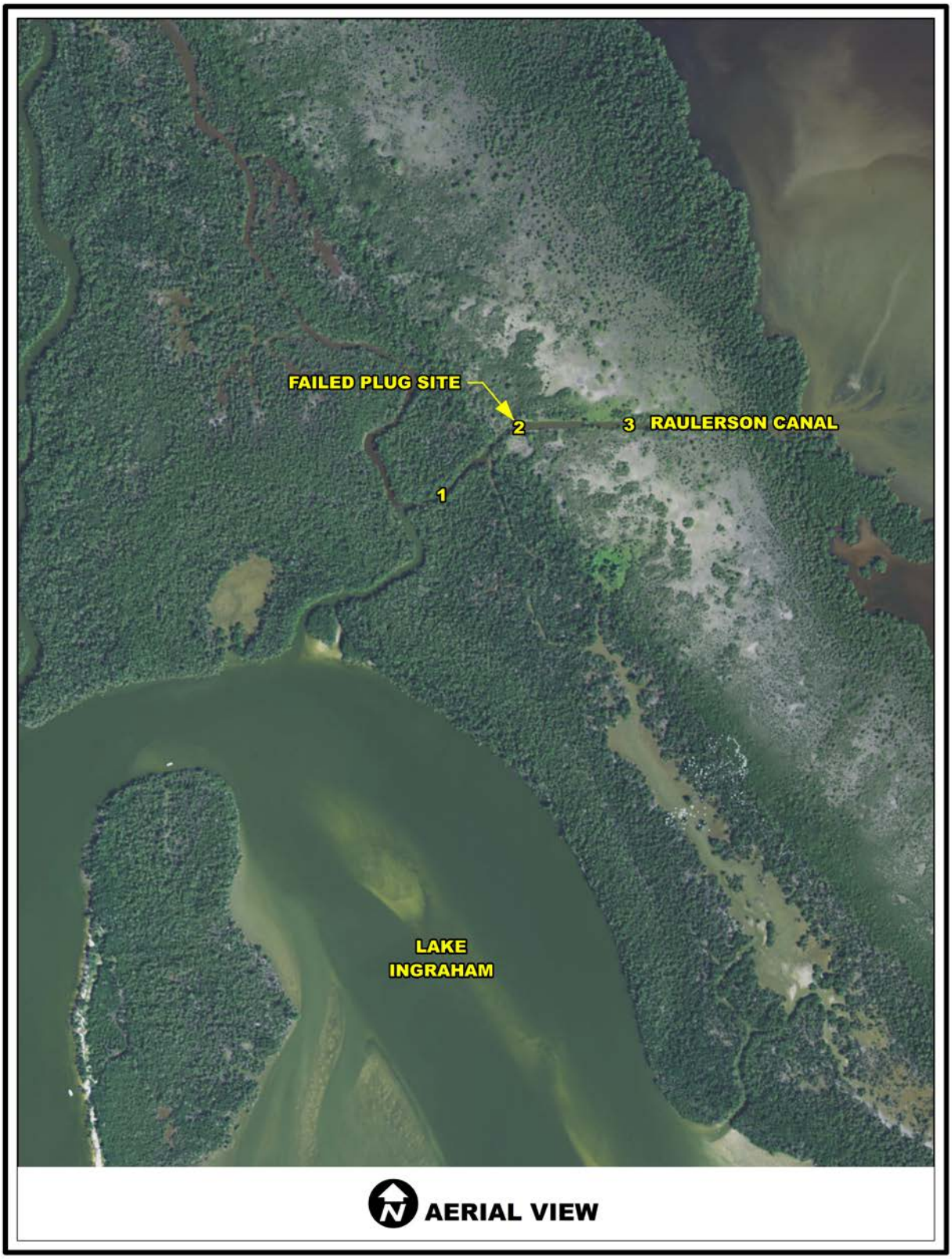


FIGURE 2.12 - RAULERSON CANAL PLUG LOCATION OPTIONS

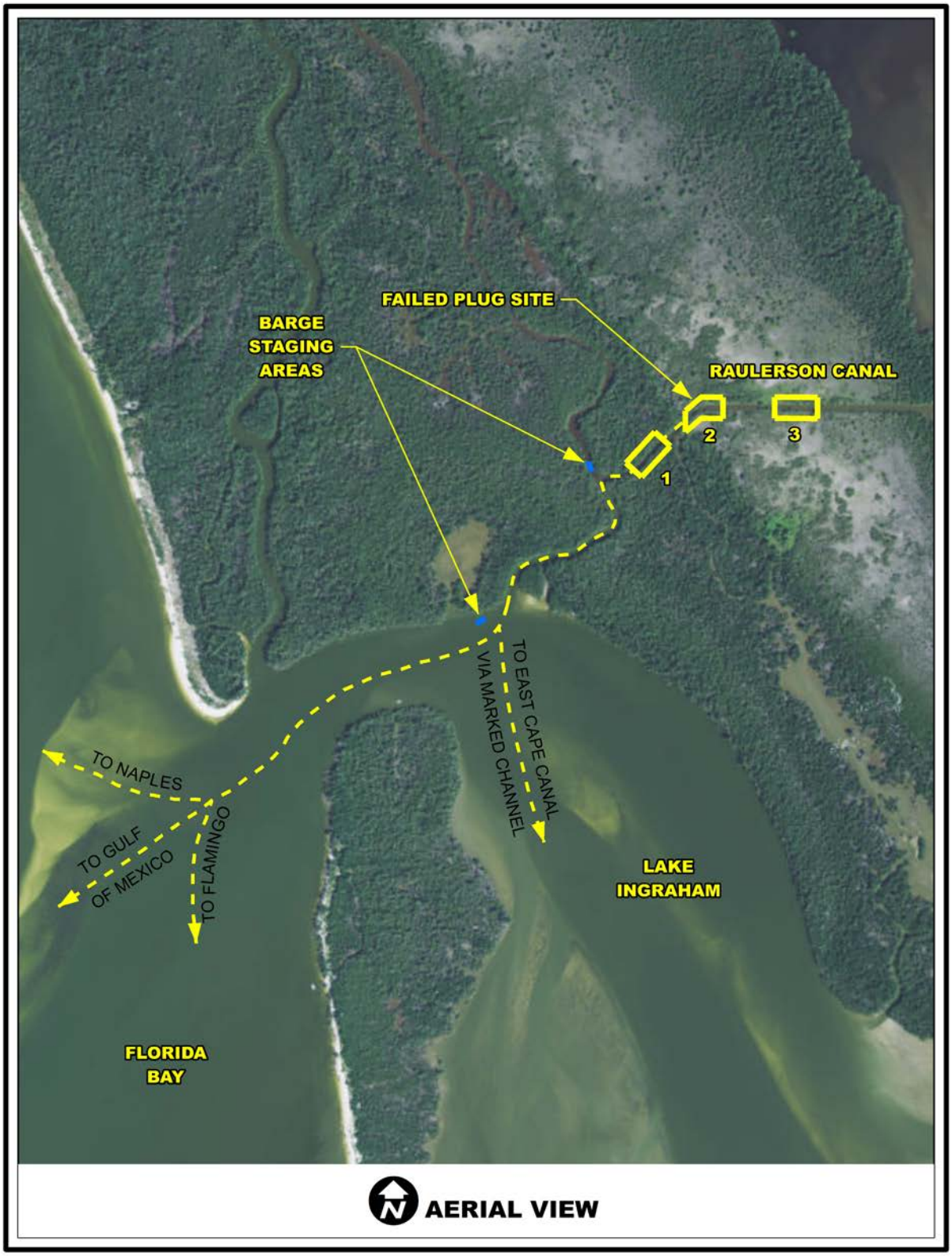


FIGURE 2.13 - RAULERSON BARGE ACCESS

2.3.2.1 Alternative 1: No Action Alternative.

The No Action Alternative involves taking no action and allowing Raulerson Canal to continue to function in its current state. Leaving the failed plug in its existing condition would allow the canal to continue to erode, widen, and transport suspended sediment to the interior wetlands as well as to Lake Ingraham, Florida Bay, and the Gulf of Mexico.

2.3.2.2 Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection.

This alternative involves constructing a canal plug cut off comprised of cross-canal steel sheet piling with sheet pile-protected canal banks that considers a safety factor. The design would use parallel back-to-back cross-tied sheet pile cross walls and a riprap system to protect the side slopes and perimeter area from erosion relating to flanking tidal flows (see **Figure 2.14**). This design has proven to be effective and stable at East Cape Canal. This plug would be constructed starting at the western edge of the canal (where it turns south) and extend 100 feet inland, in an easterly direction (Location 2).

This alternative includes the construction of an earthen plug by installing two sheetpile walls - one upstream and one downstream within the canal. In order to reduce the erosional energy forces associated with the seasonal overtopping events, the sheetpile wall design includes placement 25 feet from the edge of the canal bank as a safety factor. Therefore, the sheetpile walls would have a 25-foot margin of error on either side of the canal. These walls would be placed approximately 100 feet apart (see **Figure 2.14** and **2.15**).

The area between the two walls would be filled with sand that would be pumped in. The top of the plug surface would be covered by geotextile fabric and then a hard surface (or similar) to minimize potential erosion. The exact design of surface cover material would be determined during the final design phase of the project; it will consider surfaces that would promote and support vegetation across the entire structure while still providing sufficient erosion protection.

The fill material would likely originate from a permitted fill source outside the park and would be transported from a barge located in Lake Ingraham or from a location within the canal, closer to the plug site (see **Figure 2.13**). The sheetpile would be installed in all four quadrants of the plug to form flow deflector wingwalls. This design would also promote surface sheetflow away from the plug structures and thus prevent seepage and tunneling through the marl ridge. Additionally, fill material would be placed adjacent to each sheetpile wall (2.5:1 slope from the sheetpile to the ground on the north side) to substantially increase the lateral support for the plugs. Graded riprap (or similar material) would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion protection.

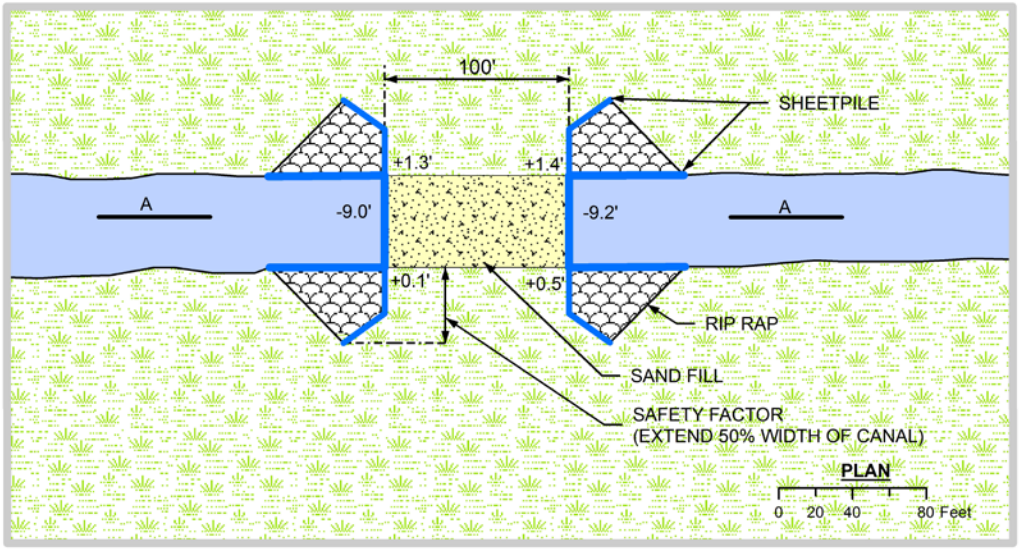
Temporary floating mooring buoys would be installed downstream (towards Lake Ingraham) of the plug structure at Raulerson Canal for anchoring motorized vessels. Marine anchors would be utilized to secure the mooring buoys to the canal bottom to minimize potential substrate disturbance with installation. The anchors and mooring buoys would be removed upon construction completion. To ensure safety, permanent warning signs would also be posted at the plug structure along Raulerson Canal. Signs would be constructed of reflective material and posted a minimum of 5-feet above mean high water.

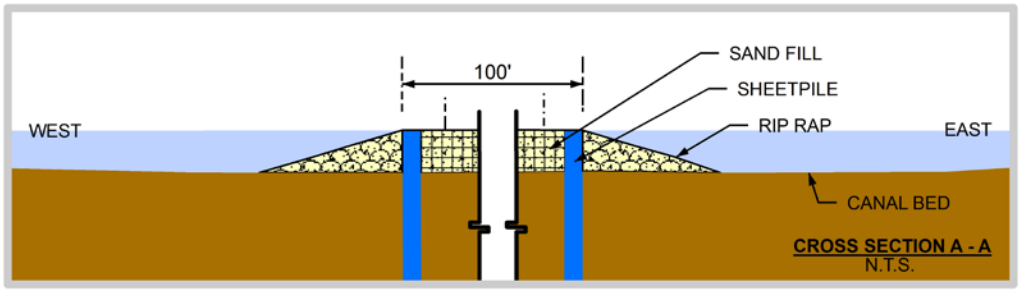
The design of this alternative has been tested and proven functional at two nearby waterways, also located in the Cape Sable region. The failed plugs on the Homestead and East Cape Canals were recently replaced in 2010 through 2011. These structures were designed to last 50 years under normal overtopping events. Since construction has been completed, the unnatural exchange of salt and freshwater through the canals has been substantially reduced allowing more natural influences on the interior wetlands of Cape Sable while also addressing safety and illegal access issues (URS 2012).

2.3.2.3 Alternative 4B: Construct a New Sheet Pile and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp.

This alternative is similar to Alternative 4A with an additional option of constructing a safe passage over the restored plug for non-motorized boaters (i.e., canoeists and kayakers) (see **Figure 2.15**).

The plug would include an engineering component to provide safe passage over the restored plug for non-motorized boaters. To provide safe portage, a floating dock structure (approximately 10-feet by 10-feet) would be constructed in the center of each plug entrance. The dock would be constructed using a wood-plastic composite lumber composed of wood and recycled plastics. The dock structure would be constructed so that a portion of the structure would extend over the water. A ladder would be placed on each dock to allow for access. A hardened path would be installed across the proposed plug using articulated block riprap (i.e., interlocking mats or equivalent) to provide safe and sustainable passage across the plug. All other construction features would be similar to Alternative 4A described above.

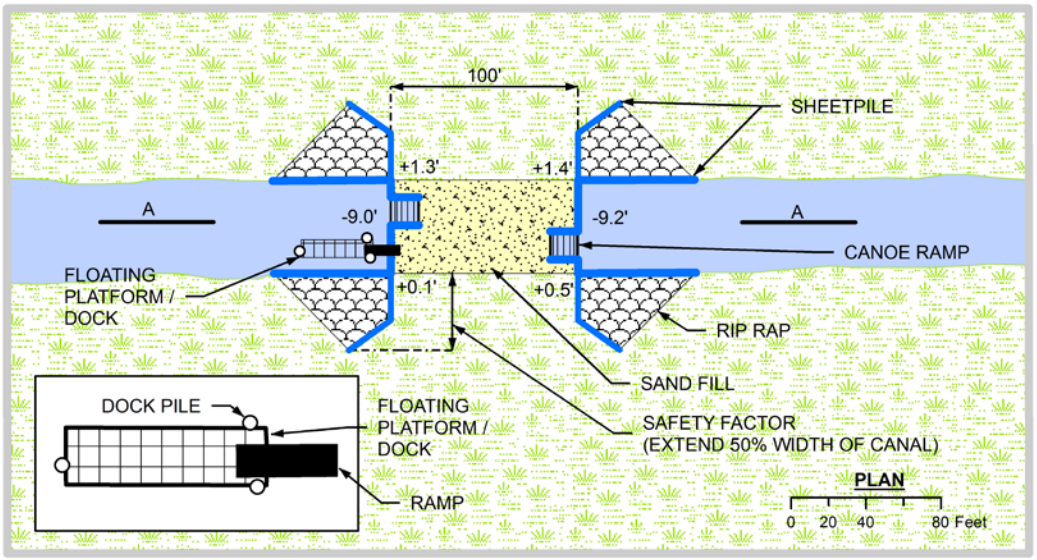


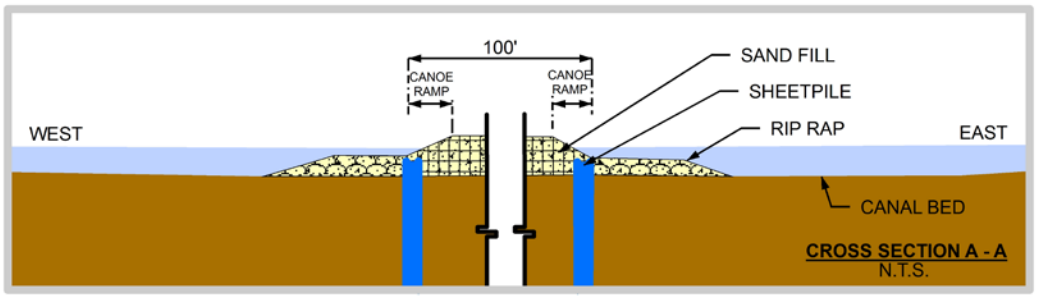


Legend

Eroded Area To Be Repaired

FIGURE 2.14 - RAULERSON CANAL: PLUG REPAIR ALTERNATIVE 4A





Legend

Eroded Area To Be Repaired

FIGURE 2.15 - RAULERSON CANAL: PLUG REPAIR ALTERNATIVE 4B

TABLE 2.2 - ALTERNATIVES COMPARISON MATRIX FOR RAULERSON CANAL

ELEMENTS	ALTERNATIVE 4A	ALTERNATIVE 4B
Summary description of the alternative	Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Location of plug	Topographic high point of the area (Location 2)	Topographic high point of the area (Location 2)
Materials needed and transport	• 1,926 CY sand fill • 4,500 LF cross-tied steel sheet piling (total for 2 sides) • 2,489 sq. yds. riprap • 578 sq. yds. erosion control	• 1,926 CY sand fill • 5,400 LF cross-tied steel sheet piling (total for 2 sides) • 2,522 sq. yds. riprap • 578 sq. yds. erosion control
Work zone and clearing	Common to all alternatives (See Section 2.4.6)	Common to all alternatives (See Section 2.4.6)
Construction crew requirements/logistics	Materials transported via barge; no dredging and no hydraulic pumping	Materials transported via barge; no dredging and no hydraulic pumping
Waste management	Common to all alternatives (See Section 2.4.8)	Common to all alternatives (See Section 2.4.8)
Estimated cost	$1,947,000	$2,127,000
Mitigation measures and BMPs	Common to all alternatives (See Section 2.5)	Common to all alternatives (See Section 2.5)
Recreational access/portage	No	Yes, boat ramp included in alternative

2.4 ELEMENTS COMMON TO ALL ACTION ALTERNATIVES

With the exception of the No Action Alternative, there are several elements common to all action alternatives. They are described below.

2.4.1 Bank Stabilization

Banks would be stabilized within the limits of the work area to prevent internal piping and erosion of the marl into and through the riprap. This would be accomplished by first placing a layer of fine sand fill over the existing sub-grade to establish a 2.5:1 side slope, which would act as both a graded filter and drainage exit for water seeping around the ends of the sheetpile (at Raulerson Canal only) and would prevent internal piping movement of the lime silts. The fine

sands would be covered by a layer of non-woven geotextile fabric to prevent movement of the fine sands into the riprap. The fabric would be covered by a riprap system consisting of a coarse bedding sand/small gravel layer overlain by a coarse riprap surface cover.

2.4.2 Monitoring and Maintenance

Anticipated monitoring during construction would include water quality/turbidity monitoring and monitoring for protected wildlife species. Standard USFWS and FWC guidelines for the conservation of protected species that have the potential to occur within the project area (including but not limited to manatees, turtles, crocodiles, and smalltooth sawfish) would be implemented during construction activities. Anticipated long-term monitoring/maintenance would include periodic monitoring of riprap and fill materials and maintenance as needed. The construction phase of the project would be conducted outside of crocodile nesting season to avoid adverse impacts to this protected species.

Hydrologic and biological monitoring currently in place would continue through construction and for a period of time after the project is complete (while funding remains available). This would allow the NPS to assess the impacts of the project and to monitor conditions, including the effects of sea level rise on the Cape Sable area. Currently the USGS operates two hydrologic monitoring stations - one in East Side Creek and one in Raulerson Canal. The stations measure flow, turbidity, and stage. Measurements are expected to continue at East Side Creek, however after the plug has been installed, data would no longer be collected at Raulerson Canal. The Audubon Society currently collects hydrologic data at six stations on the Cape and biological data at three of those stations. Monitoring at these stations is expected to continue if the project moves forward and if funding remains available. American crocodile monitoring, including nesting effort, growth, survival, body condition, and relative density has been conducted on Cape Sable since the 1970s. This monitoring is expected to continue while crocodiles remain a protected species.

2.4.3 Restoration of Disturbed Areas

Areas located within the designated work area that are disturbed but not permanently filled as part of the construction would be restored. The exact type of restoration would depend on the size and location of the area, but would generally include removal of any construction materials and incidental fill material, followed by regrading to the pre-construction contours. Any non-native vegetation observed within or directly adjacent to the work area would be removed concurrent with the regrading activities. Regrading would facilitate natural recruitment of native hydrophytic vegetation (i.e., plants adapted to grow in water). To expedite the stabilization of the area, native vegetation may be replanted in the area.

2.4.4 Staging Areas

EVER lacks suitable staging areas; therefore all equipment and fill materials (e.g., earthen fill, sheet pile and riprap) would be mobilized to a suitable water transportation staging area by conventional dump trucks or other suitable transportation vehicle. This is required to further meet the criteria for avoidance and minimization of impacts to wetland resources. The exact location of the staging area would be determined by the awarded contractor; however, the area

would be located entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.).

Construction materials would be transported via either barges and/or tugs to the respective construction staging/work areas or by helicopter. The barges are anticipated to use existing navigational channels and/or deep-water areas of the Gulf of Mexico and Florida Bay originating from the designated staging area. The exact route would be determined by the awarded contractor; however, the route would be restricted to existing navigational channels and/or deep-water areas of the Gulf of Mexico and western Florida Bay to avoid potential adverse impacts to the submerged resources. Woody vegetation/debris along the banks would be cleared to provide a safe work zone and allow for equipment access to the construction zone.

2.4.5 Turbidity Control

Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts. A turbidity monitoring plan would be implemented during construction to ensure continued compliance with state water quality criteria.

2.4.6 Waste Management

Waste is primarily expected to be generated from servicing and maintenance of equipment. This waste is expected to be maintained on the barge. Portable toilets would be arranged and placed at the plug site. The waste from the portable toilets would be pumped out, removed from the park, and disposed of at an appropriate facility.

2.4.7 Woody Vegetation Clearing and Trimming

Clearing of woody vegetation would be performed where necessary, along the banks of the waterway for equipment access and construction within the limits of a designated safe work zone. Trimming of overhanging mangrove trees may also need to occur for barge access to the designated work zone (plug site). Trimming would be conducted per the requirements of the FDEP Mangrove Trimming Permit (to be acquired prior to commencement of construction). The existing conditions of the wetlands are presented in Section 3.4.1.3, Vegetation and Wetlands.

2.5 MITIGATION MEASURES

Mitigation measures would be used to prevent or minimize potential adverse impacts associated with the selected alternative, and these measures have been included in the evaluation of impacts of all action alternatives. Mitigation measures that would be undertaken during project implementation include, but are not limited to, those listed below.

2.5.1 General Construction Mitigation Measures

- Pre- and post-construction erosion control BMPs would be implemented, including the installation and inspection of silt fences, straw bale barriers, sediment traps, or other equivalent measures, and revegetation of area to control erosion, preserve water

quality, protect wildlife and habitat, protect marine resources and EFH, and prevent soil contamination. Erosion and sediment control BMPs would be inspected and maintained on a regular basis and after each measurable rainfall to ensure they are functioning properly.

- Steps would be taken to minimize the introduction of non-native species and would include washing equipment before entering the park; minimizing disturbances; and initiating revegetation of disturbed areas immediately after construction. The NPS would follow all of the guidelines outlined in the South Florida and Caribbean Parks Exotic Plant Management Plan and the EVER Hurricane Plan (see Section 1.5.5.1).
- Environmental training would be implemented to help educate construction personnel with the intent of reducing impacts on water quality, wetland resources, wildlife, and marine resources and EFH.
- All construction areas would be protected to confine potentially adverse activities to the minimum area required for construction. All protection measures would be clearly stated in the construction specifications, and workers would be instructed to avoid conducting activities beyond the construction zone. The use of previously undisturbed areas would be minimized to the extent possible by selectively choosing staging areas and clearly defining and marking construction zones and perimeters.

2.5.2 Geology, Topography, and Soils

- Spill prevention, control, and countermeasure procedures, as well as storm water pollution prevention measures, would be implemented to protect soils from erosion and contamination.
- The use of tarps or similar cover materials would be used on stockpiled fill and other erosion prone areas during construction to minimize erosion because of storm and other high water events.

2.5.3 Water Resources

- A spill prevention, control, and counter-measures plan would be completed and implemented for any fuel storage tanks, which would meet all applicable standards for construction and leak detection. Areas used for refueling would be limited to areas where these activities currently occur.
- Equipment containing fuels would be checked frequently for leaks.
- Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts.
- A turbidity monitoring plan would be implemented to ensure compliance with state water quality criteria.
- A temporary “no wake zone” would be established in and near the project area during construction to eliminate further dispersal of suspended sediments.
- Impacts to wetland resources would be avoided and minimized to the maximum extent feasible through the implementation of construction BMPs.

2.5.4 Wildlife and Habitat

- Revegetation efforts may include use of seeds or nursery grown plant species native to the Cape Sable area; monitoring reclamation; and implementing exotic species control

as necessary. All revegetation efforts will be reviewed and approved by ENP Biological Resources Branch prior to implementation.

- Pre- and post-survey construction surveys for selected species (e.g. crocodiles, Eastern indigo snakes, and smalltooth sawfish) would be implemented.
- Spill prevention, control, and countermeasure procedures, as well as storm water pollution prevention measures, would be implemented to reduce the potential for petroleum products from leaking equipment or vehicles to reach surface waters.
- Per NPS Management Policies (2006), artificial lighting would not be used in locations where its presence would disrupt wildlife dependent on the dark; minimal-impact lighting techniques would be used (e.g., consideration of yellow versus white lights, use of timers). Artificial lighting would be shielded and directed, where necessary, with regard for natural night sky conditions. The use of lighting is not anticipated; construction activities are expected to take place during daylight hours. However, construction crews may carry emergency/safety lights, as necessary.

2.5.5 Marine Resources and EFH

- Construction procedures would include the use of turbidity curtains to contain disturbed sediments and reduce water quality impacts.
- A turbidity monitoring plan would be implemented to ensure compliance with State water quality criteria.
- Impacts to marine resources would be avoided and minimized to the maximum extent feasible through the implementation of construction BMPs and standard USFWS, NOAA, and FWC protection measures.

2.5.6 Special Status Species

- To reduce potential impacts on wildlife, construction activities occurring near sensitive habitats would be scheduled to minimize potential impacts to breeding, nesting, and rearing of young (particularly the American crocodile-nesting season). Construction would occur only during daylight hours to reduce effects on nocturnal foraging or rest.
- Pre-construction surveys would be conducted to identify any federal- and state-listed species occurring in the project area. Should individuals or nests be identified, additional measures would be taken to avoid impacts (e.g., fencing nest sites, providing information to contractors about the species).
- Construction would include all applicable environmental regulatory agencies' standard protection measures (including, but not limited to manatee, sea turtle, and smalltooth sawfish), including no wake zones and monitoring during construction. Additional specific measures may be identified during Section 7 consultation with the agencies for the project permits.
- Measures listed under "Wildlife and Habitat" and other resource protection mitigation would serve to reduce impacts on special status species.

2.5.7 Wilderness

- Measures listed above, including those under "Water Resources" and "Wildlife and Habitat," would serve to protect wilderness values and the natural quality of wilderness character.

- Construction procedures would follow the minimum requirement analysis for construction and would include provisions to minimize impacts to natural resources that contribute to wilderness values and the natural quality of wilderness character. The Minimum Requirement analysis will determine the mitigation requirements for wilderness.
- If the NPS determines that the canal plugs no longer serve their intended purpose, the NPS would examine the feasibility, environmental impacts, and costs of removing the plugs in order to reduce impacts on wilderness character. This would apply to plugs at House and Slagle Ditches, the Raulerson, Homestead and East Cape Canals, and any additional plugs that may be constructed in the future.

2.5.8 Cultural Resources

- If any archaeological resources are encountered during construction activities, mitigation of project impacts (in consultation with SHPO and other agencies as appropriate) or adjustment of the project design would occur to avoid or limit the adverse effects on prehistoric and historic archaeological resources. Stop-work provisions would be included in the construction documents should archaeological or paleontological resources be uncovered. It should be noted there is a low probability that the project area contains undiscovered archeological resources.
- Monitoring would be done if any excavation exceeds the depth of existing ground disturbance. In the event that cultural resources are encountered during any necessary excavation work, project work would be halted and the discovery process would be initiated.
- If previously unknown archaeological resources are discovered, work would be stopped in the area of any discovery and the NPS would consult with affiliated tribes, pursuant to the NAGPRA and its implementing regulations (43 CFR § 10).

2.5.9 Visitor Use and Experience

- Construction information and general information about the project would be posted at the park, distributed to visitors, and made available on the park's web site. Signage and notices would be used to inform visitors about the purpose of the project and to protect visitor and staff safety during construction activities.
- Artificial lighting, including minimum illumination levels, light-emitting diodes (LED), limited color spectrum (e.g., yellow) lights, and timers and sensors would be used, where applicable, to ensure safety.
- The use of artificial lighting would be restricted to areas where security, human safety, and specific cultural resource requirements must be met.

2.5.10 Noise/Soundscapes

- Restoration activities would involve multiple pieces of heavy equipment for placement of sheetpile and/or fill material. Best management practices for noise, such as using mufflers on heavy equipment and noise muffling construction materials, would be implemented at Cape Sable, resulting in short term minor impacts to soundscapes. Typically, heavy equipment operates at 80 to 90 decibels (dB). Sound levels decrease approximately 6 dB with the doubling of distance (Harmon 2006). Therefore, it is

estimated that natural attenuation would decrease the noise from these activities to no greater than 32 to 42 dB at a distance of about 1,500 feet from the work area; noise would continue to dissipate with increased distances from the area.

2.5.11 Air Quality

- EVER enjoys a Class I clean air status. If dust were generated during construction, best management practices for dust suppression would be initiated. Emissions from construction vehicles would be kept to a minimum by restricting idling time.

2.6 COST ANALYSIS OF THE ALTERNATIVES

A preliminary cost analysis of the no action and action alternatives was conducted to estimate the financial feasibility of each. Rough "Class C" costs were estimated for each of the alternatives based on unit prices obtained from vendors and R.S. Means (see **Table 2.3**). Class C estimates are cost estimates that occur at the conceptual level of planning. Cost estimates for Raulerson Canal (Alternatives 4A and 4B) are based on 2009 actual cost for plug construction at Homestead and East Cape Canals.

TABLE 2.3 – SUMMARY OF CLASS C COST ESTIMATES

Alternative	Class C Estimate
Alternative 2 (for both House and Slagle Ditches)	$298,000
Alternative 3 (for both House and Slagle Ditches)	$341,000
Alternative 4A (Raulerson Canal)	$5,200,830
Alternative 4B (Raulerson Canal)	$5,232,830

All estimates for construction include government factors to account for the remote location, federal wage rate factor, design contingency, government general conditions, prime fees, contracting method adjustment, and escalation. All of these estimates are represented in 2015 dollars and were based on single-unit costs, and costs were not adjusted to account for possible volume discounts or similar cost savings. As project implementation moves forward, Class B (Budgetary Estimates) will be developed at the schematic design phase and Class A (Actual Estimates) will be developed for the associated construction documents.

2.7 HOW ALTERNATIVES MEET PROJECT OBJECTIVES

All alternatives selected for analysis must meet all objectives to a large degree to be considered reasonable. The action alternatives must also address the stated purpose and resolve the need for action. Alternatives were assessed as to how well they would meet the plan objectives (see **Tables 2.4** and **2.5**). The action alternatives would meet the objectives either fully or to a large degree. A summary of impacts by alternative is presented in **Table 2.6**.

TABLE 2.4 - OBJECTIVES MATRIX FOR HOUSE AND SLAGLE DITCHES ALTERNATIVES (ALTERNATIVES 2 AND 3)

Project Objectives	**Alternative 1: No Action**	**Alternative 2: Re-backfill Eroded Plug Areas**	**Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection**
Natural Resources Objective 1: Prevent the unnatural exchange of saltwater into and loss of freshwater out of wetland communities north of the marl ridge in Cape Sable through House and Slagle Ditches	This alternative partially meets the project objective. The plugs are not currently breached at House and Slagle ditches (note that seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode.) When the plugs are breached, this alternative would no longer achieve the project objective and the value would become nil. Rank: Low to Moderate	This alternative mostly meets the project objective. Repair of the severely eroded earthen plugs would restrict the flow of saltwater into, and prevent the loss of freshwater out of, the interior wetlands of Cape Sable. This would enhance the hydrology of the area. However, overtopping damage from high water events such as hurricanes would continue to erode the plug. Rank: Moderate	This alternative fully meets the project objective. Repair of the severely eroded earthen plugs would restrict the flow of saltwater into, and prevent the loss of freshwater out of, the interior wetlands of Cape Sable. This would enhance the hydrology of the area. The potential for erosion is minimized due to the addition of slope and erosion protection (i.e., riprap and a sand drain). Overtopping damage from high-water events such as hurricanes would be minimal due to erosion control measures. Rank: High

Project Objectives	Alternative 1: No Action	Alternative 2: Re-backfill Eroded Plug Areas	Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection
Natural Resources Objective 2: Promote ecological resilience to climate change and sea level rise in the interior wetland communities of the Cape Sable region	This alternative partially meets the project objective. The plugs are not currently breached at House and Slagle ditches (note that seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode.) While the plugs remain, the effects of sea level rise on the interior of Cape Sable are minimized and wetland communities have time to adapt to changing conditions. Once the plugs are breached, they will no longer protect the interior wetlands from the effects of sea level rise and this alternative would no longer achieve the project objective and the value would become nil. Rank: Nil to Low	This alternative mostly meets the project objective. Repairing the eroded plugs would improve their longevity, increasing the certainty that they will continue to prevent the unnatural exchange of water through the canals well into the future. The repaired plugs should slow the effects of sea level rise via the canals on the interior of Cape Sable and give wetland communities time to adapt to changing conditions. However, the potential for erosion still exists and the overtopping of the plug would continue to occur during high water events such as hurricanes. Rank: Moderate	This alternative fully meets the project objective. Repairing and reinforcing the eroded plugs would improve their longevity, increasing the certainty that they will continue to prevent the unnatural exchange of water through the canals well into the future. This should slow the effects of sea level rise via the canals and give wetland communities time to adapt to changing conditions. The potential for erosion is minimized due to the addition of slope and erosion protection (i.e., riprap and a sand drain). Overtopping damage from high-water events such as hurricanes would be minimal due to erosion control measures. Rank: High

Project Objectives	**Alternative 1: No Action**	**Alternative 2: Re-backfill Eroded Plug Areas**	**Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection**
Natural Resources Objective 3: Reduce unnatural impacts to habitat quality for juvenile crocodiles, wading birds, forage fish, and other wildlife within the interior wetlands of the Cape Sable region	This alternative partially meets the project objective. The plugs are not currently breached at House and Slagle ditches (note that seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode.) When the plugs are breached, this alternative would no longer prevent unnatural impacts to habitat quality and the value would become nil. Rank: Low to Moderate	This alternative mostly meets the project objective. Repairing the eroded plugs would improve their longevity, increasing the certainty that they will continue to protect habitat quality by preventing the unnatural exchange of water, sediments, and nutrients through the ditches. However, the potential for erosion still exists and the overtopping of the plug would continue to occur during high water events such as hurricanes. Rank: Moderate	This alternative fully meets the project objective. Repairing and reinforcing the eroded plugs would improve their longevity, increasing the certainty that they will continue to protect habitat quality by preventing the unnatural exchange of water, sediment, and nutrients through the ditches. The potential for erosion is minimized due to the addition of slope and erosion protection (i.e., riprap and a sand drain). Overtopping damage from high-water events such as hurricanes would be minimal due to erosion control measures. Rank: High

Project Objectives	**Alternative 1: No Action**	**Alternative 2: Re-backfill Eroded Plug Areas**	**Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection**
Natural Resources Objective 4: Prevent the unnatural movement of sediment and nutrients through House and Slagle Ditches	This alternative partially meets the project objective. The plugs are not currently breached at House and Slagle ditches (note that seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode. When the plugs are breached, and sediments and nutrients can move through the ditches unimpeded, this alternative would no longer achieve the project objective and the value would become nil. Rank: Low to Moderate	This alternative mostly meets the project objective. Repairing the eroded plugs would improve their longevity, increasing the certainty that the plugs will continue to prevent the unnatural exchange of sediment and nutrients through the ditches. However, the potential for erosion still exists and the overtopping of the plug would continue to occur during high water events such as hurricanes. Rank: Moderate	This alternative fully meets the project objective. Repairing and reinforcing the eroded plugs would improve their longevity, increasing the certainty that they will continue to prevent the unnatural exchange of sediment and nutrients through the ditches. The potential for erosion is minimized due to the addition of slope and erosion protection (i.e., riprap and a sand drain). Overtopping damage from high-water events such as hurricanes would be minimal due to erosion control measures. Rank: High

Project Objectives	Alternative 1: No Action	Alternative 2: Re-backfill Eroded Plug Areas	Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection
Natural Resources Objective 5: Reduce/eliminate adverse impacts to marine resources in the Cape Sable region	This alternative partially meets the project objective. The plugs are not currently breached at House and Slagle ditches (note that seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode.) When the plugs are breached, and sediments and nutrients can move through the ditches and into Florida Bay unimpeded, the plugs will no longer prevent adverse impacts to marine resources in the Cape Sable region and the value would become nil. Rank: Low to Moderate	This alternative mostly meets the project objective. Repairing the eroded plugs would improve their longevity, increasing the certainty that the plugs will continue to prevent the unnatural discharge of sediments and nutrients to Florida Bay. However, the potential for erosion still exists and the overtopping of the plug would continue to occur during high water events such as hurricanes. Rank: Moderate to High	This alternative fully meets the project objective. Repairing and reinforcing the eroded plugs would improve their longevity, increasing the certainty that they will continue to prevent the unnatural discharge of sediments and nutrients to Florida Bay. The potential for erosion is minimized due to the addition of slope and erosion protection (i.e., riprap and a sand drain). Overtopping damage from high-water events such as hurricanes would be minimal due to erosion control measures. Rank: Moderate to High

Project Objectives	Alternative 1: No Action	Alternative 2: Re-backfill Eroded Plug Areas	Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection
Wilderness Objective 1: Improve the natural quality of wilderness character in the Marjory Stoneman Douglas Wilderness Area	This alternative partially meets the project objective. The plugs are not currently breached at House and Slagle ditches (note that seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode), so there is no current impact to the natural quality of wilderness. When the plugs are breached, there would be a long –term moderate to major adverse impact to the natural quality of wilderness character. Rank: Low	This alternative mostly meets the project objective. The natural quality of wilderness would experience minor adverse impacts during construction, but the effects of preventing breaching would be long term and beneficial. Under this alternative, the potential for erosion still exists and the overtopping of the plug would continue to occur during high water events such as hurricanes. Rank: Moderate	This alternative mostly meets the project objective. The natural quality of wilderness would experience minor adverse impacts during construction, but the effects of preventing breaching would be long term and beneficial. Overtopping damage from high-water events such as hurricanes would be minimal due to erosion control measures. Rank: Moderate

Project Objectives	Alternative 1: No Action	Alternative 2: Re-backfill Eroded Plug Areas	Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection
Wilderness Objective 2: Design the project features and ensure that project implementation, monitoring, and maintenance maximize compatibility with the qualities of wilderness character	This alternative mostly meets the project objective. The plugs are not currently breached at House and Slagle ditches (seepage is occurring though the plug at Slagle Ditch and the plugs continue to erode). When the plug at Slagle is breached, visitors would be unable to continue past the ditch on the Coastal Prairie Trail. This would be a negative impact to the solitude or primitive and unconfined recreation quality of wilderness. Rank: Moderate	This alternative would partially meet the project objective. This alternative would have minor impacts on the untrammeled and solitude or primitive and unconfined recreation wilderness qualities at House and Slagle Ditches. The small footprint and natural materials used for this alternative would have minor impacts to the undeveloped quality of wilderness. Rank: Low to Moderate	This alternative would partially meet the project objective, although there would be additional negative impacts to the undeveloped and solitude and primitive recreation qualities due to the additional armoring included in this alternative. The erosion protection will be an additional development in the wilderness and will be more visible than fill alone. Rank: Nil to Low
Cultural Resources Objective 1: Avoid adverse impacts to cultural and archeological resources and historic features through project design or mitigation measures	This alternative does not meet the project objective. Taking no action would allow the eroding of the earthen plugs by tidal flow to continue, thereby causing potential adverse impacts to the historic structures. Rank: Nil	This alternative mostly meets the project objective. The footprint/configuration would not be altered, causing the least impact to the historic structures and hence maintaining their integrity. Rank: Moderate	This alternative mostly meets the project objective. The footprint/configuration would not be altered, causing the least impact to the historic structures and hence maintaining their integrity. Rank: Moderate

Project Objectives	Alternative 1: No Action	Alternative 2: Re-backfill Eroded Plug Areas	Alternative 3: Re-backfill Eroded Plug Areas, include slope and erosion protection, and sand drain for seepage protection
Engineering Features Objective 1: Design engineered features, when necessary, to last at least 50 years (barring severe damage by catastrophic hurricane events) with annual/bi-annual maintenance	This alternative does not meet the project objective. The eroded plugs are in need of immediate repair and continued maintenance. Rank: Nil	This alternative meets the project objective. Although both are feasible designs, this alternative would require maintenance that is more frequent. Rank: Moderate	This alternative meets the project objective. The addition of slope and erosion protection and sand drain for seepage protection would enhance the longevity under this alternative as it would require less frequent maintenance. Rank: High

TABLE 2.5 - OBJECTIVES MATRIX FOR RAULERSON CANAL ALTERNATIVES (ALTERNATIVES 4A AND 4B)

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Natural Resources Objective 1: Reduce the unnatural exchange of salt and freshwater into the Cape Sable region north of the marl ridge through Raulerson Canal thereby restoring a more natural hydrology to the region	This alternative does not meet the project objective. Without a plug, Raulerson Canal would continue to allow the unnatural exchange of salt and freshwater in the interior wetlands of Cape Sable. Rank: Nil	These alternatives fully meet the project objective. Replacing the plug at Raulerson Canal would restrict the unnatural exchange of salt and freshwater into the interior wetlands of Cape Sable. Overtopping damage would be minimal due to the natural erosion control (e.g., planted vegetation) and dissipation of energy over the length of the plug. Rank: High	

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Natural Resources Objective 2: Promote ecological resilience to climate change and sea level rise in the interior wetland communities of the Cape Sable region	This alternative does not meet the project objective. The low-lying Cape Sable area is particularly susceptible to sea level rise from climate change. Allowing the impacts associated with the open canal to continue does not allow time for wetland communities in the interior of Cape Sable to adapt to changing conditions and would not improve the ecological resilience of the area. Rank: Nil	These alternatives meet the project objective. While the rate of sea level rise from climate change is outside of the control of NPS, constructing a plug at Raulerson Canal would decrease the effects of sea level rise on the interior of Cape Sable via Raulerson Canal and give wetland communities time to adapt to changing conditions. Rank: Moderate	
Natural Resources Objective 3: Reduce unnatural impacts to habitat quality for juvenile crocodiles, wading birds, forage fish, and other wildlife within the interior wetlands of the Cape Sable region	This alternative does not meet the project objective. The unnatural exchange of salt and fresh water though Raulerson Canal would continue to degrade the habitat quality of the interior Cape Sable wetlands. Rank: Nil	These alternatives meet the project objective. Plugging the Raulerson Canal would reduce the unnatural exchange of salt and freshwater and improve the quality of the interior wetland habitat. Rank: High	

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Natural Resources Objective 4: Reduce the unnatural movement of sediment and nutrients through the Raulerson Canal	This alternative does not meet the project objective. The canal would continue to allow the movement of sediment and nutrients in and out of the interior Cape Sable wetlands. Rank: Nil	This alternative meets the project objective. Replacement of the plug on Raulerson Canal would prevent the unnatural movement of sediment and nutrients into the interior wetlands and out to the Gulf of Mexico and Lake Ingraham. Rank: High	

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Natural Resources Objective 5: Reduce/eliminate adverse impacts to marine resources in the Cape Sable region	This alternative does not meet the project objective. Raulerson Canal would continue to export sediment and nutrients to Florida Bay, the Gulf of Mexico, and Lake Ingraham. Marine resources, such as essential fish habitat, located in the interior wetlands of Cape Sable would continue to be affected by the exchange of salt and freshwater through the canal. Rank: Nil	This alternative meets the project objective. Replacement of the plug on Raulerson Canal would restrict the exchange of salt and freshwater in the interior Cape Sable wetlands north of the marl ridge. The amount of sediment flowing into and settling in Lake Ingraham would decrease. BMPs would be implemented during construction such that no marine wildlife would be adversely impacted. Minimal impacts to coastal habitat/vegetation are anticipated to result from construction. Rank: High	This alternative meets the project objective. Replacement of the plug on Raulerson Canal would restrict the exchange of salt and freshwater in the interior Cape Sable wetlands north of the marl ridge. The amount of sediment flowing into and settling in Lake Ingraham would decrease. The canoe ramp and boat dock are expected to have a nil to minor impact on marine resources. BMPs would be implemented during construction such that no marine wildlife would be adversely impacted. Minimal impacts to coastal habitat/vegetation are anticipated to result from construction. Rank: High

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Wilderness Objective 1: Improve the natural quality of wilderness character in the Marjory Stoneman Douglas Wilderness Area	This alternative does not meet the project objective. Raulerson Canal would continue to erode, widen, and transport suspended sediment to the inland marshes as well as to Lake Ingraham and the Gulf of Mexico. The unnatural exchange of fresh and saltwater would continue within the wetlands on the interior of Cape Sable, and the value of habitat for wading birds, juvenile crocodiles, and other wildlife would remain degraded. Rank: Nil	These alternatives meet the project objective. Plugging Raulerson Canal is expected to have substantial beneficial effects upon the natural environment of the inland marshes on Cape Sable. Among other things, the unnatural exchange of fresh and saltwater would cease within the wetlands, and the quality of habitat for wading birds, juvenile crocodiles, and other wildlife is expected to improve. Limited vegetation clearing was considered to have negligible impacts, and thus is identified as having no effect. Rank: High	

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Wilderness Objective 2: Design the project features and ensure that project implementation, monitoring, and maintenance maximize compatibility with the qualities of wilderness character	This alternative does not meet the project objective. Although this alternative has no effect on the untrammeled and undeveloped qualities, it is not compatible with the natural quality of wilderness character. Rank: Low	This alternative mostly meets the project objective. Although this alternative would have minor adverse impacts to the untrammeled quality and short-term minor adverse impacts to the natural quality during construction, the plug would have long-term beneficial impacts to the natural quality of wilderness. This alternative would have moderate, but localized, adverse impacts to the undeveloped quality and minor adverse impacts to the solitude or primitive and unconfined recreation quality of wilderness. Rank: Moderate	This alternative mostly meets the project objective. Although this alternative would have minor adverse impacts to the untrammeled quality and short-term minor adverse impacts to the natural quality during construction, the plug would have long-term beneficial impacts to the natural quality of wilderness. The canoe ramp and boat dock included in this alternative would have localized moderate adverse impacts to the undeveloped quality, and minor adverse impacts to the solitude or primitive and unconfined recreation quality. Rank: Moderate

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Cultural Resources Objective 1: Avoid adverse impacts to cultural and archeological resources and historic features through project design or mitigation measures	This alternative does not meet the project objective. Taking no action would allow the passage of tidal flow past the failed plug, thereby causing potential adverse impacts to the historic structures. Rank: Nil	This alternative mostly meets the project objective. The footprint/configuration would not be altered, causing the least impact to the historic structures and hence maintaining their integrity. Rank: Moderate	This alternative mostly meets the project objective. The footprint/configuration would not be altered, causing the least impact to the historic structures and hence maintaining their integrity. Rank: Moderate
Engineered Features Objective 1: Design engineered features, when necessary, to last at least 50 years (barring severe damage by catastrophic hurricane events) with annual/bi-annual maintenance	This alternative does not meet the project objective. The plug is in need of immediate replacement and continued maintenance. Rank: Nil	These alternatives meet the project objective. The engineering design has been tested and proven at the recently completed plugs at East Cape Extension and Homestead Canals in the Cape Sable area. Rank: High	

Project Objectives	Alternative 1: No Action	Alternative 4A: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Alternative 4B: Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Visitor Use and Experience Objective 1: Provide safe passage into the Marjory Stoneman Douglas Wilderness Area for canoeists/ kayakers at the Raulerson Plug location	This alternative does not meet the project objective. Dangerous currents could trap and capsize small watercraft. Rank: Nil	This alternative mostly meets the project objective. There will be no hazardous currents because the canal has been blocked. Non-motorized boaters will have the ability to portage their vessel around the plug. Rank: Moderate	This alternative meets the project objective. There will be no hazardous currents because the canal has been blocked. This alternative provides an engineering component for a safe passage over the plug for non-motorized boaters. Rank: High
Visitor Use and Experience Objective 2: Improve the wilderness visitor experience by reducing the opportunity for illegal motorized access into the Marjory Stoneman Douglas Wilderness Area at the Raulerson Dam location	This alternative does not meet the project objective. The canal allows for illegal motorized boats entry into the wilderness area thereby diminishing the wilderness visitor experience. Rank: Nil	This alternative meets the project objective. Replacing the failed plug would prevent illegal motorized boats into the wilderness area and improve visitor experience. Rank: High	This alternative meets the project objective. Replacing the failed plug would prevent illegal motorized boats into the wilderness area and improve visitor experience. Rank: High

TABLE 2.6 - SUMMARY OF IMPACTS OF THE ALTERNATIVES

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
Location(s)	House and Slagle Ditches and Raulerson Canal	House and Slagle Ditches		Raulerson Canal	
Description of Alternative	No Action	Re-Backfill Eroded Plug Areas	Re-Backfill Eroded Plug Areas, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection	Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection	Construct a New Sheet Pile Plug and Fill Plug with Riprap Erosion Protection with an Option for a Canoe Ramp
Geology, Topography, and Soils	No beneficial effects to geology, topography, and soils are anticipated as a result of implementing the No Action Alternative. **Long-term moderate to major adverse impacts** to soils and **long-term negligible adverse impacts** to geology and topography would result from the implementation of this alternative.	Repairing the plugs in place in at House and Slagle Ditches **would not result in any long-term adverse impacts** to geology, topography, and soils at each of the plug sites. **Short-term minor to moderate adverse impacts** to geology, topography, and soils within the canal work zone would occur from turbidity/suspended soils. However, during construction, **short-term negligible to minor adverse impacts** from turbidity/suspended soils would occur beyond the direct impact footprint (i.e., outside of the turbidity barriers and/or silt fence). **Short-term moderate adverse impacts** at the plug sites are also anticipated due to soil compaction in the work zones. Furthermore, there is increased certainty that unnatural water exchange through the canals will not occur and		Alternatives 4A and 4B would **not result in any long-term adverse impacts** to the geology, soils, and topographic conditions of the site. However, **short-term minor to moderate adverse impacts** to geology, topography, and soils within the canal work zone would occur from turbidity/suspended soils. **Short-term negligible to minor adverse impacts** to geology, topography, and soils, from turbidity/suspended soils would occur beyond the direct impact footprint (outside of the turbidity barriers). **Short-term moderate adverse impacts** at the plug site are also expected to result from soil compaction in the work zones. Consequently, **long-term beneficial effects** would occur from the resulting reduction of erosional processes along the banks of Raulerson Canal.	

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
		therefore there will be **long term beneficial effects** resulting in the reduction of unnatural erosional processes.			
Hydrology	**No beneficial effects** to hydrology are anticipated as a result of No Action Alternative. The No Action Alternative would produce **long-term moderate to major adverse impacts** on hydrology.	Alternatives 2 and 3 would restore the local hydrologic regime to a more natural state and result in **long-term beneficial effects** to hydrology**.** High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel/ditch formation. However, this process is considered a natural process and should not be viewed as an adverse impact. Thus, Alternatives 2 and 3 would result in **long-term beneficial effects** to hydrology in the areas of House and Slagle Ditches.		Alternatives 4A and 4B would restore the local hydrologic regime to a more natural state and result in **long-term beneficial effects** to hydrology**.** High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel formation. However, this process is considered a natural process and should not be viewed as an adverse impact. Thus, Alternatives 4A and 4B 3 would result in long-term beneficial effects to hydrology in the Raulerson Canal area.	
Water Quality	Taking no action would produce **moderate to major adverse impacts** on the water quality of park water resources.	Alternatives 2 and 3 would result in **minor to moderate short-term adverse impacts** to water quality with the repair/restoration of the plugs at House and Slagle Ditches during construction activities; however, **long-term beneficial effects** to water quality are anticipated post construction. Therefore, following completion of the plugs, **long-term beneficial effects** to park resources in relation to water quality are expected		Alternatives 4A and 4B would allow for a reduction in the intensity and duration of saltwater entering the interior wetlands through the Raulerson Canal at times when the natural tides are not overtopping the Old Ingraham Highway. This deceleration of saltwater intrusion would offer time for Cape Sable's interior wetlands (including the wildlife and vegetation) to restabilize and possibly recover from the current impacts being caused by the failed plug. Alternatives 4A and 4B would result in **minor to moderate short-**	

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
				term adverse impacts to water quality with restoration of the plug; however, **long-term beneficial effects** to water quality are anticipated. Therefore, Alternatives 4A and 4B are expected to provide for **long-term beneficial effects** to park resources in relation to water quality.	
Vegetation and Wetlands	**House and Slagle Ditches:** Taking no action would not directly impact wetland/surface water areas. There would be **moderate to major adverse effects** to the wetland systems of the greater Cape Sable area. **No beneficial effects** to wetlands are anticipated as a result of the No Action Alternative. The No Action Alternative would produce **moderate to major adverse impacts** on	Alternatives 2 and 3 would result in **minor adverse, localized, and direct effects** on vegetation due to construction activities. However, these action alternatives would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park's master plan or other NPS planning documents. Alternatives 2 and 3 would result in **short-term, minor, adverse, and localized impacts** as well as **long-term beneficial effects**.		For Alternative 4A, construction activities would result in **minor adverse, localized, direct effects** on vegetation. However, this action alternative would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived	For Alternative 4B, construction activities would result in **minor adverse, localized, direct effects** on vegetation. However, this action alternative would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	wetlands. **Raulerson Canal:** No direct impacts to wetland/surface water areas would result with Alternative 1. There would be **moderate to major adverse effects** to the wetland systems of the greater Cape Sable area. No beneficial effects to wetlands are anticipated as a result of the No Action Alternative. The No Action Alternative would produce **moderate to major adverse impacts** on wetlands.			from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park's master plan or other NPS planning documents. Alternative 4A would result in **short-term, minor, adverse, and localized impacts** as well as **long-term beneficial effects**.	establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park's master plan or other NPS planning documents. Alternative 4B would result in **short-term, minor, adverse, and localized impacts** as well **as long-term beneficial effects**.
Wildlife and Habitat	**No direct impacts** to wildlife and wildlife habitat areas would result under the No	The action alternatives would result in **minor, short-term adverse impacts** from construction activities but **beneficial long-term effects** on wildlife and wildlife habitat from improved hydrologic conditions and reduced saltwater intrusion.			

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	Action Alternative. **No beneficial effects** to wildlife are anticipated as a result of No Action Alternative. The No Action Alternative would produce **long-term minor to moderate adverse impacts** on wildlife and habitat resources.				
Marine Resources and Essential Fish Habitat	Under the No Action Alternative, no construction would take place and current conditions and processes would continue. However, taking no action to address the issues associated with the eroding earthen plugs at House and Slagle Ditches and failed plug at Raulerson Canal would only prolong impacts on erosional	Alternatives 2 and 3 would result in some **short-term, minor, unavoidable adverse impacts** to habitats designated as EFH for several federally managed species. **No long-term adverse** EFH impacts are anticipated. EFH and other marine resources would benefit from improved hydrologic conditions and reduced saltwater intrusion. Alternatives 2 and 3 would result in **short-term minor adverse effects** and **long-term beneficial impacts** to EFH.		Alternatives 4A and 4B would result in some long-term minor unavoidable adverse impacts to habitats designated as EFH for federally managed species. This includes a small loss of habitat, and temporary disturbance to a small area of non-vegetated bottom and temporary degradation of the estuarine/marine water column due to an increase in suspended sediment concentrations. Alternatives 4A and 4B would result in **long-term minor adverse effects** and **long-term beneficial impacts** to EFH.	

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	processes within the waterways and the greater Cape Sable area. The No Action Alternative would result in **long-term minor to moderate adverse impacts** on EFH.				
Special Status Species	Under the No Action Alternative, no construction would take place and current conditions would persist. There would be **no direct adverse effect** from construction on federally listed species or their habitat; however taking no action to address the issues associated with the continuing erosion at House and Slagle Ditches and failed plug at Raulerson Canal would only prolong the impacts	Under the action alternatives any direct adverse effect from construction on federally listed species or their habitat would be temporary and would provide **indirect long-term beneficial** effects to the habitats of federally listed species. The Action Alternatives would **not likely adversely affect** special status species.			

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	on erosional processes within these waterways and the greater Cape Sable area. The No Action Alternative may potentially result in **long-term minor to moderate adverse impacts** to the American crocodile and other species and their habitats within the local project area.				
Wilderness	The Cape Sable area is designated wilderness within EVER. Therefore, the No Action Alternative would have a **negligible impact** on the untrammeled and undeveloped quality. There would be a **minor impact** to the solitude or primitive and unconfined recreation quality and a **moderate to**	Alternatives 2 and 3 would **have minor adverse effects** on the untrammeled and solitude or primitive and unconfined recreation wilderness qualities at House and Slagle Ditches. The small footprint and natural materials used for alternatives 2 and 3 would have **minor impacts** to the undeveloped quality of wilderness. The additional armoring included as part of Alternative 3 would result in **highly localized moderate adverse impacts** to the undeveloped quality. The natural quality of wilderness would experience **minor adverse impacts** during construction, but the effects of preventing breaching would be		Alternatives 4A and 4B would have **minor and adverse** impacts to the untrammeled quality of wilderness. Alternative 4A would have **localized moderate adverse impacts** to the undeveloped quality and **minor adverse impacts** to the solitude or primitive and unconfined recreation quality of wilderness. The canoe ramp and boat dock included in Alternative 4B would have **localized moderate impacts** to the undeveloped quality, and **minor to moderate impacts** to the solitude or primitive and unconfined recreation quality. These alternatives would have **minor adverse impacts** to the natural quality during construction. However, installation of a new	

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	major adverse impact to the natural quality.	**long-term and beneficial** to the Cape Sable area.		plug would result in **substantial long-term beneficial effects** on the natural environment of the interior Cape Sable wetlands.	
Cultural Resources	Under the No Action Alternative, current existing conditions would continue to degrade, resulting in **long-term minor to moderate adverse impacts** to historic structures. The No Action Alternative would **not result in major adverse impacts** on cultural resources.	Under the Action Alternatives, construction would have **minor adverse impacts** on the NHRP-eligible plugs, ditches, and canal due to the construction occurring within the overall footprint of these historic structures. However, since there would be a deceleration of erosional processes, the action alternatives would result in **long-term beneficial impacts** to historic structures and a potential historic district.			
Visitor Use and Experience	If no action is taken to rectify the existing unsafe and undesirable conditions at the eroding earthen plugs at House and Slagle Ditches and at the existing failed plug at Raulerson Canal, the visitor use	Under Alternatives 2 and 3, the undesirable conditions at the eroding plug sites would be remedied. The integrity of Old Ingraham Highway will be restored at these locations offering unhindered access to the backcountry area for park visitors. Impacts to visitor use and experience would be **long-term and beneficial**.		If Alternatives 4A and 4B are implemented, the existing unsafe (submerged debris from the existing failed plug) and undesirable conditions at the existing failed plug sites would be remedied, including the provision for a safe portage over the plug (under Alternative 4B) and prevention of illegal motorized boaters beyond the plug into the wilderness area. Impacts to visitor use and experience would be **long term and beneficial**.	

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	and experience would decline. Conditions at the plug sites would be expected to worsen substantially within the next 50 years, causing a **long-term, moderate, and adverse impact** on visitor use and experience in the park.				
Park Management and Operations	If no action is taken at the plug sites at House and Slagle Ditches and Raulerson Canal, park management and operations would be negligibly effected in both the short term and long term. Maintenance, enforcement, and research activities would continue at their current level. Once the plug fails at Slagle's Ditch, it	Under any of the Action Alternatives, impacts to park management and operations would be **long term, minor, and adverse**. Enforcement and Interpretative activities would increase in the short term to provide the public information and enforce closures related to construction activities. Monitoring at the plugs will increase over current levels; this change will be **long term, minor, and adverse**. Maintenance will increase in the long term, and effects would be **negligible to major adverse**.			

Impact Topic	Alternative 1	Alternative 2	Alternative 3	Alternative 4A	Alternative 4B
	would be necessary for the interpretative staff to notify visitors. This would be a **long-term negligible impact**.				

2.8 ENVIRONMENTALLY PREFERABLE ALTERNATIVES

According to the US Department of the Interior regulations that implement NEPA (43 CFR Section 46.30), the environmentally preferable alternative is the alternative that "causes the least damage to the biological and physical environment and best protects, preserves, and enhances historical, cultural, and natural resources. The environmentally preferable alternative is identified upon consideration and weighing by the responsible official of long-term environmental impacts against short-term impacts in evaluating what is the best protection of these resources. In some situations, such as when different alternatives impact different resources to different degrees, there may be more than one environmentally preferable alternative."

For House and Slagle Ditches, the NPS has identified the environmentally preferable alternatives as Alternative 2, Re-backfill Eroded Plug Area. At Slagle Ditch, water is currently passing through the eroded plug, which is considered a precursor to failure. Reinforcement of the plug is needed soon to prevent breaching and the subsequent adverse impacts to the interior wetlands, wildlife habitat, and marine resources that have resulted from plug failures on other canals. This alternative would provide the environmental benefits of maintaining the function of the marl ridge, without the added impacts to wilderness character that would result from the additional erosion protection features under Alternative 3.

At House Ditch, the eroded plug is not yet leaking and failure is not imminent as at Slagle Ditch. NPS would monitor the condition of the plug and should it begin leaking, Alternative 2 would be the preferable repair method. This scenario would provide the environmental benefits of repairing the plug when breaching is imminent, without the added impacts to wilderness character that would result from backfilling before it is needed or the additional erosion protection features under Alternative 3.

Alternative 4A, Construct a New Sheet Pile and Fill Plug with Erosion Protection, is the environmentally preferable alternative at the Raulerson Canal. The failed plug at Raulerson Canal allows the canal to continue to erode, widen, and transport sediment to the inland wetlands as well as to Lake Ingraham, Florida Bay, and the Gulf of Mexico. The unnatural exchange of water and sediment through the marl ridge is degrading the habitat for wading birds, juvenile crocodiles and other wildlife. Installing a new plug with erosion protection would halt the unnatural flows of water and sediment through the ridge, and improve the quality of wildlife habitat. Implementing Alternative 4A would restore the function of the marl ridge without the added impacts to wilderness character that would result from installing a boat dock, hardened footpath, and canoe ramp under Alternative 4B.

2.9 NPS PREFERRED ALTERNATIVES

The Preferred Alternative is the alternative that the NPS determines "would best accomplish the purpose and need of the proposed action while fulfilling its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors" (43 CFR § 46.420(d)). The purpose of identifying a preferred alternative is to let the public know which alternative the agency is leaning toward selecting at the time an EA is released. It is important to note that when identifying a preferred alternative, no final agency action is being taken.

Alternative 2, Re-backfill Eroded Plug Area, has been identified as the preferred alternative at Slagle and House Ditches because it meets the objectives associated with the purpose and need

for the proposed action and is the environmentally preferable alternative at both locations. At Slagle Ditch, the NPS would repair the eroded plug which is currently leaking and considered to be near failure. At House Ditch, the NPS would monitor the condition of the plug, and should it begin leaking, repair it with the same means and methods used at Slagle Ditch.

Alternative 4A, Construct a New Sheet Pile and Fill Plug with Erosion Protection, has been identified as the preferred alternative at the Raulerson Canal. This alternative meets the objectives associated with the purpose and need for the proposed action and is the environmentally preferable alternative.

2.10 IMPLEMENTATION

Prior to designing the proposed plug, geotechnical borings at the selected plug location should be obtained and analyzed for shear and bearing strength as well as standard geophysical properties. It is believed that the plug area is underlain by a very soft lime mud layer approximately 10 feet deep (i.e., N 0 to 2). This layer is supported by a weak weathered limestone (i.e., N 30 to 50). The design engineers will need this information to calculate passive and active earth pressures, consolidation data, etc. for the sheet pile design.

The following presents a preliminary implementation schedule for the Preferred Alternatives:

2.10.1 Generalized Construction Approach and Sequencing For House and Slagle Ditches

The following presents a generalized approach to the potential construction methods and proposed sequencing for the proposed action alternatives.

1. Work would be limited to an October 1 – March 31 construction window to avoid crocodile mating and nesting season. Prepare and submit required upfront submittals for the work in sufficient time to begin work on October 1.
2. Mobilize a small labor work force from Flamingo Marina to offload points requiring overland foot traffic to inland plug sites.
3. Mobilize materials and miscellaneous small equipment from offsite staging areas in the Florida Keys or elsewhere to work sites. No dredging will be conducted as this would destabilize the ditches and cause adverse environmental impacts to park resources.
    a. Helicopter delivery
        i) Material purchase from local suppliers and delivery to Flamingo Heliport area.
        ii) Material and small equipment staging and helicopter pickup at Flamingo Heliport.
        iii) Delivery to designated drop zone area adjacent to plug areas.
        iv) 8,000 lbs. delivery per trip = 2.0+ cubic yards (CY)/trip. The movement of 10 CY will require 5-6 trips per site including incidentals and equipment. The movement of 18 CY will require 9-10 trips per site including incidentals and equipment. A helicopter should be able to supply material in 1.5 days for Alternatives 2 and 3, assuming up to 5 trips per day.
        v) Short overland movement of material from drop site to plug site.
4. Locally hand trim and clear vegetation/roots from plug repair areas to provide access and a safe work zone.
5. Hand place and grade fill material in six-inch lifts, as applicable.
6. Compact fill using small, vibratory, walk-behind compactor.

7. Grade and hand place geotextile fabric and drain material including slotted PVC pipe, as applicable.
8. Hand place geotextile fabric and erosion protection, as applicable.
9. Inspect and approve completed construction.
10. Cleanup plug work sites and demobilize miscellaneous materials, bags, trash, and any equipment from jobsites including barges.
11. Demobilize personnel. All work and demobilization to be completed by March 31.

2.10.2 Generalized Construction Approach and Sequencing for Raulerson Canal

The following information provides a generalized presentation of the anticipated construction approach and sequencing for the Raulerson Canal Plug site.

1. Work would be limited to an October 1 – March 31 construction window to avoid crocodile mating and nesting season. Prepare and submit required upfront submittals for the work in sufficient time to begin work on October 1.
2. Mobilize materials and miscellaneous equipment from offsite staging areas in the Florida Keys or elsewhere via barge to work site. No dredging will be conducted as this would destabilize the canal and cause adverse environmental impacts to park resources.
    a. Approval of offsite staging area anticipated to be required by the regulatory/permitting agencies.
    b. Comply with all on-site environmental monitoring requirements during the duration of construction.
3. The feasibility of installing a temporary port-a-plug just to the east of the selected plug site will be explored. The port-a-plug could help block the tidal current velocity, which could make the steel sheet pile installation and material barge movement much easier.
4. Mobilize daily work force from Flamingo Marina.
5. Complete mangrove trimming along access canal and clearing at the approved plug site area including isolated clearing for inland sheet pile sections.
6. Acquire and deliver sheet piling and other materials to jobsite.
    a. Deliver materials via barge from offsite staging areas, or
    b. Temporarily deliver and store materials in Flamingo maintenance yard area, and subsequently load and deliver from Flamingo Marina (West Bulkhead) with approval and coordination from the park.
7. Drive easternmost sheet pile from barges and install backfill and riprap erosion protection for eastern half of plug.
8. Drive canal cutoff sheets, and westernmost sheet piling.
9. Install sheet pile backfill and riprap erosion protection around cutoff plug area and along westernmost canal sheet piling.
10. Secure final inspection and Substantial Completion Notice.
11. Cleanup plug work sites and demobilize miscellaneous materials, bags, trash, and any equipment from jobsites including barges.

Chapter 3

Affected Environment and Environmental Consequences

CHAPTER 3: AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION

This chapter describes existing environmental conditions in the areas potentially affected by the alternatives as described in Chapter 2. The focus is on the impact topic (e.g., natural and cultural resources, visitor opportunities, socioeconomic characteristics) that would be affected by the proposed alternatives, should they be implemented, and the effects to those environmental conditions. For each impact topic discussed below, the existing conditions, or "affected environment", is provided first and is followed by the "environmental consequences", or potential impacts of each of the alternatives (or groupings of alternatives if impacts are similar in nature) to each of the resources impact topics. This section analyzes both beneficial and adverse impacts that would result from the implementation of any of the proposed alternatives. A summary of the environmental consequences for each alternative is provided in Table 2.6, which can be found at the end of chapter 2.

Table 3.1 lists impact topics that are considered and those that have been considered but dismissed from detailed analysis.

TABLE 3.1 - IMPACT TOPICS CONSIDERED OR DISMISSED

Impact Topics Considered in this EA **Alternatives have the potential to affect these resources or topics (see Section 1.5.3).**	**Impact Topics Dismissed from Detailed Analysis** **These resources or topics are important, but the alternatives would have only positive impacts on them, and/or any adverse impacts would be negligible to minor (see Section 1.5.4).**
Geology, Topography, and Soils (Section 3.3)	Air Quality
Water Resources including Hydrology, Water Quality, and Vegetation/Wetlands (Section 3.4)	Conflicts with Land Use Plans, Controls, or Policies
Wildlife and Habitat (Section 3.5)	Cultural Landscapes
Marine Resources and Essential Fish Habitat (Section 3.6)	Ecologically Critical Areas
Special Status Species (Section 3.7)	Energy Requirements and Conservation Potential
Wilderness (Section 3.8)	Environmental Justice for Minority and Low-Income Populations
Cultural Resources (Section 3.9)	Ethnographic Resources
Visitor Use and Experience (Section 3.10)	Floodplains
Park Management and Operations (Section 3.11)	Gateway Communities and Urban Quality
	Indian Trust Assets
	Museum Collections
	Natural or Depletable Resource Requirements and Conservation Potential
	Night Sky
	Prime and Unique Farmlands
	Socioeconomics
	Soundscapes
	Transportation

This section also summarizes the laws and policies relevant to each impact topic and explains the general methodology used to analyze impacts, including definitions of impact thresholds for measuring the intensity of impacts. In addition, an assessment of cumulative impacts is included for each topic.

3.2 METHODOLOGY FOR ESTABLISHING IMPACT THRESHOLDS AND MEASURING EFFECTS BY RESOURCE

The general approach for measuring the effects of the alternatives on each resource category includes general analysis methods as described in guiding regulations, basic assumptions, and thresholds used to define the level of impact resulting from each alternative. The analysis of impacts follows CEQ guidelines, DO #12 (NPS 2011), and its accompanying handbook (NPS 2015b).

3.2.1 General Analysis Methods

For each impact topic, the analysis includes a brief description of the affected environment and an evaluation of the potential impacts of implementing each alternative. Potential impacts are characterized in terms of type, context, duration, and intensity. The following assumptions were made:

- **Type** determines if the effects are beneficial or adverse.
    - *Beneficial***:** A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
    - *Adverse***:** A change that declines, degrades, and/or moves the resource away from a desired condition or detracts from its appearance or condition.

- **Context** or **area affected** by the proposed alternative such as local, park-wide, regional, global, affected interests, society as a whole, or any combination of these. Context is variable and depends on the circumstances involved with each impact topic. The **analysis area** is described under each topic and may include either the primary area adjacent to the existing waterways (see **Figures 1.3**) or the expanded greater Cape Sable area (see **Figure 1.2**).

- **Intensity** describes the effects in terms of negligible, minor, moderate, or major. Since definitions of impact intensity (i.e., negligible, minor, moderate, major) vary by impact topic, intensity definitions are provided separately for each impact topic. In some cases, in order to minimize redundancy, alternatives were grouped together when impacts were determined to be similar.

- **Duration** answers the question if the effect is short term or long term. The duration of the impact varies according to the impact topic. For the purposes of this analysis, the following assumptions are used for all impact topics except cultural resources:
    - *Short-term impacts:* Those impacts occurring in the immediate future or during plan implementation, usually from one to six months or up to one year. For natural systems (i.e., vegetation, wildlife, wetlands), it is assumed that recovery would take less than one year.
    - *Long-term impacts:* Those impacts occurring after plan implementation, through the next 10 years. For natural systems (i.e., vegetation, wildlife, wetlands), it is assumed that recovery would take more than one year.

Each alternative is compared to a baseline (No Action Alternative) to determine the context, duration, and intensity of the resource impacts. In the absence of quantitative data, best professional judgment was used to determine impacts. In general, impacts were determined using existing literature, federal and state standards, and consultation with subject matter experts, park staff, and other agencies.

3.2.2 Cumulative Impacts

NEPA regulations require an assessment of cumulative impacts in the federal decision-making process. Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative actions are those that have additive impacts on a particular environmental resource. The cumulative impacts need to be analyzed in terms of the specific resource, ecosystem, and human community being affected and should focus on meaningful effects (CEQ 1997).

The Cape Sable area is a remote and isolated region of the park. Therefore, known past, present, and reasonably foreseeable future actions are limited. Several plans, policies, and actions that could have an impact on park resources in relationship to the proposed action are presented in **Section 1.5.5**. A discussion of the anticipated impacts from these projects and actions follows, all of which would be considered negligible.

- **Original Construction of Cape Sable Canals** – Early in the 20th century, at least seven canals were dredged through the marl ridge in attempts to drain the cape's interior wetland areas and reclaim the land for development, agriculture, and cattle grazing. The network of canals opened up the cape's interior wetlands to the tidal influence and an inflow of saltwater from Florida Bay and the Gulf of Mexico, increasing salinity and triggering substantial change in the ecology of the area. Canal construction appears to have had a dramatic effect on the southern portion of the interior wetlands of Cape Sable. By 1953, mangroves and other salt tolerant plant communities had colonized the higher marl areas (Wanless and Vlaswinkel 2005).

- **EVER GMP** – The GMP is a long-term programmatic plan that includes desired conditions and management direction for park resources. It provides broad direction for land use and visitor management, but does not include information on site-specific treatments or restoration activities. Those activities and their potential environmental effects would be detailed in follow-on implementation plans with accompanying NEPA documentation. The GMP would have negligible impacts on resources within the project area and the region.

- **Cape Sable Canals Dam Restoration Project, Phase I** - In 2011, NPS replaced two failed plugs at Homestead and East Cape Extension Canals with the aim of reducing saltwater intrusion from canals dug early in the 20th century and restoring the Cape Sable wetlands to a more natural state. The new canal plugs provide sustainable solutions to issues associated with saltwater intrusion in and degradation of brackish marshes north of the Cape Sable marl ridge, illegal motorized boat access into the Marjory Stoneman Douglas Wilderness area, and unsafe conditions for motorized and non-motorized boaters at the plug sites. The new plugs are having long-term beneficial effects on the natural quality of wilderness character in the Cape Sable area. Their presence also has a localized, long-term adverse impact on the undeveloped, the untrammeled, and the solitude or primitive recreation qualities of wilderness at the plug sites.

- **South Florida and Caribbean Parks Exotic Plant Management Plan** – Exotic vegetation management activities, such as the use of fire and chemical, mechanical, and biological treatments, would have short-term, localized, adverse impacts on some resources in the project area; however, beneficial impacts would occur in localized areas over the long-term. Overall, the effects of sporadic exotic vegetation management in the project area and in the region would be negligible.

- **Hydrologic restoration activities** – There are several current and future projects designed to improve water delivery to the south Florida region and the Everglades ecosystem: specifically the CERP, the CEPP, the MWD project, and the Tamiami Trail 2 project. Each of these is designed to improve and restore flows to the interior wetlands of the Everglades region, including the park; however, as many are in their initial phases or only recently completed, therefore their impact on resources in the park and the region are unknown at this time. Furthermore, given the location of the Cape Sable area and the project site in relation to these cumulative projects, the impact and influence on resources within the region and the local project area would likely be undetectable and thus negligible.

- **Visitor use and experience projects** – Projects to provide visitor opportunities or enhance visitor experience in the region would not be observably affected by projects such as the Florida Circumnavigation Saltwater Paddling Trail (see **Section 1.5.5.3**). The impact to visitor use and experience in the project area and the region would be negligible.

As discussed above, it was determined that these cumulative projects and actions would have only negligible impacts on resources in the project area, and that any of the action alternatives would contribute only a negligible increment to the overall impact on resources within the region. Accordingly, cumulative effects were considered so small as to be undetectable, and thus discountable. Therefore, no cumulative impacts are anticipated as a result of this project and a detailed analysis is not included in this EA.

3.3 GEOLOGY, TOPOGRAPHY, AND SOILS

3.3.1 Affected Environment

3.3.1.1 Geology and Topography.

The southernmost point in the continental United States, the Cape Sable peninsula extends from the southwestern tip of the Florida peninsula into the Gulf of Mexico and Florida Bay. Situated within EVER, Cape Sable contains stretches of shell beaches fringed by a mix of mangrove trees and marsh. Most of the physical structure of the Florida peninsula was in place about two million years ago. Since then, several periods of glaciation caused the sea level to rise and fall, alternately inundating and then retreating from the land. During inundation, layers of limestone, sand, and seashells were deposited to form the near-surface bedrock under modern-day Florida.

In general, the Cape Sable area consists of very low lying, flat topography that averages five to ten feet above mean sea level and is comprised mainly of limestone, which is relatively soft, permeable and prone to erosion (Crisfield 2005). The lower freshwater Everglades is defined by two subtle limestone topographic highs, a Pliocene ridge to the northwest, and a Pleistocene ridge to the southeast. These two limestone features create a gently sloping vertical gradient that directs the lower Everglades flow towards Cape Sable (Wanless and Vlaswinkel 2005).

The mainland portion of EVER overlies the unconfined Surficial Aquifer System (SAS), which consists of Miocene to Holocene age siliciclastic and carbonate sediments, and varies in thickness from 165 feet to 270 feet. It contains two named carbonate aquifers - Gray Limestone Aquifer and Biscayne Aquifer - and two layers of siliciclastic sediments. The Hawthorn Group forms the base of the SAS. The 550- to 800-foot thick sequence of low permeable sediments of the Hawthorn Group makes it an effective confining unit for the underlying Floridan Aquifer System. In south Florida, the Floridan Aquifer occurs between depths of 820 and 3,280 feet below the land surface and is artesian with a potentiometric surface (head) of about 40 feet above the land surface. The Biscayne Aquifer forms the top of the SAS, and is the principle source of water supply for south Florida. The Biscayne Aquifer is an unconfined karst aquifer dominantly composed of highly porous units of the Fort Thompson and Miami Limestone Formations with the Key Largo formation inter-fingering in some areas. The Biscayne Aquifer contains high permeability limestone and calcareous sand units and ranges in thickness from 0 to 80 feet, increasing in thickness toward the east. In many portions of EVER, the Biscayne Aquifer is overlain by marl and peat deposits (Price 2003).

Evidence suggests that coastal flooding occurred approximately 2,800 to 2,000 years ago, accompanied by rapid sedimentation, which resulted in a series of coastal marl ridges. These firm tan ridges are composed of detritus and calcium carbonate mud (marl) overlying a sequence of grey marl followed by pleistocene limestone bedrock at approximately 10 to 13 feet below sea level. The marl ridge extends from near Everglades City southward to Cape Sable. As the continuous marl ridge formed, discharge through the Cape Sable area was blocked shifting north through the Shark and Harney River systems (Wanless and Vlaswinkel 2005). The approximate location of the marl ridge within the Cape Sable study area is shown on **Figure 1.5**.

The largest of Cape Sable's lakes, Lake Ingraham appears to have been formed through impoundment between the marl ridge and an outer beach ridge, and possibly as a result of a small oscillation in sea level that occurred approximately 1,200 years ago. Shoreline erosion has since created the scalloped cape shoreline of today.

As a result of the marl ridge, the interior of Cape Sable was transformed into a mixture of isolated low supratidal to shallow subtidal carbonate mud flats followed by the formation of brackish to freshwater marshes. As sea level gradually rose, these marshes eventually spread resulting in the vast interior wetlands we see today. The marl ridge partially acts as a boundary between the intertidal zone and the predominantly freshwater interior. During tides that rise over 4 feet mean sea level, the marl ridge is overtopped and tidal waters flow into the interior (Crisfield 2005).

There are three basic Holocene sediment sequences in the Cape Sable area. The first comprises approximately half of Cape Sable from the southern portion of Cape Sable and the western portion up to Big Sable Creek. This sequence is dominated by calcium carbonate mud (marl) overlain by a few feet of organic peat. The second sequence is located in the landward and northern portions of Cape Sable and comprised entirely of organic peat. The third sequence dominates the western coast and capes comprised of calcareous shelly sand (Wanless and Vlaswinkel 2005).

3.3.1.2 Soils.

Limestone, calcareous shelly sand, marl and peat, are the four lithologic substrates encountered within the park. Of these, marl (entisols) and peat (histosols) are the two dominant soil types. Marls (or entisols) are a form of calcitic mud, and is the primary soil type encountered along the

coastal, southern, and western interior regions of the park. They are the main soil of the short hydroperiod wet prairies of the southern Everglades (Lodge 2004). Marls are typically characterized as light-colored carbonate muds having plastic or clay-like properties.

Marsh peats (or histosols) are a product of long hydroperiod wetlands (Lodge, 2004) that are formed under anaerobic conditions during extended periods of flooding, where the volume of decaying plant material exceeds the ability of microbes to decompose it. Two types of peat occur throughout the wetlands in the park, Everglades peat and Loxahatchee peat (Lodge 2004). Everglades peat is composed almost entirely of sawgrass and has a dark brown to black color. Loxahatchee peat is primarily composed of slough plant matter that usually includes a high percentage of waterlily remains. Loxahatchee peat is typically lighter in color and is more common in the northern regions of the park.

3.3.2 Environmental Consequences

3.3.2.1 Assumptions, Methodology and Impact Thresholds.

NPS' Management Policies (NPS 2006) directs NPS to protect geologic features (i.e., products and physical components of geologic processes) from the unacceptable impacts of human activity, while allowing natural processes to continue. Examples of geologic features include: rocks, soils, and minerals; geysers and hot springs; cave and karst systems; canyons and arches; sand dunes, moraines, and terraces; dramatic or unusual rock outcrops and formations; and paleontological and paleoecological resources such as fossilized plants or animals, or their traces. For the purposes of analysis in this document, geologic features also include soil erosion, effects on soil productivity, and the ability of the soil to support native vegetation.

Potential impacts to soils are assessed based on the extent of disturbance to natural undisturbed soils, the potential for soil erosion resulting from disturbance, and limitations associated with the soils. Analysis of possible impacts to soil resources was based on site inspections, review of existing literature and maps, and information provided by the NPS and other agencies. The following thresholds were used to determine the magnitude of impacts on soils and geologic features:

Analysis Area: The focus of this analysis are the primary areas adjacent to the proposed plug reconstruction sites at House and Slagle Ditches; however, impacts to soils in the expanded study area of the greater Cape Sable area are also discussed.

Intensity Thresholds:

- *Negligible:* Soils and geologic features would not be affected or effects would not be measurable. Any soil erosion, effects on soil productivity, or the ability of the soil to support native vegetation would be slight, and would occur in a relatively small area.
- *Minor:* Effects on soils or geologic features would be detectable, but only a small area would be affected. If mitigation was needed to compensate for adverse effects, it would be relatively simple to implement and would likely be successful.
- *Moderate:* Effects on soils or geologic features would be readily apparent and would occur over a relatively large area. Mitigation would likely be necessary to successfully compensate for adverse effects.
- *Major:* Effects on soils or geologic features would be readily apparent and would substantially change the soil or geologic characteristics over a large area. Extensive

mitigation would be needed to compensate for adverse effects, and its success would not be assured.

Duration: Short-term impacts occur during all or part of alternative implementation; long-term impacts extend beyond implementation of the alternative.

3.3.2.2 Impacts of the Alternatives.

3.3.2.2.1 No Action Alternative for House and Slagle Ditches

1) Analysis. Under the No Action Alternative, the current plugs at House and Slagle Ditches would remain unchanged. As a result, soils within and adjacent to these areas would not be disturbed or compacted. However, due to the ongoing erosion at both sites, soils in the already eroded locations would have a greater potential for erosion during high tides and high water events such as severe storms and hurricanes. The impacts related to the current erosional processes would continue at existing or potentially increasing rates. In the event of a hurricane or other high water event, there would be a high probability that in addition to current conditions, further erosion would occur at the sites (Crisfield 2005).

House and Slagle plugs are currently intact, but when they to fail, sediments would be transported and deposited both into Cape Sable and out into Florida Bay via the open channels. Due to the continued erosion of the ditch/canal banks and associated sedimentation in Cape Sable's open waters, the long-term unnatural exchange of water and sediments would result in potentially moderate adverse impacts to the soil, topographic, and/or geologic characteristics.

3.3.2.2.2 No Action Alternative for Raulerson Canal

1) Analysis. Under the No Action Alternative, the failed plug at Raulerson Canal would remain unchanged. As a result, soils within and adjacent to this areas would not be disturbed or compacted. However, they would have a greater potential for erosion during high tides and high water events such as severe storms and hurricanes. In the event of a hurricane or other high water event, there would be a high probability that in addition to current conditions, further erosion would occur at the site (Crisfield 2005). Under the No Action Alternative, it is expected that associated channel widening would continue along Raulerson Canal.

Currently the greatest impact to soils and topography in the surrounding wetlands is most likely caused by Raulerson Canal due to the unnatural exchange of water through the canal. Sediments are transported and deposited both into Cape Sable and out into Florida Bay via open channels. Due to the continued erosion of the ditch/canal banks and associated sedimentation in Cape Sable's open waters, this alternative would continue to allow the long term unnatural exchange of water to create and move these sediments with potentially moderate to major impacts to the soil, topographic, and/or geologic characteristics.

2) Climate Change and Sea Level Rise. Geology, topography, and soils in EVER would be impacted by climate change as a result of increased storm intensity and duration including the increasing amount and duration of saltwater flow into the interior wetlands of Cape Sable. Everglades soils subsidence and accretion could be affected by increased storm intensity (NPS 2008). Additionally, intrusion of saltwater inland could contribute to coastal erosion, inundation, and changes in wetlands and vegetation across south Florida (NWF 2006).

3) Conclusion. No beneficial effects to geology, topography, and soils are anticipated as a result of implementing the No Action Alternative. Long-term moderate to major adverse impacts to soils and long-term negligible adverse impacts to geology and topography would result from the implementation of this alternative.

3.3.2.2.3 Alternative 2: Re-backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection

1) Analysis. Under Alternative 2 and Alternative 3, the existing plugs at House and Slagle Ditches would be backfilled, essentially restoring the plugs at their existing locations. Under these alternatives, construction would be limited to filling the eroded areas with a coarse grade limestone and rock fill containing silty binder-type fines. The backfill would be placed in sufficient quantities to reconstruct the original plugs, keeping them consistent with the adjacent plug slope and elevation/grades. Minor regrading and excavation may be required before placing the backfill material, resulting in long-term negligible adverse impacts to the geologic and topographic conditions of the site.

Alternative 3 also includes slope and erosion protection measures (e.g., riprap), geofabric along the slopes of the plug and a few feet on each side, and a geotextile fabric-wrapped sand drain for seepage protection. A slotted PVC drainpipe would be inserted into the sand drain material to collect and discharge any seepage water passing through the plug fill and entering the drain. Sand drains consist of a boring through the silt that is filled with sand (or gravel) to allow the soil to drain and are helpful to accelerate the process of consolidation settlement of the plugs (see **Figure 2.11**).

Due to the space limitations in the work area at both plug sites, a designated work zone would be established in which equipment would be staged for use during construction. The designated work zone includes a 60-foot-by-60-foot helicopter drop area and an accessway to the plug site. Additional staging may occur on nearby floating barge(s) at the mouth of the ditches in Florida Bay to the south, if needed. Woody vegetation/debris along the banks would be cleared to provide a safe work zone and allow for equipment access to the construction zone.

Plug reconstruction activities would include the use of machinery, which would result in soils being disturbed and compacted within the work areas and designated accessways. This could pose short-term minor adverse impacts to the soils. In addition to the riprap, compacted soils reduce root growth and the ability for rainfall to infiltrate the soil, which could increase stormwater runoff. Compacted soils could inhibit seed germination and plant growth, which, over the long-term, could decrease the amount of organic material within the soils and decreases overall soil productivity. To minimize and mitigate potential impacts to the soils, BMPs would be implemented during construction. The movement of equipment and materials would be limited to times when the areas are not too wet and would be able to support the weight of the equipment and materials.

In the proposed construction areas, soils within these sites would likely be disturbed and compacted by construction-related activities resulting in short-term moderate adverse impacts to the soils. Compacted soils would reduce root growth and the ability for rainfall to percolate

into the soil, which could increase stormwater runoff. Moderately compacted soils would inhibit seed germination and plant growth which, over the long term, decreases the amount of organic material within the soils and therefore decreases the overall soil productivity. To minimize potential impacts to soils, BMPs would be implemented during construction. Equipment use would be limited to times when the areas are not too wet and able to support the weight of equipment. After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted) and replanted with native vegetation where possible. Since construction would be limited to the designated work zones, long-term adverse impacts to soils are not expected to occur outside of the immediate construction footprints.

After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted) and would be replanted with native vegetation to reduce the potential for erosion. Therefore, long-term adverse impacts to soils within the work area are not expected to occur outside of the immediate footprint of the plugs. Since the elevation matches existing adjacent grades, the area is expected to return to pre-existing conditions within five years. Erosional damage from water overtopping the plugs would also be minimal due to the presence of rooted vegetation or slope armoring. Thus, this filling activity would result in short-term, minor adverse impacts to existing soils and long-term beneficial effects to geology, topography, and soils as a result of these alternatives.

During construction, turbidity/suspended soils would be contained within the construction work area using staked silt fences and/or floating turbidity curtains or equivalent to minimize the potential for turbidity to occur beyond the limits of construction. Erosion control barriers would be installed prior to construction and would remain in place and regularly inspected for the duration of construction. To ensure compliance with water quality standards, a turbidity monitoring plan would be implemented during in-water construction to ensure compliance with water quality standards in Outstanding Florida Waters (OFWs). If monitoring reveals that turbidity levels exceed the standards, construction activities would cease immediately and would not resume until corrective measures are implemented (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment). Upon completion of construction, the waterways would be returned to pre-construction conditions. Therefore, negligible to minor adverse impacts beyond the construction footprints are anticipated to occur as a result of turbidity/suspended soils.

Effects from turbidity/suspended solids would result in short-term minor to moderate adverse impacts to geology, topography, and soils within the work zones with a potential for short-term negligible to minor adverse impacts to geology, topography, and soils beyond the direct impact footprints (i.e., outside of the turbidity barriers and/or silt fence). Construction-related turbidity would result in short-term moderate adverse impacts to geology, topography, and soils within the construction footprints with a potential for short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (i.e., outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for geology, topography, and soils as a result of turbidity/suspended soils.

Restoring the plugs (and reinforcing the plugs in the case of Alternative 3) would increase the certainty that the plugs would endure for a longer period of time (as compared to the No Action Alternative) and would continue to prevent the unnatural exchange water through the canals. Therefore, this alternative would result in long-term beneficial impacts to geology, topography, and soils.

2) Climate Change and Sea Level Rise. Geology, topography, and soils would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable resulting

from climate change. While slowing the rate of sea level rise is beyond the resources of the park, there will be increased certainty that these impacts would be mitigated in the short to intermediate term by the plugs reconstruction. The reconstructed plugs increase the certainty that canals will not be conduits of unnatural exchange of water for some time to come and this may reduce the intensity and duration of unnatural saltwater intrusion. This will allow the wetlands and ecosystem of Cape Sable to be governed by only natural processes. The slowing or postponement of impacts by the reconstructed plug structures would allow more time for the interior Cape Sable wetlands to recover from the current impacts and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Repairing the plugs in place in at House and Slagle Ditches would not result in any long-term adverse impacts to geology, topography, and soils at each of the plug sites. However, during construction, short-term negligible to minor adverse impacts from turbidity/suspended soils would occur beyond the direct impact footprint (i.e., outside of the turbidity barriers and/or silt fence). Short-term moderate adverse impacts at the plug sites are also anticipated due to soil compaction in the work zones. Furthermore, there is increased certainty that unnatural water exchange through the canals will not occur and therefore there will be long term beneficial effects resulting in the reduction of unnatural erosional processes.

3.3.2.2.4 Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. Alternative 4A and 4B involves the installation of a sheetpile plug at Raulerson Canal with riprap erosion protection. Construction would be similar to recently completed plugs at East Cape Extension and Homestead Canal, also located in EVER. Alternative 4B offers an option of constructing a safe passage over the restored plug for non-motorized boaters (i.e., canoeists and kayakers). All other construction features for Alternative 4B would be similar to Alternative 4A.

Staging is anticipated to occur on nearby floating barge(s). The barge(s) are anticipated to access the Raulerson Canal through existing navigational channels and/or deep-water areas of Florida Bay originating from a designated staging area in the Florida Keys or other suitable location due to a lack of a suitable staging area in EVER. The exact location of the staging area would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands (e.g., parking lot, paved area, previously filled area).

Restoration activities would include using heavy machinery and would result in soils being disturbed and compacted within and adjacent to the project area. This would pose short-term minor adverse impacts to the soils at the site. Compacted soils reduce root growth and the ability for rainfall to infiltrate the soil, which would increase runoff. Compacted soils would also inhibit seed germination and plant growth, which, over the long-term, decreases the amount of organic material within the soils and decreases overall soil productivity. To minimize the impacts to the soils, all BMPs would be implemented during construction. After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted) and replanted with native wetland vegetation. Therefore, long-term adverse impacts to soils are not expected to occur outside of the designated work area.

Woody vegetation /debris clearing would be performed along the banks as needed to provide for a safe work zone. Riprap armoring would be transported to the work area using a barge. In the vicinity of the wingwalls on either end of the plug, minor leveling, grading, and excavation may be required, resulting in long-term negligible adverse impacts to the geologic or topographic conditions within the designated work area.

Construction-related turbidity would be contained within the construction footprint using staked and/or floating turbidity curtains or other suitable barriers to minimize the potential for turbidity beyond the limits of construction. The barriers would be installed prior to commencement of construction activities and would remain in place and regularly inspected throughout construction. To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be implemented during construction. If monitoring reveals that turbidity levels exceed the standards, all construction activities would cease immediately and would not resume until corrective measures are implemented (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment). Thus, turbidity would result in short-term minor to moderate adverse impacts to soils, geology and topography within the work zone with a potential for short-term negligible to minor adverse impacts to soils, geology and topography beyond the direct impact footprint (outside of the turbidity barriers). Additionally, no long-term adverse effects are anticipated for soils, geology, and topography as a result of these alternatives.
The resulting restored plug would decrease the velocity of currents during tidal flows, thus reducing erosional processes along the banks. Thus, erosion and channel widening would be expected to decrease, consequently reducing sediment deposition in the interior wetlands and Lake Ingraham, providing a benefit to these systems. Therefore, long-term beneficial impacts to geology, topography, and soils are expected to occur at Raulerson Canal. Furthermore, the proposed location of the plug, centered at the highest elevation along Raulerson Canal would serve as a natural hydrologic barrier further reducing natural erosional processes that have been exacerbated with the existing failed plug.

2) Climate Change and Sea Level Rise. Geology, topography, and soils would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable resulting from climate change. While slowing the rate of sea level rise is beyond the resources of the park, there would be increased certainty that these impacts would be mitigated in the short to intermediate term by the plug reconstruction. The reconstructed plug increases the certainty that the canal will not be a conduit of unnatural exchange of water for some time to come and this may reduce the intensity and duration of unnatural saltwater intrusion. This will allow the wetlands and ecosystem of Cape Sable to be governed by only natural processes. The slowing or postponement of impacts by the reconstructed plug structure would allow time for the interior wetlands of Cape Sable to recover from the current impacts and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. These alternatives would not result in any long-term adverse impacts to the geology, soils, and topographic conditions of the site. However, short-term minor to moderate adverse impacts to geology, topography, and soils within the canal work zone would occur from turbidity/suspended soils. Short-term negligible to minor adverse impacts to geology, topography, and soils, from turbidity/suspended soils would occur beyond the direct impact footprint (outside of the turbidity barriers). Short-term moderate adverse impacts at the plug site are also expected to result from soil compaction in the work zones. Consequently, long-term beneficial effects would occur from the resulting reduction of erosional processes along the banks of Raulerson Canal.

3.4 WATER RESOURCES

3.4.1 Affected Environment

Cape Sable is surrounded by water on three sides - Florida Bay to the south, the Gulf of Mexico to the west and Whitewater Bay to the northeast. It is located between the outlets of two major watersheds of the park: Shark River Slough and Taylor Slough. Shark River Slough flows from its origin in the northeast portion of the park and empties into the Gulf of Mexico to the west of Cape Sable, while Taylor Slough drains a smaller watershed along the eastern portion of the park and flows into northeastern Florida Bay (NPS 2003). Surface waters located within the Cape Sable study area include several manmade canals, natural tidal creeks, and Lake Ingraham. Given the nature of the Everglades hydrology, these surface waters support the groundwater, which lies in unconfined aquifers just below the surface. Water availability in the park is very seasonal. During the summer rainy season, increased precipitation recharges aquifers near the surface, while during drier winter months, the near surface aquifers provide water to the surface water bodies.

Coastal wetlands are influenced strongly by the quantity and quality of water available. Starting with the wet season in June, water levels increase throughout the summer months, peaking in late September or early October. Water levels typically decline through October and November, culminating in dry season conditions from January through April or May. One underlying cause of this cycle is seasonal changes in sea surface elevation caused by thermal expansion of the Gulf of Mexico during summer months and subsequent contraction during the winter (Marmar 1954; Stumpf 1998). Rainfall patterns are also seasonal, with 60 percent of the rainfall occurring from June to September and only 25 percent from November through April (Duever 1994), thereby augmenting the underlying water level cycle caused by sea surface elevation.

3.4.1.1 Hydrology.

The hydrologic system of the Cape Sable region is multidimensional, encompassing marine, intertidal, and estuarine sub-systems. In addition to the different hydrologic systems, the area is subject to tropical storms, hurricanes, and sea level rise due to climate change. Tropical weather systems and strong winds associated with cold fronts during winter months can cause short-term changes in water levels through wind-driven tides (Holmquist 1989). Wetlands closer to the Gulf of Mexico also experience changes in water level on a twice daily cycle through diurnal tides while more isolated wetlands (e.g., the interior wetlands of Cape Sable and Shark River Slough) may not experience diurnal tides at all (Lorenz 2000). In addition, water management practices can result in pulsed increases in water levels at a regional spatial scale due to the opening and closing of canal structures.

Saltwater from Florida Bay and the Gulf of Mexico has been entering the Cape Sable region through a series of man-made canals constructed in the early 20th century, as well as through natural waterways such as East Side Creek. In addition, during very high tides where the marl ridge is overtopped, saltwater from the Gulf of Mexico enters the Cape Sable area.

The open canals transport sediment and organic material from the interior wetlands and eventually into Lake Ingraham. East Side Creek connects to East Cape Canal and sediment and saltwater is moved out to Florida Bay through East Cape Canal and East Side Creek. Raulerson Canal may move sediment to Lake Ingraham and Florida Bay and salt water into the interior. The ecological collapse of the southern interior wetlands that occurred pre-1950s, was a direct

result of the attempted draining of the interior Cape Sable wetlands via the man-made canals constructed through the marl ridge; large high water events and hurricanes (e.g., the 1935 Labor Day Hurricane sent a six-foot storm surge across Cape Sable eliminating forested wetlands adjacent to Lake Ingraham, Hurricane Donna in 1960 moved a whole area of mangrove forest and instantly created new islands, Hurricane Andrew in 1992 was described as destroying large areas of marsh wetlands); and saline intrusion through the man-made canals (Wanless and Vlaswinkel 2005).

The unnatural exchange of water through the canals has altered the natural hydrology and water quality of the interior wetlands of Cape Sable. Altered salinity levels, the loss of freshwater, and tidal forces caused landscape changes to the southern interior wetlands of Cape Sable after the canals were constructed. In this area, the wetland plant communities appear to have been lost to open water. Today, there is not significant evidence that large areas of wetland plant communities are transitioning from one habitat type to another or that interior wetlands are converting to open water. However, the altered hydrology and water quality caused by the unnatural exchange of water through the canals is having a negative impact on habitat for numerous plant and animal species, including juvenile crocodiles and forage fish suitable to wading birds, in the southern interior wetlands of Cape Sable.

3.4.1.2 Water Quality.

The annual salinity cycle is linked to the seasonality of the water level cycle (Robinson 2011). Salt concentrations are typically highest in late May or early June and rapidly decline with the onset of the wet season (Jiang 2011). With the exception of relatively brief pulses in salinity in the early wet season (that usually only occur in dry years), salinity remains low throughout the wet season and is typically at its lowest from September through December. Salinity begins to slowly increase in December followed by a steady and sustained increase beginning in January or February that continues through to the beginning of the wet season. A delayed wet season could lead to long periods of hypersalinity. The saline cycle varies from location to location based on the proximity to marine and freshwater influences (Lorenz 1999; Lorenz 2006).

Concerns for water quality in the Cape Sable study area include increased turbidity from ebb tides, currents, floods, and from human-induced effects (e.g., motorized boats and man-made canals). Large amounts of sediment are being deposited in Lake Ingraham through the canals (Wanless and Vlaswinkel 2005). The results of their study showed that approximately 12% of the sediment transported into Lake Ingraham by daily tidal currents is stored within the lake. This deposition of sediments is virtually converting Lake Ingraham into a mud flat.

The failed plug at Raulerson Canal resulted in an open hydrologic connection to Lake Ingraham. As the erosion continues at House and Slagle Ditches, they are frequently overtopped and increasingly becoming hydrologically connected to Lake Ingraham. Spring tides have a larger tidal range and therefore larger velocities; larger velocities result in higher suspended sediment concentrations and overall higher transports; however, the winter storms make up the largest contribution to the net sediment flux (Wanless and Vlaswinkel 2005). This process has been slowed with the recent construction of East Cape and Homestead Canal plugs. However, the open canals and at least one natural tributary, East Side Creek continue to transport sediment and organic material from interior wetlands to Lake Ingraham where much of this material has been deposited. Sediment, and probably nutrients, from the interior wetlands also make their way to Florida Bay and the Gulf of Mexico.

Waters in the park are designated OFW. An OFW is a water designated worthy of special protection because of its high-quality natural attributes. This special designation is applied to certain waters, and is intended to protect existing good water quality (FDEP 2015). Therefore, per Rule 62-302 F.A.C., no degradation of surface water quality is permitted. Typically, within OFWs, onshore or in-water activities with the potential to create turbidity are restricted to maintain conditions within zero Nephelometric Turbidity Units (NTU) above ambient conditions. Surface waters located within the Cape Sable study area include several natural tidal creeks and Lake Ingraham.

Although the majority of the park is designated wilderness and motorized vehicles are prohibited, the use of motorized boats within the Cape Sable study area continues and has the potential to adversely affect water quality from an oil or gas release. Spill control kits are typically available from park personnel/marine patrol to address potential spill impacts, as needed.

3.4.1.3 Vegetation and Wetlands.

The majority of the land in the Cape Sable area is classified as wetland habitat, an extremely important component of the EVER landscape that supports a variety of wildlife. Florida Bay is classified as an estuarine subtidal habitat with aquatic beds of unknown substrate characteristics. Wetlands of the greater Everglades ecosystem include a mosaic of vegetation types, including tree-islands, mangrove forests, cypress swamps, marl prairies, sawgrass marshes, and sloughs (USGS 2006). The National Wetlands Inventory (NWI) wetland classification of the Cape Sable study area is shown in **Figure 3.1** (USFWS 2014). “E” refers to estuarine (i.e., where the tide meets the current). The “E1” wetlands are classified as estuarine subtidal (i.e., continuously submerged substrate). “E2” wetlands are estuarine intertidal (i.e., from extreme low water to extreme high water). The “M” wetlands are classified as marine. Similarly, “M1” refers to subtidal and “M2” to intertidal.

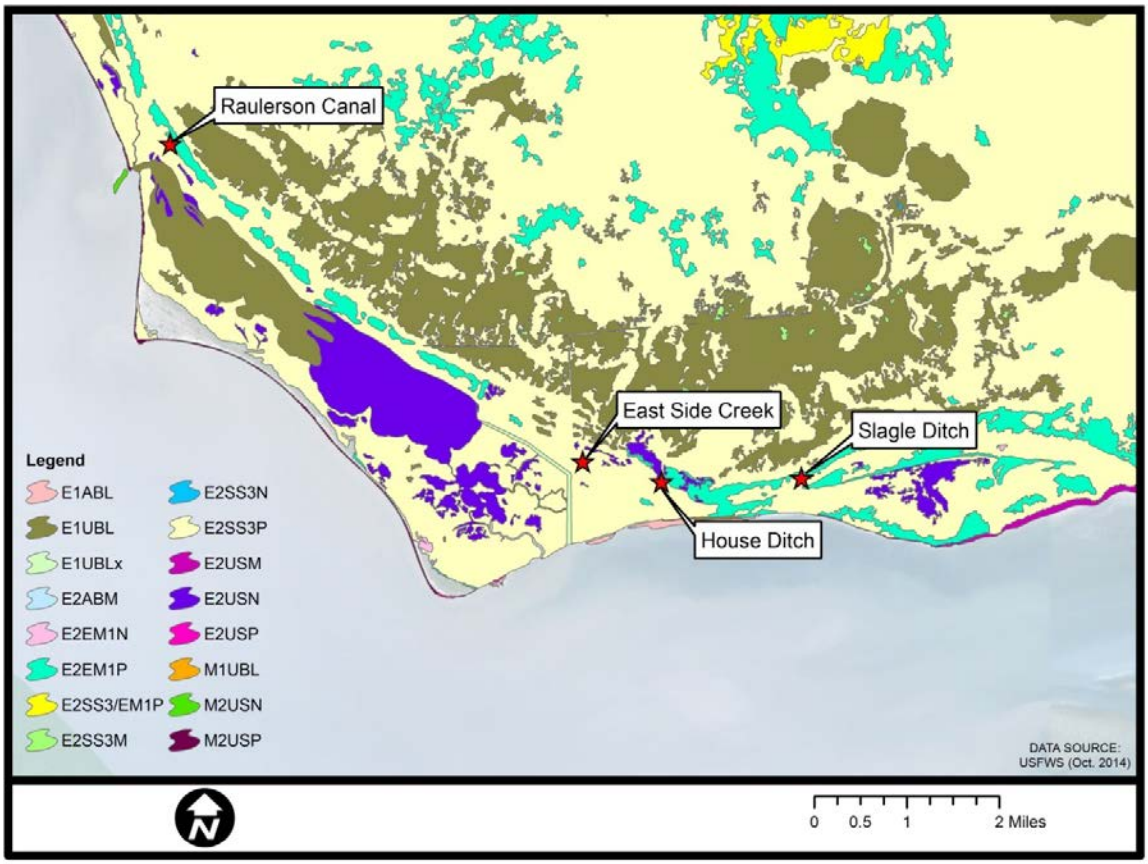


FIGURE 3.1 - NATIONAL WETLANDS INVENTORY MAP

As previously discussed in Section 1.3.2.12, EO 11990: Protection of Wetlands, directs all federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. In the absence of such alternatives, parks must modify actions to preserve and enhance wetland values and minimize degradation. Consistent with EO 11990 and NPS DO #77-1: Wetland Protection, NPS adopted a goal of "no net loss of wetlands." DO #77-1 states that for new actions where impacts to wetlands cannot be avoided, proposals must include plans for compensatory mitigation that restores wetlands on NPS lands, where possible, at a minimum acreage ratio of 1:1.

The NPS defines wetlands as vegetated areas that are flooded or saturated for a duration sufficient to allow development of at least one of the three wetland indicators described in the 1987 U.S. Army Corps of Engineers (USACE) Wetland Delineation Manual (USACE 1987). The three wetland indicators used include wetland hydrology, hydric soil, or hydrophytic vegetation. This definition differs from that used by USACE to delineate jurisdictional wetlands. The USACE definition requires the presence of all three wetland indicators for an area to be classified as a wetland.

The proposed action meets NPS DO #77-1 Procedural Manual, Exception 4.2.1(h) - Actions designed to restore degraded (or completely lost) wetland, stream, riparian, or other aquatic habitats or ecological processes; provides that an action may be excepted if the "…restoration refers to reestablishing environments in which natural ecological processes can, to the extent practicable, function as they did prior to the disturbance." It further states "short-term wetland disturbances that are directly associated with and necessary for implementing the restoration

may be allowed." In addition, this exception may be applied if "actions causing a cumulative total of up to 0.25 acres of new, long-term adverse impacts on natural wetlands may be allowed under the exception if they are directly associated with and necessary for the restoration (e.g., small structures)."

In the case of this particular exception and this action, temporary loss is not calculated. As documented in the previous discussion, any combination of the action alternatives results in a maximum permanent disturbance of 0.031 acres. Therefore, this action is eligible for NPS Exception 4.2.1(h) and exempted from preparing a NPS Wetlands Statement of Findings.

Detailed characterizations of wetland/surface water areas located within and adjacent to the Cape Sable study area are as follows:

3.4.1.3.1 Southern Interior Wetlands

NWI: *USFWS – E2SS3U (Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Unknown Tidal) and E2USM (Estuarine, Intertidal, Unconsolidated Shore, Irregularly Exposed)*

FLUCFCS: *542/612/512 - Southern Interior Wetlands/ Embayment not opening directly into Gulf of Mexico-Mangrove Swamp/Streams & Waterways*

The habitats on the mainland side of the marl ridge are primarily a mosaic of mangrove wetland and numerous shallow bottom subtidal areas of open water. The southern interior of Cape Sable was a continuous marsh with isolated round lakes prior to the construction of the man-made canals which increased saltwater intrusion into the interior Cape Sable wetlands (Wanless and Vlaswinkel 2005). The southern wetlands were separated from the intertidal habitats of Lake Ingraham by the marl ridge. In addition to periodic overtopping of the marl ridge, the interior wetland area receives saltwater input via canals. Further north, the central and northern interior wetlands contain a mosaic of brackish, marine, and hyper-saline plant communities although most of the interior is dominated by mangroves interspersed with open water. In addition to mangroves, common flora in the central and northern interior areas includes cordgrass (*Spartina* spp.) and sawgrass (*Cladium jamaicense*).

3.4.1.3.2 Florida Bay

NWI: *USFWS – E1UBL (Estuarine, Subtidal, Unconsolidated Bottom, Subtidal) and E1ABL (Estuarine, Subtidal, Aquatic Bed, Subtidal)*

FLUCFCS: *541 – Embayment opening directly into Gulf of Mexico*

Florida Bay is located at the southernmost tip of the Florida Peninsula between the mainland and the Florida Keys, most of which lies within the boundaries of EVER. Florida Bay is classified as an estuarine subtidal habitat with aquatic beds of unknown substrate characteristics. As part of the Cape Sable Phase I project, soil boring was conducted at Homestead and East Cape Canals. The soil boring sample for Homestead confirmed the presence of approximately 13 feet of marl followed by a peat layer less than 1 foot thick. Below the peat was a layer of limestone, at least 2 feet thick (URS 2007). The soil boring sample for East Cape Canal confirmed the presence of approximately 14 feet of marl followed by a peat layer less than 1 feet thick. Below the peat was a layer of limestone, at least 3.5 feet thick (URS 2007). Since the two soil borings provided relatively similar results within the overall Cape Sable area, it is assumed that similar conditions

are to be expected at House and Slagle Ditches and Raulerson Canal. The bay is characterized by many shallow interconnected basins, with an average depth of only three feet. It is an area where freshwater from the everglades mixes with the salty waters from the Gulf of Mexico to form an estuary with interconnected basins, grassy mud banks, seagrass flats, and mangrove islands that serve as nesting, nursery, and/or feeding grounds for a host of marine animals.

3.4.1.3.3 Lake Ingraham

NWI: *USFWS – E2USM/N (Estuarine, Intertidal, Unconsolidated Shore, Irregularly Exposed / Regularly Flooded)*

FLUCFCS: *541/651 – Embayment opening directly into Gulf of Mexico / Tidal Flats*

Lake Ingraham is a shallow, intertidal embayment approximately 5 miles in length by 0.5 mile in width with the long axis trending northwest/southeast. This shallow embayment (3-5 feet in water depth) is separated from the marine waters of the Gulf of Mexico and Florida Bay by a narrow carbonate sand beach ridge and barrier beach, and from the interior Cape Sable complex of mangrove wetlands and numerous shallow subtidal open water areas by an emergent calcium carbonate marl ridge. Several manmade canals provide access to the lake and function as tidal inlets enhancing tidal flow into and out of the lake. The expansion of the East Cape, Middle Cape, and Homestead Canals exacerbated sediment deposition in the interior wetlands and is converting Lake Ingraham into a tidal mud flat.

Recently the flood tidal delta in Lake Ingraham formed a sediment body over 2.5 miles over the entire width of the lake, is 2 to 3 feet thick, and resembles an emergent system at low tide (Wanless and Vlaswinkel 2005). The sedimentation allows for the growth of abundant surface algal and cyanobacterial mats on the substrate as well as providing suitable habitat for the colonization of mangrove seedlings (see **Figure 3.2**). More recently, the replacement of plugs at East Cape and Homestead Canals lowered salinity in these wetlands and reduced the impacts of saltwater intrusion.

FIGURE 3.2 - MANGROVES AND ALGAL MATS FORMING ON THE HIGHER PORTIONS OF THE DELTA IN LAKE INGRAHAM (SOURCE: WANLESS AND VLASWINKEL 2005)

3.4.1.3.4 House Ditch

NWI: *USFWS – E2FO3N (Estuarine, Intertidal, Forested, Broad-Leaved Evergreen, Regularly Flooded), E2SS3P (Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Irregularly Flooded), and E1UBLx (Estuarine, Subtidal, Unconsolidated Bottom, Subtidal, Excavated)* (see **Figure 3. 3**)

FLUCFCS: *612/512 – Mangrove Swamps / Streams and Waterways*

House Ditch was constructed in the 1920s and cuts across the marl ridge from the interior wetlands to connect to Florida Bay. The ditch was originally excavated for drainage, development, and agricultural purposes. The substrate at the 40-foot-by-40-foot proposed plug site is partially composed of fill material previously used for the construction of the slightly elevated Old Ingraham Highway in the 1920s which bisects the alignment of House Ditch. The underlying substrate consists of a sequence of fine carbonate mud, marl, underlain by a relatively narrow peat layer followed by limestone bedrock. South of the elevated remnant of the Old Ingraham Highway, the narrow, regularly inundated ditch is overgrown with red mangroves (*Rhizophera mangle*) and black mangroves (*Avicennia germinans*) with their associated prop roots and pneumatophores, respectively.

The House Ditch alignment north of the Old Ingraham Highway consists of a relatively wide expanse of open water bordered primarily by black mangroves and saltwort (*Batis maritima*). No submerged vegetation was observed in this system. The elevated remnant of the Old Ingraham Highway is vegetated primarily with non-wetland species. The woody component is dominated by saffron plum (*Sideroxylon celastrinum*) along with limber caper (*Capparis flexuosa*) and buttonwood (*Conocarpus erectus*). Common ground cover species include Indian hemp (*Sida rhombifolia*), sleepy morning (*Waltheria indica*), sensitive pea (*Chamaecrista nictitans*), and scorpion's-tail (*Heliotropium angiospermum*).

The proposed location for a 60-foot by 60-foot helicopter drop area, identified approximately 150 feet north-northwest of the proposed plug site, is composed of a regularly to irregularly inundated mosaic of non-vegetated marl flats and saltwort prairie. Note that this area was chosen due to its locality to the plug site and, in order to minimize long-term impacts to sensitive resources within the park, its limited quantity of woody vegetation (i.e., mature mangrove trees). However, widely scattered shrub-size black mangroves are present. The area between the proposed plug site and the potential helicopter drop area consists primarily of black mangrove scrub-shrub with a dense ground cover of saltwort. This area would be used as a temporary accessway to and from the plug site.

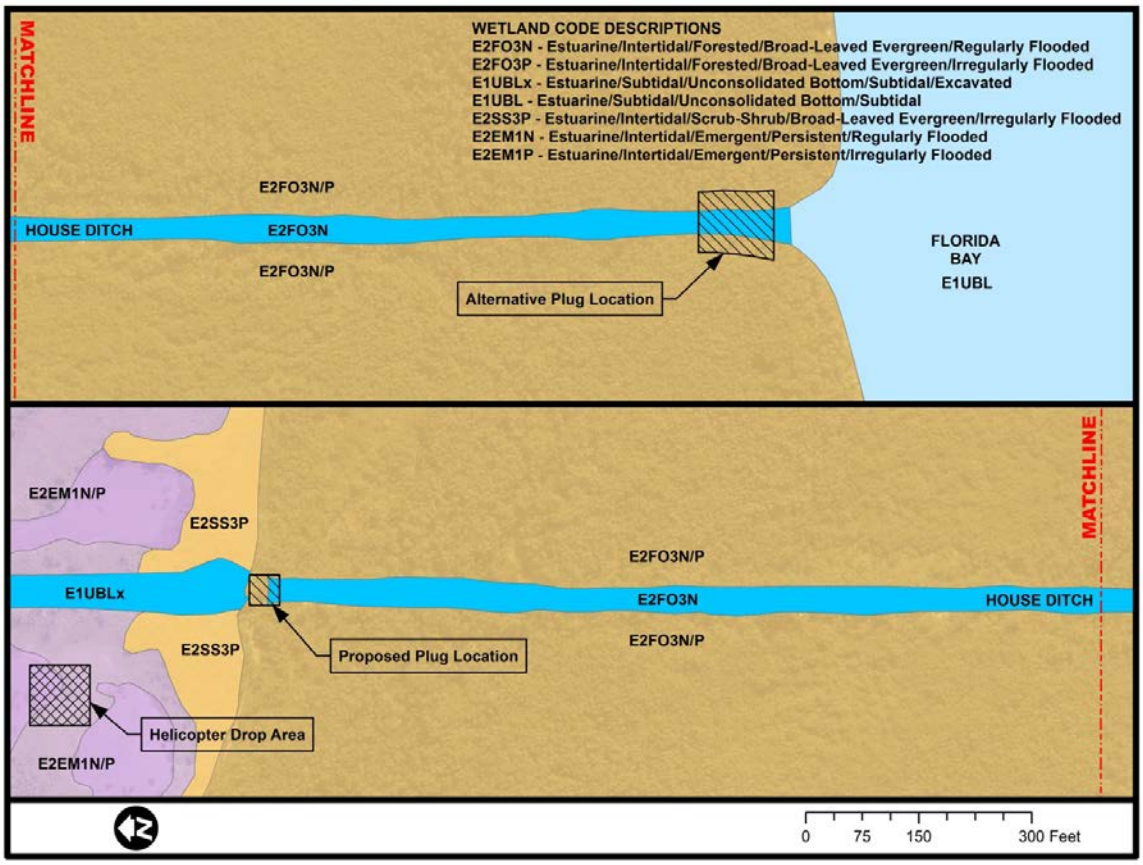


FIGURE 3.3 - HOUSE DITCH NWI MAP

3.4.1.3.5 Slagle Ditch

NWI: *USFWS – E2FO3N (Estuarine, Intertidal, Forested, Broad-Leaved Evergreen, Regularly Flooded), E2SS3P (Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Irregularly Flooded), and E1UBLx (Estuarine, Subtidal, Unconsolidated Bottom, Subtidal, Excavated)* (**Figure 3.4**)

FLUCFCS: *612/512 – Mangrove Swamps / Streams and Waterways*

Slagle Ditch was constructed in the 1920s and cuts across the marl ridge from the interior wetlands to connect to Florida Bay. The ditch was originally excavated for drainage, development, and agricultural purposes. The substrate at the 40-foot-by-40-foot proposed plug site is partially composed of fill material that was used for the construction of the slightly elevated Old Ingraham Highway in the 1920s, which bisects the alignment of the Slagle Ditch. The underlying substrate consists of a sequence of fine carbonate mud, marl, underlain by a relatively narrow peat layer followed by limestone bedrock. South of the elevated remnant of the Old Ingraham Highway, the narrow, regularly inundated ditch is overgrown with red and black mangroves and their associated prop roots and pneumatophores, respectively.

The Slagle Ditch alignment north of the Old Ingraham Highway consists of open water bordered primarily by black mangroves and saltwort with occasional white mangroves and red mangroves interspersed. No submerged vegetation was observed in this system. The slightly elevated remnant of the Old Ingraham Highway is vegetated with a mix of wetland and non-

wetland species. Common tree and shrub species include buttonwood, saffron plum, catclaw blackbead (*Pithecellobium unguis-cati*), limber caper, gray knicker (*Caesalpinia bonduc*), and white indigoberry (*Randia aculeata*). Common ground cover species include saltwort, sea blite (*Suaeda linearis*), common wireweed, bushy seaside oxeye (*Borrichia frutescens*), perennial glasswort (*Sarcocornia ambigua*), saltgrass (*Distichlis spicata*), and bladdermallow (*Herissantia crispa*).

A potential 60-foot by 60-foot helicopter drop area, identified approximately 150 feet north-northwest of the proposed plug site, is composed of a regularly to irregularly inundated saltwort prairie with widely scattered black mangrove shrubs. Note that this area was chosen due to its locality to the plug site and, in order to minimize long-term impacts to sensitive resources within the park, its limited quantity of woody vegetation (i.e., mature mangrove trees). The area between the proposed plug site and the potential helicopter drop area consists primarily of saltwort prairie transitioning southward to black mangrove scrub-shrub with a dense ground cover of saltwort. The potential helicopter drop sites identified in the 2012 Feasibility Study were selected during a desktop analysis only. However, after the 2015 surveys field verified current conditions, it was determined that the 60-foot–by-60-foot area 150 feet north-northwest of the proposed plug site was preferred from an environmental standpoint (as compared the site identified in the 2012 Feasibility Study) and would avoid and minimize potential impacts to wetland resources.

A potential 4-foot wide access accessway was identified between the proposed plug site and an unnamed tidal creek that would provide foot-access to the head of the accessway (just east of Slagle Ditch). The accessway would be used to transport construction materials to the proposed plug site from limits of barge access. This accessway traverses a red mangrove forested community near the unnamed creek through a mosaic of black mangrove scrub-shrub communities, saltwort prairie, and buttonwood dominated areas. This area would be used as a temporary accessway to and from the plug site.

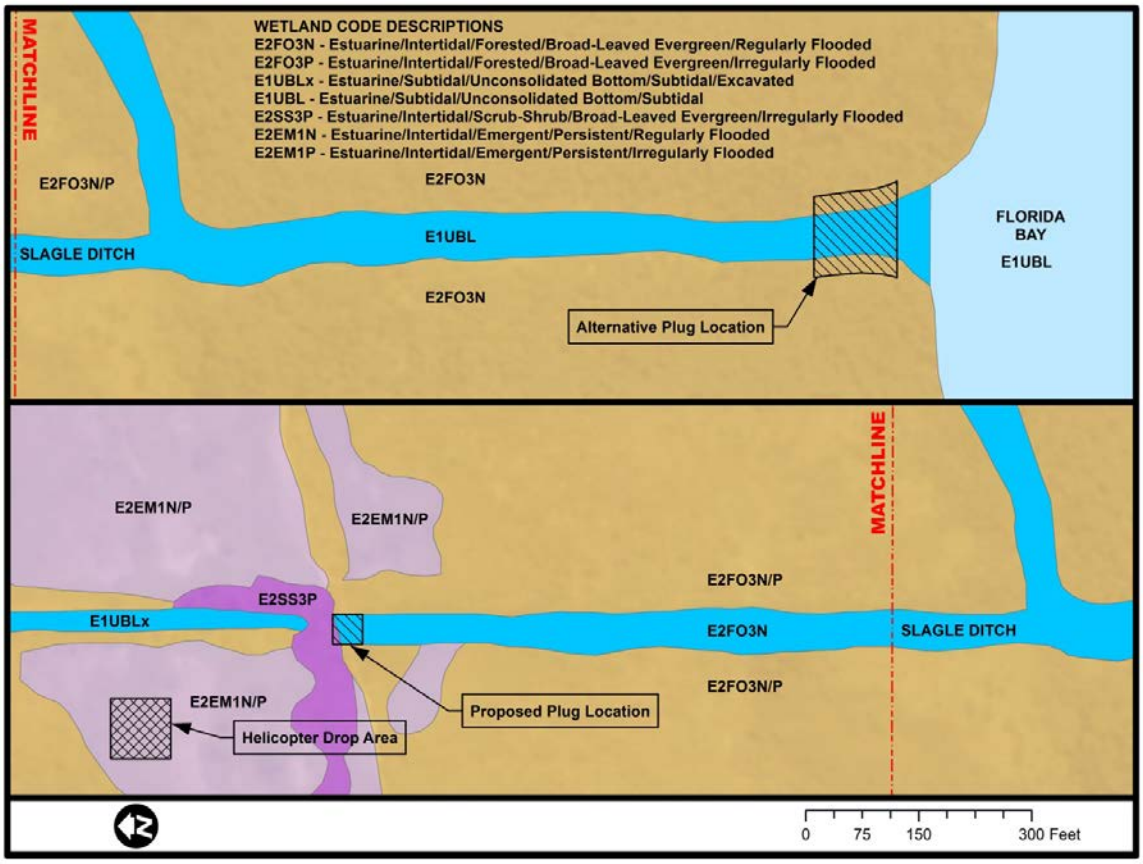


FIGURE 3.4 - SLAGLE DITCH NWI MAP

3.4.1.3.6 Raulerson Canal

NWI: *USFWS – E2FO3P (Estuarine, Intertidal, Forested, Broad-Leaved Evergreen, Irregularly Flooded), E2SS3P (Estuarine, Intertidal, Scrub-Shrub, Broad-Leaved Evergreen, Irregularly Flooded), and E1UBLx (Estuarine, Subtidal, Unconsolidated Bottom, Subtidal, Excavated)* (see **Figure 3.5**)

FLUCFCS: *612/512 – Mangrove Swamps / Streams and Waterways*

The Raulerson Canal was constructed in the 1920s and cuts across the marl ridge from the interior wetlands to connect to a naturally formed tidal creek (Little Sable Creek) entering the northwestern extent of Lake Ingraham at the extensively eroded Middle Cape Canal. The permanently inundated Raulerson Canal was originally excavated for drainage, development, and agricultural purposes. The substrate at the proposed plug site on the excavated canal is comprised of a sequence of fine carbonate mud, marl, underlain by a relatively narrow peat layer followed by limestone bedrock. No submerged vegetation exists within the waterway itself, possibly due to considerable turbidity resulting from the interaction of strong tidal currents and suspended fine particles originating from the marl substrate. A benthic report was completed in 2015. Living seagrass was not found or not expected to be found at any of the proposed project sites.

The banks along the approach to the proposed plug site are comprised primarily of regularly flooded mangrove wetlands dominated by red mangrove, black mangrove, and white mangrove

with a sparse to dense groundcover dominated by saltwort. The south side of the canal at the proposed plug site is characterized by a regularly to irregularly inundated dense ground cover of saltwort with an open canopy black mangrove woodland on the west transitioning eastward to a saltwort community with sporadic occurrences of black mangrove and white mangrove shrubs. The north side of the canal at the proposed plug site is characterized by a regularly to irregularly inundated open canopy woodland dominated by black mangrove with a lesser component of white mangrove and red mangrove and a moderate to dense ground cover of saltwort.

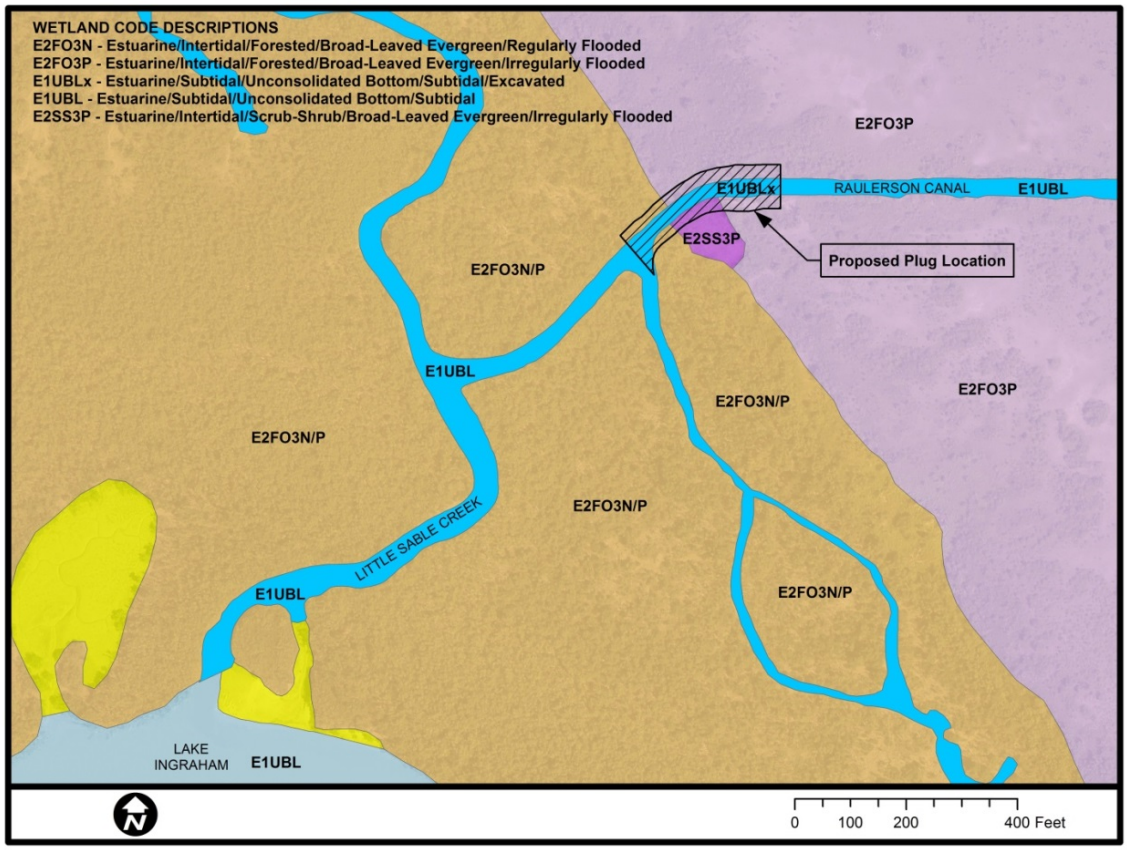


FIGURE 3.5 - RAULERSON CANAL NWI MAP

3.4.2 Environmental Consequences

3.4.2.1 Assumptions, Methodology, and Intensity Thresholds.

As previously discussed, the Clean Water Act supports establishment and enforcement of water quality standards (see **Section 1.3.2.6**). The state of Florida has designated all waters in EVER as "Outstanding Florida Waters" (OFWs) which are "worthy of special protection because of their natural attributes" (Section 403.061 (27), F.S.). Consequently there is an anti-degradation standard for OFWs that include minimum criteria related to the presence of debris, oils, scum, color, odor, taste, and turbidity.

Maps showing water resources within the Cape Sable area (including NWI maps and aerial photographs), summaries from other studies in the area, site visits, and coordination with NPS

staff were used to identify baseline conditions for the analysis. In general, it was assumed that the construction phase of the alternatives would impact water resources. The primary steps taken in assessing impacts on water resources included determining what the likely pollutants might be from construction activities and subsequent use of the area; and whether or not any planned use, construction, or associated pollutants would directly or indirectly affect water quality and/or wetlands over either a short or long term, and over what area this would occur. Mitigation measures are listed in Chapter 2 and are mentioned in the analysis where appropriate. The thresholds for the intensity of an impact are defined for the different water resources topics in Sections 3.4.2.2.1, 3.4.2.2.2, and 3.4.2.2.4.

NPS has determined that this project is in compliance with EO 11988 and 11990. Floodplain management does not apply to certain park functions in "isolated backcountry sites, natural or undeveloped sites along trails or roads, survey and study sites, or other similar activities" that are often located near water for the enjoyment of visitors but require little physical development and do not involve overnight occupation (NPS *DO #77-2: Floodplain Management*). This project meets the criteria under Section V.B. *Excepted Actions* and no further action is required. In addition, the NPS seeks to avoid adverse wetland impacts to the extent practicable, minimize impacts that would not be avoided, and mitigate/compensate for remaining unavoidable adverse wetland impacts (NPS *DO #77-1: Wetland Protection*).

3.4.2.1.1 Hydrology

Analysis Area: The area of analysis for hydrology is the expanded study area that includes Lake Ingraham, the House and Slagle Ditches, Raulerson Canal, and the southern interior wetlands.

Intensity:

- *Negligible:* Hydrology would not be affected, or changes would be at low levels of detection. Any detected effects to hydrology would be slight and localized.
- *Minor:* Changes in hydrology would be measurable, although the changes would be small and localized.
- *Moderate:* Changes in hydrology would be measurable and regional.
- *Major:* Changes in hydrology would be readily measurable, and would have observable consequences on a regional scale.

Duration: Short-term: Recovers in less than 1 year. Long-term: Takes more than 1 year to recover.

3.4.2.1.2 Water Quality

Analysis Area: The area of analysis for water quality is the expanded study area that includes Lake Ingraham, House and Slagle Ditches, Raulerson Canal, and the southern interior wetlands.

Intensity:

- *Negligible:* Chemical, physical or biological effects would not be detectable, and parameters would be well below water quality standards or criteria for the designated use of the water and within historical or desired water quality conditions.
- *Minor:* Chemical, physical or biological effects would be detectable, but parameters would be well below water quality standards or criteria and within historical or desired water quality conditions.

- *Moderate:* Chemical, physical or biological effects would be detectable, but parameters would be at or below water quality standards or criteria; however, historical baseline or desired water quality conditions may be altered on a limited time and space basis.
- *Major:* Chemical, physical or biological effects would be detectable and would be frequently altered from the historical baseline or desired water quality conditions; and/or chemical, physical, or biological water quality standards or criteria may be exceeded.

3.4.2.1.3 Vegetation and Wetlands

The impact thresholds for wetlands are based on the wetlands acreage permanently filled or restored, and the size, integrity, and connectivity of the wetlands affected. These indicators are defined as follows:

- *Size:* The severity of impacts to wetlands depends on the size of the wetland impacted. A small area of impact in a large wetland would be likely to have less of an effect than a large area of impact in a small wetland. The change in size of a wetland, as a result of an impact, would also influence the integrity and connectivity of the wetland and vice versa.
- *Integrity:* Highly intact wetland areas with little prior disturbance would be more susceptible to impacts from direct development than a wetland previously degraded by development or other activities. The loss of function and productivity of the higher quality wetland would be a greater loss than that of a lower quality wetland. Additionally, indirect impacts due to human trampling or a change in vegetation or hydrology would also impact the integrity of the wetland.
- *Connectivity:* The relationship of wetlands to other wetlands or other valuable natural resources is also important in determining the degree of impact or project benefits. Narrow, previous corridors that are infrequently or seasonally used would have less fragmenting effect than would a wide hard-surface roadway with high volumes of vehicular or pedestrian traffic. Establishment of buildings or other structures in wetlands areas would also create barriers to the natural dispersal of plants and animals and impact the connectivity of wetlands.

Analysis Area: The area of analysis for wetlands is the expanded study area that includes Lake Ingraham, the House and Slagle Ditches, Raulerson Canal, and the southern interior wetlands.

Intensity:

- *Negligible:* No measurable or perceptible effects on size, integrity, or connectivity of wetlands would occur. A US Army Corps of Engineers (USACE) 404 permit would not be required.
- *Minor:* The effect on wetlands would be measurable or perceptible, but small in terms of area and the nature of the impact. A small effect on size, integrity, or connectivity would occur; however, the overall viability would not be affected. If left alone, an adversely affected wetland would recover, and the impact would be reversed. A USACE 404 permit would not be required; likely this would be a USACE “no permit required” determination with less than 0.1 acre of impact.
- *Moderate:* The impact would be sufficient to cause a measurable effect on one of the three parameters (size, integrity, connectivity) or would result in a permanent change in wetland acreage, but not to large areas. Wetland functions would not be affected in the

long term. A USACE 404 permit would be required; likely this would be a Nationwide Permit totaling less than 0.5 acre of impact.

- *Major:* The impact would result in a measurable effect on all three parameters (size, integrity, connectivity) or a permanent change of large wetland areas. The impact would be substantial and highly noticeable. The character of the wetland would be changed so that the functions typically provided by the wetland would be substantially altered. A USACE 404 permit would be required; likely this would be an Individual Permit totaling more than 0.5 acre of impact.

3.4.2.2 Impacts of the Alternatives.

3.4.2.2.1 Hydrology

3.4.2.2.1.1 No Action Alternative

1) Analysis. Under the No Action Alternative, current conditions would continue and there would be no beneficial effects on the current hydrologic conditions. Taking no action would prolong the unnatural impacts on hydrologic processes in the Cape Sable area including the loss of the marl ridge's function as a hydrologic barrier and the flow of saline waters through a man-made canal. All of these processes would continue to act at current or potentially increasing rates with No Action Alternative and would result in long-term moderate to major adverse impacts.

Under the No Action Alternative at House and Slagle Ditches, the erosional processes that are occurring on the banks would continue to occur. The No Action Alternative at Raulerson Canal would allow for the unnatural exchange of water through the canal to have unnatural influences on hydrology and overall water quality.

2) Climate Change and Sea Level Rise. With the potential increase in frequency and intensity of storms and floods, hydrology within the park would be impacted from climate change and sea level rise. The potential for increased quantities and durations of saltwater into the interior wetlands of Cape Sable would affect the future conditions of the park's water resources. These increasingly extreme weather events would likely exacerbate existing erosion which could, in turn, increase sedimentation, further degrading water quality.

3) Conclusion. No beneficial effects to hydrology are anticipated as a result of No Action Alternative. As long as the plug in House and Slagle remain in place, the No Action Alternative would have no effect on hydrology. However, when these plugs fail, there may be long-term moderate impacts to hydrology at House and Slagle Ditches. At Raulerson Canal, the No Action Alternative would continue to allow the unnatural exchange of water through the canal. This flow would continue to exacerbate the adverse impacts to the greater Cape Sable area caused by the excavation of the man-made canals and would produce long-term moderate adverse impacts on hydrology.

3.4.2.2.1.2 Alternative 2: Re-Backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-Backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection

1) Analysis. This alternative proposes to repair the existing earthen plugs at House and Slagle Ditches by placing earthen fill and, for Alternative 3 only, riprap for stabilization and armoring. This alternative would result in strengthening the existing plugs in the vicinity of Old Ingraham Highway and increase the certainty that the plugs will prevent the unnatural exchange of water through the ditches well into the future. The flow of saline waters over the marl ridge in the vicinity of the earthen plug sites would be restricted to the natural tidal cycles and the existing tidal creeks in the area (e.g., East Side Creek), consequently, resulting in a reduction in sediment and organic material transport into Lake Ingraham and Florida Bay. The rehabilitated earthen plugs would allow the marl ridge to maintain its function as a natural hydrologic barrier at these locations and increases the certainty that they will continue to do so well into the future. These features allow the hydrology and water quality of the Capes to be governed by more natural processes. Overtopping of the marl ridge with saline waters would likely still occur during hurricanes and other high water events.

Since waterway access would be limited for Alternatives 2 and 3 due to shallow waterways being densely overgrown with protected mangrove resources, a helicopter would be used to import suitable fill material and equipment from an offsite staging area located in previously disturbed uplands (exact location to be chosen by the awarded contractor). The material and equipment would be placed down within a designated 60-foot-by60-foot helicopter drop area and would be transported to the plug site via small equipment and manual labor. Prior to filling, BMPs would be implemented to avoid and minimize impacts to adjacent wetlands. The affected area would also be planted with native wetland vegetation to reduce the potential for erosion. Since the resulting elevation would match existing adjacent grades, the area is expected to return to pre-existing conditions within five years. As a precaution, a monitoring/maintenance program would be initiated by the NPS in order to monitor the regrowth of wetland vegetation in the disturbed work zone area for a period of up to five years. Thus, Alternative 2 and 3 would lead to long-term beneficial impacts on overall hydrologic flows in the areas of House and Slagle Ditches.

2) Climate Change and Sea Level Rise. Hydrology would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the repair/restoration of the eroded plugs. The earthen plugs would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via House and Slagle Ditches. The slowing or postponement of impacts by the restoration of the plug structures would allow time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the breached plugs and allow more time for the system and resources to adjust to the changes resulting from climate change and sea level rise.

3) Conclusion. These alternatives would restore the local hydrologic regime to a more natural state. High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel/ditch formation. Erosion would continue to occur on the banks of House and Slagle Ditches even if they are repaired and/or reinforced. However, continuing the current erosional process is considered a natural process and should not be

viewed as an adverse impact. Thus, Alternative 2 and 3 would result in long-term beneficial effects to hydrology in the areas of House and Slagle Ditches.

3.4.2.2.1.3 Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. Under Alternative 4A and 4B, the failed plug at Raulerson Canal would be removed and replaced at the same location, the highest elevation point along Raulerson Canal. The impacts during construction of either alternative would be a direct result of the placement of the new sheetpile, fill, and/or erosion control measures.

Alternative 4A and 4B would result in a dramatic decrease in the quantity and velocity of water flow during tidal flows; thus, reducing the rate of erosion along the canal banks and channel widening, resulting in a reduction in sediment and organic material transport into Lake Ingraham and Florida Bay. The rehabilitated plug would allow the marl ridge to regain its function as a natural hydrologic barrier.

Any structure placed in the canal would be subjected to substantial hydraulic conditions over the course of time (e.g., rising tides, extreme tide wash-over, overland floods). Episodic and potentially extreme conditions occur with tropical storms and hurricanes however, engineering design has considered these issues and the design is expected to withstand the elements for at least the next 50 years. The design for these alternatives is similar to the existing plugs successfully implemented at East Cape and Homestead Canals. Consequently, this would reduce the rate of intrusion of saltwater into the interior wetlands and would result in an increase of the retention of freshwater from wet season rains in the interior wetlands.

Overtopping of the marl ridge with saline waters would still occur however during the natural tidal cycles and likely during major storm events. Thus, implementation of Alternative 4A or 4Bwould lead to long-term beneficial impacts on overall hydrologic flows in the Raulerson Canal area.

2) Climate Change and Sea Level Rise. Hydrology would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the construction of the proposed plug structure. The plug would reduce the intensity and duration of saltwater entering the interior Cape Sable wetland wetlands via Raulerson Canal. The slowing or postponement of impacts by the construction of a plug structure would allow time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the breached plugs and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. These alternatives would restore the local hydrologic regime to a more natural state. High tidal fluxes would still overtop the marl ridge, potentially increasing the potential for bank/land scour and new channel formation. However, this process is considered a natural process and should not be viewed as an adverse impact. Thus, Alternative 4A or 4B would result in long-term beneficial effects on hydrologic flows in the Raulerson Canal area.

3.4.2.2.2 Water Quality

3.4.2.2.2.1 No Action Alternative

1) Analysis. The existing plugs at House and Slagle Ditches, although severely eroded are currently in place. Taking no action would expose these ditches to the continuing erosion processes and would have minimal impact to water quality as long as they remain. However, when they fail, the failed plugs at House and Slagle Ditches would have short-and long-term moderate adverse effects to water quality due to sedimentation and unnatural exchange of salt and fresh water.

As there is currently no plug in place, taking no action to address the failed plug at Raulerson Canal would allow for the continued unnatural exchange of salt and fresh water, adversely impacting the interior Cape Sable wetlands.

When the plugs fail at House and Slagle Ditches, they would have similar adverse impacts to water quality as taking no action at Raulerson Canal. In addition to sediment deposition, the resulting turbidity/suspended soils have the potential to cause short- and long-term moderate to major adverse impacts on marine resources within and downstream of the study area (i.e., Florida Bay and the Gulf of Mexico) via reduced sunlight penetration. Also, sediment erosion has the potential to increase nutrient loading in Lake Ingraham and subsequently, Florida Bay and the Gulf of Mexico. This increase in nutrients (i.e., phosphorus and nitrogen) would have the potential to result in algal/phytoplankton blooms which would result in short- and long-term, moderate to major, adverse impacts on downstream marine resources. Furthermore, turbid waters would adversely affect the aesthetics of park water resources, which, in turn, has the potential to result in short- and potentially long-term moderate adverse impacts in visitor usage of the area (reduction of the number of visitors utilizing the Cape Sable wilderness area due to reduced water quality). These resulting adverse effects would result in moderate to major adverse impacts.

2) Climate Change and Sea Level Rise. Water quality would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable.

3) Conclusion. No beneficial effects to water quality are anticipated as a result of No Action Alternative. The No Action Alternative would produce short-and long-term moderate to major adverse impacts on the water quality of park water resources.

3.4.2.2.2.2 Alternative 2: Re-Backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-Backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection

1) Analysis. Under Alternatives 2 and 3, the existing plug sites would be repaired. The impacts to occur during construction would be a direct result of the placement of the new earthen fill, and (under Alternative 3 only) riprap for stabilization, and armoring.

As a result of construction, soils within these work zones at each plug site are likely to be disturbed and compacted, which would increase runoff, potentially contributing to a reduction

of water quality in the immediate area. Soils disturbed by construction, as well as potential oil/fuel spills from equipment would contribute to turbidity and pollution in surface waters, respectively. If severe, turbidity could reduce light penetration and visibility and adversely affect aquatic organisms. Also, any increase in nutrients (e.g., phosphorus and nitrogen) has the potential to result in algal/phytoplankton blooms which would also result in short-term and long-term, moderate to major, adverse impacts on downstream marine resources.

Necessary measures (BMPs) including the use of staked silt fence, turbidity barriers and a temporary mixing zone, would be implemented to minimize the potential for runoff during construction and prevent turbidity and consequent degradation of water quality. Silt fences would be installed prior to commencement of construction around the outer perimeter of each work zone to minimize the potential for runoff entering adjacent wetlands. Turbidity barriers would be installed prior to construction activities at a sufficient distance from the work zone to create a temporary mixing zone upstream and downstream of the plug location. The mixing zone would allow for settling of any turbidity generated during construction. The project is located in an OFW, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient).

To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be implemented during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are performed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment). The barriers would remain in place and be regularly inspected throughout the construction phase of the project. The turbidity barriers and silt fences would be removed once turbidity has subsided following completion of construction. Therefore, anticipated runoff within the work area would be expected to result in short-term minor to moderate adverse impacts to local water quality with a potential for short-term negligible to minor adverse impacts to water quality outside the limits of the turbidity barriers and silt fences. Additionally, no long-term adverse effects are anticipated for water quality as a result of runoff generated from construction of the plugs.

The use of NPS spill prevention, control, and countermeasure procedures would reduce the potential for petroleum products from leaking equipment to reach surface waters. Thus, taking into consideration the impacts and the proposed mitigation measures for incidental spills/discharges, construction activities are anticipated to result in short-term, localized, minor, adverse impacts to water quality within close proximity of the plug site.

After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted). To further reduce the potential for erosion, the temporarily impacted areas would be restored to pre-existing conditions and replanted, as needed, with native wetland vegetation. Potential erosional impacts on the fill material within the plugs from water overtopping the Old Ingraham Highway would be minimal due to armoring and/or rooted vegetation. Thus, the decrease in the current rate of erosion, sedimentation, and turbidity, reduction of saltwater intrusion and retention of freshwater would lead to long-term beneficial impacts on overall water quality in the greater Cape Sable area.

2) Climate Change and Sea Level Rise. Water quality would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the repair/restoration of the proposed plug structures. The plugs would essentially help to reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via House and Slagle Ditches. The slowing or postponement of impacts by

the repair/restoration of the plug structures would maintain the allowance of time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the previously breached canals in the area and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Alternatives 2 and 3 would result in minor to moderate short-term adverse impacts to water quality with the repair/restoration of the plugs at House and Slagle Ditches during construction activities; however, long-term beneficial effects to water quality are anticipated post construction. Therefore, following completion of the plugs, long-term beneficial effects to park resources in relation to water quality are expected.

3.4.2.2.2.3 Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and Alternative 4B: Construct a New Sheet Pile Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. Alternatives 4A and 4B and involve the removal and replacement of the failed sheet pile plug at the Raulerson Canal. Fill material, riprap, and other erosion protection measures would be transported to the construction work area using barge(s). Due to a lack of a suitable staging area(s) in the park, the barge(s) are anticipated to originate from a designated staging area in the Florida Keys or other suitable location and access the construction zone using existing navigational channels and/or deep-water areas of Florida Bay. The exact location of the staging area would be determined by the awarded contractor however, the area would be located entirely in previously disturbed uplands (e.g., parking lot, paved area, previously filled area). Woody vegetation /debris clearing would be performed along the canal banks to provide for equipment access and to provide for a safe work zone. Staging areas would be contained within turbidity barriers to further minimize impacts to water quality during construction (e.g., to contain incidental unanticipated discharges of fill material or oil/fuel). Therefore, negligible to minor adverse effects to water quality have the potential to occur at the equipment staging areas.

Implementation of Alternative 4A and 4B would prevent illegal motorized boat entry into the wilderness area resulting in a potential benefit to water quality. The use of fuels in motorized boats has the potential to create minimal releases from the engines during operation, introducing small quantities of oil and gas components into the surface waters in the wilderness area. However, in most cases, any emissions would be diluted by the volume of water and water movements and would not be expected to cause more than short-term localized minor impacts on water quality. Spill control kits are also typically available from park personnel/marine patrol to address potential spill impacts, if they occur. Under Alternative 4B the proposed canoe/kayak portage would provide safe passage over the plug, further reducing the potential for adverse impacts to the adjacent wetland vegetation and canal banks, minimizing future soil disturbance in the vicinity of the plug. Subsequently, the aesthetics of park water resources would be maintained or enhanced with repair of the Raulerson Canal plug resulting in a benefit to park visitors. Thus, long-term beneficial impacts to park resources would occur as a result of these potential benefits to overall water quality.

As a result of construction, soils within these work zones are likely to be disturbed and compacted, which would increase runoff, potentially contributing to a localized reduction of water quality in the area. In addition, any oil/fuel spills from equipment could potentially

contribute to additional turbidity and/or pollution in surface waters. If severe, turbidity could reduce light penetration and visibility potentially adversely affecting submerged aquatic vegetation and aquatic organisms. Any increase in nutrients (i.e., phosphorus and nitrogen) has the potential to result in algal/phytoplankton blooms which would also result in short-term and long-term, moderate to major, adverse impacts on downstream marine resources.

Necessary measures (BMPs) such as the use of staked silt fence, turbidity barriers and a temporary mixing zone, would be implemented to prevent turbidity and associated water quality degradation at the plug site during construction activities. After construction is completed, temporarily disturbed areas would be restored to pre-existing conditions (e.g., regraded, compacted) and replanted with native coastal wetland vegetation. Once construction has been completed and any turbidity has subsided, the turbidity barriers and silt fence would be removed. Therefore, anticipated surface water runoff within the work area would be expected to result in short-term minor to moderate adverse impacts to water quality within the canal work zone area (within the limits of the turbidity barriers and silt fence) with a potential for short-term negligible to minor adverse impacts to water quality outside of the limits of these erosion control measures. Additionally, no long-term adverse effects are anticipated for water quality as a result of Alternatives 4A or 4B.

Alternatives 4A or 4B would greatly reduce the current erosional processes occurring at Raulerson Canal thereby improving the water quality immediately within these areas as well as the interior wetlands of the greater Cape Sable area. The quantity and velocity of water flow during tidal flows would decrease. The flow of saline waters over Old Ingraham Highway would be restricted to the natural tidal cycles and the existing tidal creeks in the area (i.e., East Side Creek), consequently reducing the rate of saltwater intrusion into the interior wetlands. In turn, the rate of erosional processes that have the potential to reduce water quality would be decreased and would result in an increase of the retention of freshwater from wet season rains in the interior wetlands. Potential erosional impacts on the fill material within the plug from water overtopping the Old Ingraham Highway would be minimal due to the plug surface being covered by geotextile fabric and then a hard surface (or similar) to minimize potential erosion (the exact design of surface cover material would be determined during the final design phase of the project; however, it will consider surfaces that would promote and support vegetation across the entire structure while still providing sufficient erosion protection). In addition, sheetpile would be installed in all four quadrants of the plug to form flow deflector wingwalls. This design would promote surface sheetflow away from the plug. Additionally, fill material would be placed adjacent to each sheetpile wall and riprap (or similar material) would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion protection. Thus, the decrease in the current rate of erosion, sedimentation, and turbidity, reduction of saltwater intrusion, and retention of freshwater would lead to long-term beneficial impacts on overall water quality in the greater Cape Sable area.

2) Climate Change and Sea Level Rise. Water quality would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the construction of the proposed plug. The plug would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via Raulerson Canal. The slowing or postponement of impacts by the construction of a plug structure would allow time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the breached plug along Raulerson Canal and the previously breached plug along East Cape and Homestead Canals and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Alternative 4A or Alternative 4B would allow for a reduction in the intensity and duration of saltwater entering the interior wetlands through the Raulerson Canal at times when the natural tides are not overtopping the Old Ingraham Highway. This deceleration of saltwater intrusion would offer time for Cape Sable's interior wetlands (including the wildlife and vegetation) to restabilize and possibly recover from the current impacts being caused by the failed plug. Alternative 4A or Alternative 4B would result in minor to moderate short-term adverse impacts to water quality with restoration of the plug; however, long-term beneficial effects to water quality are anticipated. Therefore, Alternative 4A and Alternative 4B are expected to provide for long-term beneficial effects to park resources in relation to water quality.

3.4.2.2.3 Vegetation and Wetlands

3.4.2.2.3.1 House and Slagle Ditches Plug Restoration Alternatives

3.4.2.2.3.1.1 No Action Alternative

1) Analysis. For the No Action Alternative, no construction would take place and current conditions/processes would continue. There would be no direct adverse effect from construction on existing wetland vegetation communities within the project area.

However, taking no action would allow the plugs to continue to be exposed to current and potential future erosional processes. Eventually, the plugs at will become breached and tidal flows will be capable of propagating north past the Old Ingraham Highway (also known as the Coastal Prairie Trail) to the park's interior brackish/freshwater wetlands. According to Wanless and Vlaswinkel (2005), the ecological collapse of the southern interior wetlands was a direct result of the draining the wetlands by constructing the man-made canals through the marl ridge, as well as large storm events/hurricanes and saline intrusion. The areas colonized by mangroves have progressed. Soil has been lost and freshwater marsh communities have been replaced with open water saline communities. Thus, the characteristics and functions of large portions of the interior wetlands have a potential to continue to transition at increased rates from brackish ecosystems to marine ecosystems adversely impacting existing wildlife utilizing these areas. This process is accelerated with saltwater moving through open waterways where plugs have failed (e.g., Raulerson Canal). These processes would continue to act at current or potentially increasing rates. Related erosion and channel widening could also be expected to continue resulting in long-term degradation and permanent loss of portions of adjacent and downstream vegetated wetlands. Therefore, with the No Action Alternative, long-term moderate to major adverse impacts to existing wetland resources could be expected.

2) Climate Change and Sea Level Rise. While all the environmental impacts of climate change would affect South Florida and EVER within the next century, the key concern for the low-lying Cape Sable area would be rising sea level, "with a very high likelihood" that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF 2008). Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior brackish Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be exacerbated in the short-term to intermediate-term time frame by the No Action Alternative. Doing nothing would likely result in an increasing in the intensity and duration of saltwater entering the interior Cape Sable wetlands via House and Slagle Ditches.

3) Conclusion. No direct impacts to wetland/surface water areas would result with the No Action Alternative. No beneficial effects to wetlands are anticipated as a result of the No Action Alternative. In the short term, the No Action Alternative would result in negligible impact on wetlands in the vicinity of House and Slagle Ditches. In the long term, by not reinforcing the existing structures, the No Action Alternative would result in moderate to major adverse impacts to the wetlands system of the greater Cape Sable area.

3.4.2.2.3.1.2 Alternative 2: Re-Backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-Backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection

1) Analysis. Alternative 2 involves re-backfilling of the eroded plug areas with a course grade limestone and rock fill containing silty binder-type fines. Alternative 2 would essentially restore the plugs at the existing locations on House and Slagle Ditches. The backfill would be placed in sufficient quantities to re-construct the original plug cross-section consistent with matching the adjacent plug slopes and elevation/ grades.

It appears as if the width of the ditch plug was initially on the order of 18 feet (+/-) and it was adequate to initially function as a narrow inland roadway for the movement of materials and equipment deep into the backcountry along what is now termed as the Old Ingraham Highway. Based on observations made in the field, it appears that a coarser well graded sand and gravel mixture was used to initially construct the plug. The surface of the plug is dense and hard and likely well compacted as a result of its early use as a roadway into the interior wetlands.

Action Alternative 3 is an expanded variation of Alternative 2. Alternative 2 re-establishes the plug section at the existing plug location, and includes slope and erosion protection, as well as a geotextile fabric-wrapped sand drain for seepage protection.

The resulting approximate quantities per wetland type for Alternative 2 and for Alternative 3 are listed in Table 3.2 and depicted on aerial photography. Please note that for purposes of this analysis, impact quantities are approximate and have been rounded. Impact quantities will be refined with development of engineering plans for this project

Direct permanent impacts of approximately 0.014 acres and zero acres within wetlands for the Slagle Ditch and House Ditch, respectively, would occur as result of implementing Alternative 2 or Alternative 3. In addition, direct permanent impacts of approximately 0.005 acres and 0.021 acres within surface waters for the Slagle Ditch and House Ditch, respectively, would occur as result of implementing Alternative 2 or Alternative 3. Wetland impacts would be similar for implementation of either alternative for both plugs. Direct impacts are a result of backfilling the eroded plug areas.

Temporary impacts (see **Table 3.2**) are limited to the clearing of woody vegetation within the designated work zone for the plug (outside the limits of the direct impacts), the helicopter drop area, and the accessway from the helicopter drop area to the plug site. No clearing of herbaceous vegetation would need to occur and no soil disturbance (i.e., dredge and/or fill activities) is proposed. Remaining vegetation within these areas (mainly herbaceous species or juvenile shrub or tree species) would likely be compacted for the term of construction. Timber matting or similar material may be placed by the contractor, as needed, in order to minimize soil rutting

with transporting materials and equipment to and from the helicopter drop area (based on field conditions at time of construction). Following completion of construction, any timber matting or other materials placed on the ground would be removed and the area would be restored to pre-existing grades if any incidental soil rutting occurred. The helicopter drop area and the portion of the accessway located within wetlands are expected to recover within one or two growing seasons. The temporary work zone area at the plug site is expected to recover within a few growing seasons via natural recruitment of hydrophytic vegetation. Supplemental plantings of native wetland vegetation may be required to facilitate recovery if a sufficient seed source is not available or if the area is determined to be prone to the growth of exotic vegetation. If planted, NPS may monitor the area for a period of two to five years and perform maintenance as needed to control the area exotic free.

TABLE 3.2 - DIRECT IMPACTS TO WETLANDS/SURFACE WATERS FOR ALTERNATIVES 2 AND 3 AT HOUSE AND SLAGLE DITCHES

Wetland/Surface Water ID	Type of Impact/ Perm or Temp	Work Description	Approx. Direct Wetland Impacts (ft^2)	Approx. Direct Wetland Impacts (acres)
House Ditch				
E1UBLx	Fill / Permanent	Plug	925	0.021
E1UBLx	Work Zone Clearing / Temporary	Plug	300	0.007
E2SS3P	Work Zone Clearing / Temporary	Plug	250	0.006
E2EMIN/P	Woody Vegetation Clearing / Temporary	Accessway / Timber Matting	550	0.013
E2SS3P	Woody Vegetation Clearing / Temporary	Accessway / Timber Matting	125	0.003
E2EMIN/P	Woody Vegetation Clearing / Temporary	Helicopter Drop Area	3,600	0.083
E2EMIN/P	Woody Vegetation Clearing / Temporary	Helicopter Drop Area	3,600	0.083
Slagle Ditch				
E1UBLx	Fill / Permanent	Plug	200	0.005
E2SS3P	Fill / Permanent	Plug	600	0.014

Wetland/Surface Water ID	Type of Impact/ Perm or Temp	Work Description	Approx. Direct Wetland Impacts (ft^2)	Approx. Direct Wetland Impacts (acres)
E1UBLx	Work Zone Clearing / Temporary	Plug	200	0.005
E2SS3P	Work Zone Clearing / Temporary	Plug	400	0.009
E2SS3P	Woody Vegetation Clearing / Temporary	Accessway / Timber Matting	200	0.005
E2EMIN/P	Woody Vegetation Clearing / Temporary	Accessway / Timber Matting	800	0.018
E2EMIN/P	Woody Vegetation Clearing / Temporary	Helicopter Drop Area	3,600	0.083

To minimize wetland resource impacts, BMPs would be implemented during construction. These practices would include employment of staked silt fence and turbidity barriers. Silt fence would be employed prior to commencement of construction around the outer perimeter of each work zone to minimize the potential for impacts to adjacent undisturbed wetlands. Turbidity barriers (staked or floating) would be employed in surface waters prior to commencement of construction at a sufficient distance (approximately 20 feet if conditions allow) from the work zone to create a temporary mixing zone upstream and downstream of the plug location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., restricted to zero NTUs above ambient). The barriers would remain in place and be regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be employed during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are employed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment, etc.). The turbidity barriers and silt fence would be removed at the work areas once any generated turbidity has subsided following construction completion of the plugs.

The areas to be affected by the physical footprint of the alternatives are a mixture of regularly flooded mangrove and saltwater wetlands as well as the open water area of the ditch. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following excavation of the ditches.

Per Chapter 62-345 F.A.C., a functional analysis of the wetland areas to be impacted (permanent and temporary impacts) was conducted using the FDEP Uniform Mitigation Assessment Method (UMAM) (FDEP 2004) which has been adopted by the South Florida Water Management District

(SFWMD) and the USACE. The UMAM provides a standardized procedure for assessing the functions provided by wetlands and other surface waters; the amount that those functions are reduced by a proposed impact; and the amount of mitigation necessary to compensate for that loss in terms of current condition; hydrologic connection; uniqueness; location; fish and wildlife utilization; time lag; and mitigation risk.

Impacts to surface water areas with no protected submerged aquatic vegetation typically do not require mitigation; thus, a UMAM analysis was not performed for impacts to the waterways. A summary of the results of the assessment on the areas to be permanently and temporarily impacted as a result of implementing Alternative 2 or 3 for House and Slagle Ditches is provided in **Table 3.3** below. "Current" indicates the functional value of the assessment area based on existing conditions per the three categories of indicators of wetland function (location and landscape support, water environment and community structure) scored to the extent that they affect the ecological value of the assessment area. Scores per each category range from ten to zero based on reasonable scientific judgment. A score of ten indicates an optimal level whereas a score of zero indicates a severely diminished or negligible level. The "Current" score is determined by summing the scores for each of the indicators and dividing that value by 30 to yield a number between zero and one. The "Current" assessment score is calculated twice, providing a functional assessment score without construction (existing conditions) and a functional assessment score with construction (proposed conditions). The "Delta" indicates the functional value difference between the existing conditions (without construction) and the proposed conditions (with construction). For example, a negative delta would indicate that a loss in functional value would occur with construction. "Functional Loss" indicates the total calculated loss based on the size of the wetland being impacted and the loss in functional value that would occur (impact area x "Delta") and have been rounded to the nearest thousandths of a unit. The UMAM assessment forms may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

TABLE 3.3 - UMAM FUNCTIONAL ASSESSMENT – IMPACTED AREAS – ALTERNATIVES 2 AND 3 AT HOUSE AND SLAGLE DITCHES

Wetland/Surface Water ID	Type of Impact/ Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
House Ditch						
E2SS3P	Fill / Permanent	0.006	0.667	0.500	-0.167	-0.001
E2EMIN/P	Work Zone Clearing / Temporary	0.013	0.733	0.667	-0.066	-0.001
E2SS3P	Woody Vegetation Clearing / Temporary	0.003	0.733	0.667	-0.066	-0.001
E2EMIN/P	Woody Vegetation Clearing / Temporary	0.083	0.733	0.667	-0.066	-0.005

Wetland/Surface Water ID	Type of Impact/ Perm or Temp	Assess. Area Size	Current (Without)	Current (With)	Delta	Functional Loss
E2EMIN/P	Woody Vegetation Clearing / Temporary	0.083	0.733	0.667	-0.066	-0.005
Slagle Ditch						
E2SS3P	Fill / Permanent	0.014	0.667	0.500	-0.167	-0.003
E2SS3P	Work Zone Clearing / Temporary	0.009	0.667	0.500	-0.167	-0.002
E2SS3P	Woody Vegetation Clearing / Temporary	0.005	0.773	0.667	-0.066	-0.001
E2EMIN/P	Woody Vegetation Clearing / Temporary	0.018	0.733	0.667	-0.066	-0.001
E2EMIN/P	Woody Vegetation Clearing / Temporary	0.083	0.733	0.667	-0.066	-0.005

The UMAM analysis indicates that the banks of the Slagle Ditch and House Ditch in the vicinity of the proposed plugs have an existing functional assessment score of 0.667, which falls within the moderate quality range, between 0.50 and 0.79. Wetlands assigned UMAM scores less than 0.50 are typically highly disturbed and have limited wetland functions. Wetlands assigned UMAM scores greater than 0.79 are typically high quality wetlands with pristine wetland functions.

As shown in **Table 3.3**, the functional loss for 0.014 acre and 0.006 acre of permanent filling impacts to wetlands at Slagle Ditch and House Ditch was determined to be -0.003 and -0.001, respectively, for a total of -0.004. The functional loss for 0.106 acres and 0.099 acres of temporary impacts to wetlands as a result of vegetation clearing activities at Slagle Ditch and House Ditch was determined to be -0.009 and -0.007, respectively.

Thus, the total functional loss for 0.014 acre of permanent impacts and 0.106 acre of temporary impacts to wetlands with implementing either Alternatives 2 or Alternative 3 for Slagle Ditch is -0.012. In addition, the total functional loss for 0.006 acres of permanent impacts and 0.099 acres of temporary impacts to wetlands with implementing either Alternatives 2 or Alternative 3 for House Ditch is -0.008.

All BMPs typically associated with NPS construction projects would be properly implemented and maintained throughout all construction activities minimizing short-term indirect impacts to adjacent and downstream wetland areas. Water quality impacts resulting from erosion and sedimentation during construction activities would be controlled through the use of BMPs, including temporary erosion control measures. Temporary erosion control measures would

consist of staked silt fence and turbidity barriers. No substantial impacts due to sedimentation or water quality degradation are anticipated to occur during construction activities; however, the project would require a temporary mixing zone upstream and downstream of the plug location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient). If turbid conditions persist outside of the temporary mixing zone, the awarded contractor would be required to take all necessary measures to control turbidity. These measures may include timing construction activities with tidal cycles, modifications to equipment, or temporarily ceasing operations completely, if necessary. Permanent erosion control measures would consist of restoring disturbed areas (e.g., regrading, compacting, planting) for stability.

The potential for long-term indirect impacts resulting from the project were also analyzed due to the lack of a vegetative upland buffer between the proposed plug sites and the adjacent wetlands. However, since the plug areas are located in the remote backcountry of EVER, continued long-term disturbance at the plug sites is not anticipated.

Furthermore, no adverse impacts are anticipated to occur to the watershed as a result of the proposed project due to the derived benefits. Although a small area of existing wetland vegetation would be permanently impacted with construction of these alternatives, the upstream and downstream benefits to existing wetland functions for Lake Ingraham (approximately 1,863 acres) and the interior wetlands of Cape Sable (approximately 55,894 acres based on the aerial extent of this area from just north of the marl ridge to the southern edge of Whitewater Bay) outweighs the wetland functional loss derived from the implementation of either Alternative 2 or Alternative 3.

This is evidenced through the use of the UMAM functional analysis, which was used to assess the potential benefits to the interior Cape Sable wetlands and Lake Ingraham (see **Figure 3.6** for locations of the proposed offsite mitigation areas) derived as a result of the proposed project. Since the Cape Sable area interior wetlands are contiguous and retain similar wetland functions, it was appropriate to conduct one UMAM functional assessment for the entire area. In addition, the temporary impacts would be mitigated through onsite restoration activities as discussed above; however, a mitigation UMAM functional analysis was also performed for these temporary impacts to show that any resulting temporal functional losses would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior wetlands of Cape Sable. The resulting UMAM assessment scores are provided in **Table 3.4**, below. The UMAM assessment forms may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

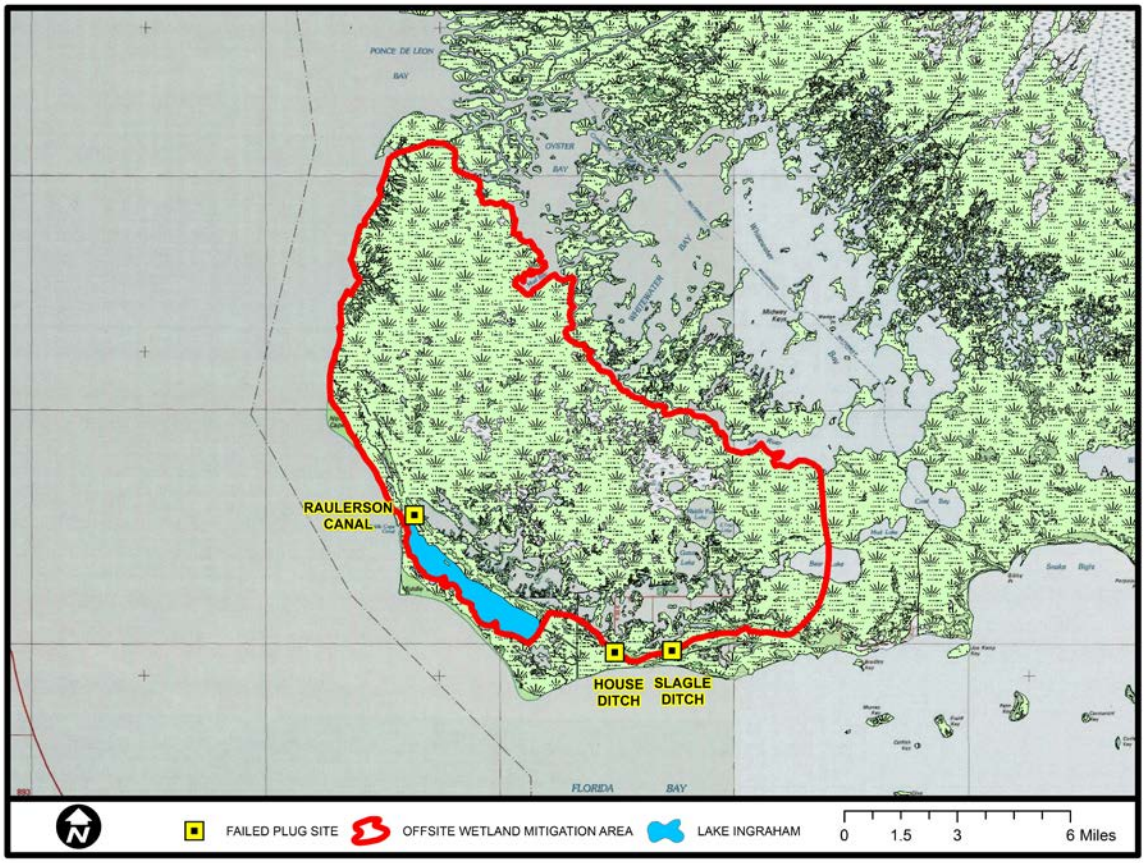


FIGURE 3.6 - OFFSITE WETLAND MITIGATION AREAS: LAKE INGRAHAM AND SOUTHERN INTERIOR WETLANDS

TABLE 3.4 - UMAM FUNCTIONAL ASSESSMENT FOR MITIGATION AREAS, ALTERNATIVES 2 AND 3

Mitigation Area ID	**Assess. Area Size** (acres)	**Current** (w/o)	**Current** (With)	**Delta**	**Time Lag**	**Risk**	**Relative Functional Gain**	**Functional Gain**
Temporary Work Zone Onsite Restoration at Slagle Ditch	0.106	0.500	0.667	0.167	1.14	1.25	0.117	0.012
Lake Ingraham Offsite Enhancement	1,863	0.767	0.867	0.100	1.0	1.25	0.080	149.040
Interior Cape Sable Wetlands Offsite Enhancement	55,894	0.767	0.833	0.067	1.0	1.25	0.053	2,962.382

Mitigation Area ID	Assess. Area Size (acres)	Current (w/o)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain
Temporary Work Zone Onsite Restoration at House Ditch and Slagle Ditches	0.099	0.500	0.667	0.167	1.14	1.25	0.117	0.012

The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation site) and risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) scores for the mitigation areas listed in **Table 3.4**, above, were determined as follows:

Temporary Work Zone Onsite Restoration (Slagle Ditch and House Ditch): The time lag was determined to be five years resulting in a T-factor score of 1.14 to allow for regrowth of trimmed vegetation and attain comparable pre-impact conditions. The risk was determined to have a score of 1.25 since vulnerability is low with a high probability of success (hydrological conditions, water quality, adjacent land uses not a factor; vulnerability to colonization of undesirable invasive exotics is low; vulnerability to undesirable plant communities is low).

Lake Ingraham and the Interior Cape Sable Wetlands: The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation sites) was determined to be immediate (less than one year) resulting in a T-factor score of 1.0 due to the following immediately derived benefits:

- Lake Ingraham
  - By reinforcing the existing plugs at House and Slagle Ditches, the plugs would prevent the loss of sediment from the interior brackish wetlands
  - By reinforcing the existing plugs at House and Slagle Ditches, the plugs would prevent degradation of habitat for wading birds, forage fish, and other wildlife within Lake Ingraham
- Interior Cape Sable Wetlands
  - By reinforcing the existing plugs at House and Slagle Ditches, the plugs would restrict the unnatural exchange of saltwater into and loss of freshwater out of the wetlands north of the marl ridge
  - By reinforcing the existing plugs at House and Slagle Ditches, the plugs would prevent the unnatural movement of sediment and nutrients from the interior Cape Sable wetlands
  - By reinforcing the existing plugs at House and Slagle Ditches, the plugs would prevent degradation of nesting and juvenile habitat for crocodiles, wading birds, forage fish, and other wildlife

The risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) was determined to have a score of 1.25.

The mitigation functional gain was calculated as follows:

- A relative functional gain [mitigation Delta / (risk x time lag)] of 0.117 would result from the restoration of the temporary work zones at Slagle Ditch or House Ditch. The actual mitigation functional gain (gain in functions provided by that mitigation assessment area = mitigation acres x relative functional gain) provided by this onsite restoration which equates to is 0.012 functional units each for Slagle Ditch and for House Ditch.
- A relative functional gain of 0.080 would result for the restoration in Lake Ingraham. The actual mitigation functional gain provided by this onsite mitigation is 149.040 functional units for the enhancement of approximately 1,863 acres of Lake Ingraham.
- A relative functional gain of 0.053 would result for the interior wetlands. The actual mitigation functional gain provided by this onsite mitigation was determined to be approximately 2,962.382 functional units for the enhancement of approximately 55,894 acres of interior wetlands.

Thus, for Slagle Ditch, the total calculated functional gain for onsite restoration of 0.106 acres and offsite enhancement of 57,757.00 acres of wetlands is 3,111.43; whereas, the total calculated functional loss for 0.014 acres of permanent impacts and 0.106 acres of temporary impacts to wetlands with implementing either Alternative 2 or Alternative 3 is -0.012 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with the construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing either Alternative 2 or Alternative 3 for Slagle Ditch.

Similarly, for House Ditch, the total calculated functional gain for onsite restoration of 0.099 acres and offsite enhancement of 57,757.00 acres of wetlands is 3,111.43; whereas, the total calculated functional loss for 0.0.006 acres of permanent impacts and 0.099 acres of temporary impacts to wetlands with implementing either Alternative 2 or Alternative 3 is -0.008 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing either Alternative 2 or Alternative 3 for House Ditch.

2) Climate Change and Sea Level Rise. Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior brackish wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short-term to intermediate-term time frame by the construction of the proposed plug structures. The plugs would help to reduce the intensity and duration of saltwater entering the interior brackish Cape Sable wetlands as the water would flow over the plugs at House and Slagle Ditches. The slowing or postponement of impacts by the reinforcement of the plugs would allow additional time for the interior wetlands of Cape Sable to restabilize and recover from the current saltwater intrusion and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. For Alternative 2 and Alternative 3, construction activities would result in minor adverse, localized, direct effects on vegetation. However, these action alternatives would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3)

identified as a goal in the park's master plan or other NPS planning documents. Alternative 2 or Alternative 3 would result in short-term, minor, adverse, and localized impacts as well as long-term beneficial effects.

3.4.2.2.3.2 Raulerson Canal Plug Restoration Alternatives

3.4.2.2.3.2.1 No Action Alternative.

1) Analysis. The No Action Alternative involves taking no action and allowing Raulerson Canal to continue to function in its current state without a plug. Leaving the failed plug in its present condition would allow the canal to continue to erode, widen, and transport suspended sediment to the inland wetlands as well as to Florida Bay and the Gulf of Mexico.

2) Climate Change and Sea Level Rise. While all the environmental impacts of climate change would affect South Florida and EVER within the next century, the key concern for the low-lying Cape Sable area would be rising sea level, "with a very high likelihood" that the sea level would rise an additional 1.5 feet in the next 50 years and a cumulative total of three to five feet within a century (CCATF 2008). Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be exacerbated in the short-term to intermediate-term time frame by the No Action Alternative. Doing nothing would likely result in an increasing in the intensity and duration of saltwater entering the interior Cape Sable wetlands via Raulerson Canal.

3) Conclusion. No direct impacts to wetland/surface water areas would result with Alternative 1. There would be moderate to major adverse effects to the wetland systems of the greater Cape Sable area. No beneficial effects to wetlands are anticipated as a result of the No Action Alternative. The No Action Alternative would produce moderate to major adverse impacts on wetlands.

3.4.2.2.3.2.2 Alternative 4A: Construct a New Sheet Pile and Fill Plug with Riprap Erosion Protection at the Former Failed Plug Location.

1) Analysis. This alternative involves constructing a canal plug cut off comprised of cross canal steel sheet piling with sheet pile-protected canal banks that considers a safety factor. The design will use parallel back-to-back cross-tied sheet pile cross walls and a riprap system to protect the side slopes and perimeter area from erosion relating to flanking tidal flows. This design has proven to be effective and stable at East Cape and Homestead Canals. This plug would be constructed starting at the western edge of the canal (where it turns south) and extending 100 feet inland, in an easterly direction.

This alternative includes construction of a plug by installing two sheetpile walls - one upstream and one downstream within the canal. In order to not place the sheetpile walls directly at the edge of the canal bank and to reduce the erosional energy forces associated with the seasonal overtopping events, the sheetpile walls would consider a safety factor of 50%. The safety factor considers the canal width (approximately 50 feet wide); 50% of which is 25 feet. Therefore, the sheetpile walls would be have a 25-foot margin on either side of the canal and would be placed approximately 100 feet apart.

The area between the two walls would be filled with sand that would be pumped in from a nearby barge. The top of the plug surface will be covered by geotextile fabric and then a hard surface to minimize potential erosion of the surface of the pumped in sand. The exact design of surface cover material would be determined during the final design phase of the project; it will consider surfaces that would promote and support vegetation across the entire structure while still providing sufficient erosion protection.

The fill material would originate from an off-site location and would potentially be transported from a barge located in Lake Ingraham or at a location within the canal closer to the plug site. The sheetpile would be installed in all four quadrants of the plugs to form flow deflector wingwalls to promote surface sheetflow away from the plug structures and thus prevent seepage and tunneling through the marl. Additionally, fill material would be placed adjacent to each sheetpile wall (2.5:1 slope from the sheetpile to the ground on the north side) to substantially increase the lateral support for the plugs. Graded riprap would be placed on top of the fill material along the outside face of the sheetpile walls and along the deflector wingwalls and canal banks to provide erosion resistance.

This alternative was determined to be feasible as it is located at the topographic high point (per the available topographic data). The resulting approximate quantities per wetland type for Alternative 4A are listed in **Table 3.5**. Please note that impact quantities are approximate and have been rounded. Impact quantities will be refined with development of engineering plans for this project.

TABLE 3.5 - DIRECT IMPACTS TO WETLANDS/SURFACE WATERS FOR RAULERSON CANAL, ALTERNATIVE 4A

Wetland/ Surface Water ID	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
E2FO3N/P	Fill, Sheetpile and Riprap - Permanent	Banks of Raulerson Canal	200	0.005
E1UBLx	Fill, Sheetpile and Riprap - Permanent	Banks of Raulerson Canal	5,600	0.130
E2SS3P	Fill and Riprap - Permanent	Banks of Raulerson Canal	300	0.007
E2FO3P	Fill and Riprap - Permanent	Banks of Raulerson Canal	200	0.005
E2FO3N/P	Work Zone Clearing - Temporary	Banks of Raulerson Canal	900	0.020
E1UBLx	Work Zone Clearing - Temporary	Banks of Raulerson Canal	2,300	0.050
E2SS3P	Work Zone Clearing - Temporary	Banks of Raulerson Canal	2,000	0.050
E2FO3P	Work Zone Clearing - Temporary	Banks of Raulerson Canal	8,500	0.200

Wetland/ Surface Water ID	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
E2SS3P/ E2FO3P/ E2FO3N/P	Mangrove Trimming - Temporary	Banks of Little Sable Creek and Raulerson Canal	8,700	0.199

Direct permanent impacts of 0.130 acres within surface waters of the Raulerson Canal would occur as result of implementing Alternative 4A. These filling impacts are a direct result of the placement of the additional sheetpile needed to extend the existing plug to the banks of the canal as well as the placement of earthen fill and riprap for stabilization and armoring. A benthic survey was conducted by NPS in 2015 in the vicinity of the Raulerson Canal plug and along the canal accessways to the plug site. No submerged aquatic vegetation (SAV) was found to exist most likely due to the lack of light penetration through the waters due to high turbidity during tidal flows. Penetration of light to two meters in depth was reduced by 92% to 98% of irradiance measured just below the surface of the water per NPS scientists. Therefore, no impacts to SAV are expected to occur as a result of this project.

Direct permanent impacts of 0.017 acres within wetlands along the banks of Raulerson Canal would also occur. These filling impacts are also associated with the placement of the additional sheetpile needed for the wingwalls as well as the placement of riprap for support and armoring.

To minimize wetland resource impacts, BMPs would be implemented during construction. These practices would include employment of staked silt fence and turbidity barriers. Silt fence would be employed prior to commencement of construction around the outer perimeter of each work zone to minimize the potential for impacts to adjacent undisturbed wetlands. Turbidity barriers (staked or floating) would be employed in surface waters prior to commencement of construction at a sufficient distance (approximately 300-500 feet if conditions allow) from the work zone to create a temporary mixing zone upstream and downstream of the plug location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., restricted to zero NTUs above ambient). The barriers would remain in place and be regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be employed during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are employed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment, etc.). The turbidity barriers and silt fence would be removed at the work areas once any generated turbidity has subsided following construction completion of the plugs.

Due to the space limitations in the work area, staging is anticipated to occur on floating barge(s) along the Little Sable Creek, Raulerson Canal and/or within Lake Ingraham just southwest of the work zone. The barge(s) are anticipated to access Little Sable Creek through existing navigational channels and/or deep-water areas of Florida Bay. The barge(s) would originate from a designated staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) or other suitable area due to a lack of suitable staging areas in EVER and to further meet the criteria for avoidance and minimization of impacts to wetland resources. The exact location of the staging area would be determined by the awarded contractor; however, the area would be located entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.). No adverse impacts to protected wetland resources are anticipated to occur as a result of utilizing the proposed staging areas and accessways.

Trimming of overhanging mangrove trees may need to occur within Little Sable Creek or Raulerson Canal for barge access. Trimming would be conducted per the requirements of the FDEP's Mangrove Trimming Permit (to be acquired prior to commencement of construction). Approximately 0.199 acres (8,674.22 sq. ft.) along Little Sable Creek and Raulerson Canal may require trimming (areas based on aerial coverage of vegetation over each waterway between the mouth of Lake Ingraham and the failed plug site that would need to be trimmed to allow for barge access). Following construction completion, regrowth of the mangroves over the waterway would be left unrestricted and the area is expected to return to full functionality within a few growing seasons.

The 0.320-acre temporary work zone along Raulerson Canal would be temporarily cleared of woody vegetation above the existing substrate prior to construction. Following completion of construction activities, the work zone would be restored (e.g., regraded, compacted, etc.) to pre-existing conditions to facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area and to minimize the establishment of exotic and/or nuisance vegetation, native vegetation may be planted in these areas. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of two to five years.

The areas to be affected by the physical footprint of the alternatives are a mixture of regularly flooded mangrove and saltwater wetlands as well as the open water area of the canal. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following excavation of the canal.

As previously discussed, per Chapter 62-345 F.A.C., a functional analysis of the wetland areas to be impacted (permanent and temporary impacts) was conducted using the FDEP UMAM (FDEP 2004) which has been adopted by the SFWMD and the USACE (see **Table 3.6**).

TABLE 3.6 - UMAM FUNCTIONAL ASSESSMENT – IMPACTED AREA FOR ALTERNATIVE 4A AT RAULERSON CANAL

Wetland/Surface Water ID	**Type of Impact/ Perm or Temp**	**Assess. Area Size (acres)**	**Current** (Without)	**Current** (With)	**Delta**	**Functional Loss**
E2FO3N/P / E2SS3P	Fill, Sheetpile and Riprap - Permanent	0.017	0.667	0.500	-0.167	-0.003
E2FO3N/P / E2FO3P / E2SS3P	Work Zone Clearing - Temporary	0.270	0.667	0.500	-0.167	-0.045
E2SS3P/ E2FO3P/ E2FO3N/P	Canal Banks – Mangrove Trimming	0.199	0.700	0.567	-0.133	-0.265

The UMAM analysis indicates that the banks of Raulerson Canal in the vicinity of the proposed plug has an existing functional assessment score of 0.667, which falls within the moderate

quality range, between 0.50 and 0.79. Wetlands assigned UMAM scores less than 0.50 are typically highly disturbed and have limited wetland functions. Wetlands assigned UMAM scores greater than 0.79 are typically high quality wetlands with pristine wetland functions.

As shown in **Table 3.6**, the functional loss for 0.017 acres of permanent filling impacts to wetlands along the Raulerson Canal was determined to be -0.003; the functional loss for 0.199 acres of temporary impacts to mangroves as a result of trimming activities along the Little Sable Creek and Raulerson Canal was determined to be -0.265; the functional loss for 0.270 acres of temporary impacts to wetlands as a result of woody vegetation clearing activities along the Raulerson Canal was determined to be -0.045. Thus, the total functional loss for 0.117 acres of permanent impacts and 0.270 acres of temporary impacts to wetlands and 0.199 acres of temporary impacts to mangroves (trimming) with implementing Alternative 4A for the Raulerson Canal is -0.313.

All BMPs typically associated with NPS construction projects would be implemented and maintained throughout all construction activities minimizing short-term indirect impacts to adjacent and downstream wetland areas. Water quality impacts resulting from erosion and sedimentation during construction activities would be controlled through the use of BMPs, including temporary erosion control measures. Temporary erosion control measures would consist of staked silt fence and turbidity barriers. No substantial impacts due to sedimentation or water quality degradation are anticipated to occur during construction activities; however, the project would require a temporary mixing zone upstream and downstream of the plug location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient). If turbid conditions persist outside of the temporary mixing zone, the awarded contractor would be required to take all necessary measures to control turbidity. These measures may include timing construction activities with tidal cycles, modifications to equipment, or temporarily ceasing operations completely, if necessary. Permanent erosion control measures would consist of restoring disturbed areas (e.g., regrading, compacting, planting) and placement of riprap on disturbed banks for stability.

The potential for long-term indirect impacts resulting from the project were also analyzed due to the lack of a vegetative upland buffer between the proposed plug site and the adjacent wetlands. However, since the area is located in the backcountry of EVER and no active roadways or trails lead to this area, continued long-term disturbance at the plug sites is not anticipated.

Furthermore, no adverse impacts are anticipated to occur to the watershed as a result of the proposed project due to the derived benefits. Although a small area of existing wetland vegetation would be permanently impacted with construction of these alternatives, the upstream and downstream benefits to existing wetland functions for Lake Ingraham (approximately 1,863 acres) and the interior Cape Sable wetlands (approximately 55,894 acres based on the aerial extent of this area from just north of the marl ridge to the southern edge of Whitewater Bay) outweighs the wetland functional loss derived from the implementation of Alternative 4A.

This is evidenced through the use of the UMAM functional analysis, which was used to assess the potential benefits to the interior Cape Sable wetlands and Lake Ingraham (see **Figure 3.6** for locations of the proposed offsite mitigation areas) derived as a result of the proposed project. Since the Cape Sable area interior wetlands are contiguous and retain similar wetland functions, it was appropriate to conduct one UMAM functional assessment for the entire area. In addition, the temporary impacts would be mitigated through onsite restoration activities as discussed above; however, a mitigation UMAM functional analysis was also performed for these temporary

impacts to show that any resulting temporal functional losses would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior Cape Sable wetlands. The resulting UMAM assessment scores are provided in **Table 3.7**, below. The UMAM assessment forms may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

TABLE 3.7 - UMAM FUNCTIONAL ASSESSMENT FOR MITIGATION AREAS FOR ALTERNATIVE 4A AT RAULERSON CANAL

Mitigation Area ID	Assess. Area Size (acres)	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
Temporary Work Zone Onsite Restoration	0.27	0.500	0.667	0.167	1.14	1.25	0.117	0.032
Lake Ingraham Offsite Enhancement	1,863	0.700	0.767	-0.100	1.0	1.25	0.080	149.040
Interior Wetlands Offsite Enhancement	55,894	0.667	0.767	-0.067	1.0	1.25	0.053	2,962.382

The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation site) and risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) scores for the mitigation areas listed in **Table 3.7**, above, were determined as follows:

Temporary Work Zone Restoration: The time lag was determined to be five years resulting in a T-factor score of 1.14 to allow for regrowth of the mangrove/saltwort-dominated vegetation and attain comparable pre-impact conditions. The risk was determined to have a score of 1.25 since vulnerability is low with a high probability of success (hydrological conditions, water quality, adjacent land uses not a factor; vulnerability to colonization of undesirable invasive exotics is low; vulnerability to undesirable plant communities is low).

Lake Ingraham and the Interior Wetlands: The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation sites) was determined to be immediate (less than one year) resulting in a T-factor score of 1.0 due to the following immediately derived benefits:

- Lake Ingraham
  - The new plug at Raulerson Canal would slow the rate of sediment deposition in Lake Ingraham

    - The new plug at Raulerson Canal would improve habitat for wading birds, forage fish, and other wildlife within Lake Ingraham due to the decrease in sediment deposition
- Interior Wetlands
    - The new plug at Raulerson Canal would restrict the unnatural flow of saltwater into brackish marshes north of the marl ridge
    - The new plug at Raulerson Canal would slow the rate of loss of sediment and nutrients from the interior brackish marshes
    - The new plug at Raulerson Canal would improve nesting and juvenile habitat for crocodiles, wading birds, forage fish, and other wildlife within the interior Cape Sable wetlands

The risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) was determined to have a score of 1.25. The risk factor was determined based on the potential for scour during high tidal fluxes overtopping the marl ridge to erode new channels around the permanent riprap armor.

The mitigation functional gain was calculated as follows:

- A relative functional gain of 0.117 would result for the restoration of the temporary work zones for the Raulerson Canal. The actual mitigation functional gain provided by this onsite restoration is 0.032.
- A relative functional gain of 0.053 would result for the interior wetlands and 0.080 for Lake Ingraham. The actual mitigation functional gain provided by the mitigation sites was determined to be 2,962.382 for the enhancement of approximately 55,894 acres of interior wetlands and 149.040 for the enhancement of 1,863 acres of Lake Ingraham.

Thus, for Raulerson Canal, the total calculated functional gain for onsite restoration of 0.027 acres and offsite enhancement of 57,757 acres of wetlands is 3,111.454; whereas, the total calculated functional loss for 0.017 acres of permanent impacts, 0.199 acres of mangrove trimming (for barge access) and 0.270 acres of temporary impacts to wetlands with implementing Alternative 4A is -0.313 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative 4A for Raulerson Canal.

2) Climate Change and Sea Level Rise. Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior brackish Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate-term by the construction of the proposed plug structure. The plug would reduce the intensity and duration of saltwater entering the interior brackish Cape Sable wetlands via Raulerson Canal. The slowing or postponement of impacts by the construction of a plug structure would allow time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the failed plug and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. For Alternative 4A, construction activities would result in minor adverse, localized, direct effects on vegetation. However, this action alternative would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific

purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the park's master plan or other NPS planning documents. Alternative 4A would result in short-term, minor, adverse, and localized impacts as well as long-term beneficial effects.

3.4.2.2.3.2.3 Alternative 4B: Construct a New Sheet Pile and Fill Plug with Riprap Erosion Protection at the Former Failed Plug Location with an Option for a Canoe Ramp.

1.) Analysis. This alternative is similar to Alternative 4A with an additional option of constructing a safe passage over the restored plug for non-motorized boaters (i.e., canoeists and kayakers) and a floating platform for safely docking motorized (or non-motorized) vessels to the plug. All other construction features will be similar to Alternative 4A.

The resulting approximate quantities per wetland type for Alternative 4B are listed in **Table 3.8** and depicted on aerial photography. Please note that impact quantities are approximate and have been rounded. Impact quantities will be refined with development of engineering plans for this project.

TABLE 3.8 - DIRECT IMPACTS TO WETLANDS/SURFACE WATERS, ALTERNATIVE 4B AT RAULERSON CANAL

Wetland/Surface Water ID	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
E2FO3N/P	Fill, Sheetpile and Riprap - Permanent	Banks of Raulerson Canal	200	0.005
E1UBLx	Fill, Sheetpile and Riprap - Permanent	Banks of Raulerson Canal	5,300	0.120
E2SS3P	Fill, Sheetpile and Riprap - Permanent	Banks of Raulerson Canal	300	0.007
E2FO3P	Fill, Sheetpile and Riprap - Permanent	Banks of Raulerson Canal	200	0.005
E2FO3N/P	Work Zone Clearing - Temporary	Banks of Raulerson Canal	900	0.020
E1UBLx	Work Zone Clearing - Temporary	Banks of Raulerson Canal	2,600	0.060
E2SS3P	Work Zone Clearing - Temporary	Banks of Raulerson Canal	2,000	0.050
E2FO3P	Work Zone Clearing - Temporary	Banks of Raulerson Canal	8,500	0.200

Wetland/Surface Water ID	Type of Impact/ Perm or Temp	Description	Direct Wetland Impacts (ft^2)	Direct Wetland Impacts (acres)
E2SS3P/ E2FO3P/ E2FO3N/P	Mangrove Trimming - Temporary	Banks of Little Sable Creek and Raulerson Canal	8,674	0.199

Direct permanent impacts of 0.120 acres within surface waters of the Raulerson Canal would occur as result of implementing Alternative 4B. These filling impacts are a direct result of the placement of the additional sheetpile needed to extend the existing plug to the banks of the canal as well as the placement of earthen fill, canoe/kayak portage ramps, and riprap for stabilization and armoring. In addition, these impacts include the permanent placement of a floating platform of floating dock on the downstream side (west side) of the proposed plug for safe mooring of motorized vessels to enhance visitor experience. A benthic survey was conducted by NPS in 2015 in the vicinity of the Raulerson Canal plug and along the canal accessways to the plug site. No submerged aquatic vegetation (SAV) was found to exist most likely due to the lack of light penetration through the waters due to high turbidity during tidal flows. Penetration of light to two meters in depth was reduced by 92% to 98% of irradiance measured just below the surface of the water per NPS scientists. Therefore, no impacts to SAV are expected to occur as a result of this project.

Direct permanent impacts of 0.017 acres within wetlands along the banks of Raulerson Canal would also occur. These filling impacts are also associated with the placement of the additional sheetpile needed for the wingwalls as well as the placement of riprap for support and armoring.

To minimize wetland resource impacts, BMPs would be implemented during construction. These practices would include employment of staked silt fence and turbidity barriers. Silt fence would be employed prior to commencement of construction around the outer perimeter of each work zone to minimize the potential for impacts to adjacent undisturbed wetlands. Turbidity barriers (staked or floating) would be employed in surface waters prior to commencement of construction at a sufficient distance (approximately 300-500 feet if conditions allow) from the work zone to create a temporary mixing zone upstream and downstream of the plug location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., restricted to zero NTUs above ambient). The barriers would remain in place and be regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be employed during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are employed (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment, etc.). The turbidity barriers and silt fence would be removed at the work areas once any turbidity has subsided following construction completion of the plugs.

Due to the space limitations in the work area, staging is anticipated to occur on floating barge(s) along the Little Sable Creek, Raulerson Canal and/or within Lake Ingraham just southwest of the work zone. The barge(s) are anticipated to access Little Sable Creek through existing navigational channels and/or deep water areas of Florida Bay. The barge(s) would originate from a designated staging area in the Florida Keys (e.g., Sugarloaf Key or Marathon) or other suitable area due to a lack of suitable staging areas in EVER and to further meet the criteria for avoidance and minimization of impacts to wetland resources. The exact location of the staging area would be determined by the awarded contractor; however, the area would be located

entirely in previously disturbed uplands (i.e., parking lot, paved area, previously filled area, etc.). No adverse impacts to protected wetland resources are anticipated to occur as a result of utilizing the proposed staging areas and accessways.

Trimming of overhanging mangrove trees may need to occur within Little Sable Creek or Raulerson Canal for barge access. Trimming would be conducted per the requirements of the FDEP's Mangrove Trimming Permit (to be acquired prior to commencement of construction). Approximately 0.199 acres (8,674.22 sq. ft.) along Little Sable Creek and Raulerson Canal may require trimming (areas based on aerial coverage of vegetation over each waterway between the mouth of Lake Ingraham and the failed plug site that would need to be trimmed to allow for barge access). Following construction completion, regrowth of the mangroves over the waterway would be left unrestricted and the area is expected to return to full functionality within a few growing seasons.

The 0.330-acre temporary work zone along Raulerson Canal would be temporarily cleared of woody vegetation above the existing substrate prior to construction. Following completion of construction activities, the work zone would be restored (e.g., regraded, compacted, etc.) to pre-existing conditions to facilitate natural recruitment of native hydrophytic vegetation. To expedite the stabilization of the area and to minimize the establishment of exotic and/or nuisance vegetation, native vegetation may be planted in these areas. A monitoring program would be initiated by the NPS in order to monitor the re-growth of native vegetation in the work zone areas for a period of two to five years.
The areas to be affected by the physical footprint of the alternatives are a mixture of regularly flooded mangrove and saltwater wetlands as well as the open water area of the canal. The wetlands are part of and contiguous with the estuarine wetland system of the greater Cape Sable area in the vicinity of the existing marl ridge. The primary functions of these wetlands include surface and subsurface water storage, support of the biogeochemical processes (nutrient cycling, peat accretion, etc.), support of characteristic plant community, and providing suitable habitat for native fish and wildlife. These functions appear to be retained, although degraded, following excavation of the canal.

As discussed, in accordance with Chapter 62-345 F.A.C., a functional analysis of the wetland areas to be impacted (permanent and temporary impacts) was conducted using the FDEP UMAM (FDEP 2004) which has been adopted by the SFWMD and the USACE (see **Table 3.9**).

TABLE 3.9 - UMAM FUNCTIONAL ASSESSMENT – IMPACTED AREA FOR ALTERNATIVE 4B AT RAULERSON CANAL

Wetland/ Surface Water ID	Type of Impact/ Perm or Temp	Assess. Area Size (acres)	Current (Without)	Current (With)	Delta	Functional Loss
E2FO3N/P / E2SS3P	Fill, Sheetpile and Riprap - Permanent	0.017	0.667	0.500	-0.167	-0.003
E2FO3N/P / E2FO3P / E2SS3P	Work Zone Clearing - Temporary	0.270	0.667	0.500	-0.167	-0.045
E2SS3P/ E2FO3P/ E2FO3N/P	Canal Banks – Mangrove Trimming	0.199	0.700	0.567	-0.133	-0.265

The UMAM analysis indicates that the banks of Raulerson Canal in the vicinity of the proposed plug has an existing functional assessment score of 0.667, which falls within the moderate quality range, between 0.50 and 0.79. Wetlands assigned UMAM scores less than 0.50 are typically highly disturbed and have limited wetland functions. Wetlands assigned UMAM scores greater than 0.79 are typically high quality wetlands with pristine wetland functions.

As shown in **Table 3.9**, the functional loss for 0.017 acres of permanent filling impacts to wetlands along the Raulerson Canal was determined to be -0.003; the functional loss for 0.199 acres of temporary impacts to mangroves as a result of trimming activities along the Little Sable Creek and Raulerson Canal was determined to be -0.265; the functional loss for 0.270 acres of temporary impacts to wetlands as a result of woody vegetation clearing activities along the Raulerson Canal was determined to be -0.045. Thus, the total functional loss for 0.017 acres of permanent impacts and 0.270 acres of temporary impacts to wetlands and 0.199 acres of temporary impacts to mangroves (trimming) with implementing Alternative 4B for the Raulerson Canal is -0.313.

All BMPs typically associated with NPS construction projects would be properly implemented and maintained throughout all construction activities minimizing short-term indirect impacts to adjacent and downstream wetland areas. Water quality impacts resulting from erosion and sedimentation during construction activities would be controlled through the use of BMPs, including temporary erosion control measures. Temporary erosion control measures would consist of staked silt fence and turbidity barriers. No substantial impacts due to sedimentation or water quality degradation are anticipated to occur during construction activities; however, the project would require a temporary mixing zone upstream and downstream of the plug location in order to allow for settling of any turbidity generated during construction since the project is located in OFWs, which has restrictive requirements pertaining to water quality (i.e., zero NTUs above ambient). If turbid conditions persist outside of the temporary mixing zone, the awarded contractor would be required to take all necessary measures to control turbidity. These measures may include timing construction activities with tidal cycles, modifications to equipment, or temporarily ceasing operations completely, if necessary. Permanent erosion control measures would consist of restoring disturbed areas (e.g., regrading, compacting, planting, etc.) and placement of riprap on disturbed banks for stability.

The potential for long-term indirect impacts resulting from the project were also analyzed due to the lack of a vegetative upland buffer between the proposed plug site and the adjacent wetlands. However, since the area is located in the backcountry of EVER and no active roadways or trails lead to this area, continued long-term disturbance at the plug sites is not anticipated.

No adverse impacts are anticipated to occur to the watershed as a result of the proposed project due to the derived benefits. Although a small area of existing wetland vegetation would be permanently impacted with construction of these alternatives, the upstream and downstream benefits to existing wetland functions for Lake Ingraham (approximately 1,863 acres) and the interior wetlands of Cape Sable (approximately 55,894 acres based on the aerial extent of this area from just north of the marl ridge to the southern edge of Whitewater Bay) outweighs the wetland functional loss derived from the implementation of Alternative 4B.

This is evidenced through the use of the UMAM functional analysis, which was used to assess the potential benefits to the interior Cape Sable wetlands and Lake Ingraham (see **Figure 4.3** for locations of the proposed offsite mitigation areas) derived as a result of the proposed project. Since the Cape Sable area interior wetlands are contiguous and retain similar wetland functions, it was appropriate to conduct one UMAM functional assessment for the entire area. In addition, the temporary impacts would be mitigated through onsite restoration activities as discussed

above; however, a mitigation UMAM functional analysis was also performed for these temporary impacts to show that any resulting temporal functional losses would be mitigated with the upstream and downstream benefits to existing wetland functions within Lake Ingraham and the interior Cape Sable wetlands. The resulting UMAM assessment scores are provided in **Table 3.10**, below. The UMAM assessment forms may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

TABLE 3.10 - UMAM FUNCTIONAL ASSESSMENT FOR MITIGATION AREAS, ALTERNATIVE 4B

Mitigation Area ID	Assess Area Size (acres)	Current (Without)	Current (With)	Delta	Time Lag	Risk	Relative Functional Gain	Functional Gain (Mitigation Credits)
Temporary Work Zone Onsite Restoration	0.27	0.500	0.667	-0.167	1.14	1.25	0.117	0.032
Lake Ingraham Offsite Enhancement	1,863	0.700	0.767	-0.100	1.0	1.25	0.080	149.040
Interior Wetlands Offsite Enhancement	55,894	0.667	0.767	-0.067	1.0	1.25	0.053	2,962.382

The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation site) and risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) scores for the mitigation areas listed in **Table 3.10**, above, were determined as follows:

Temporary Work Zone Restoration: The time lag was determined to be five years resulting in a T-factor score of 1.14 to allow for regrowth of the mangrove/saltwort-dominated vegetation and attain comparable pre-impact conditions. The risk was determined to have a score of 1.25 since vulnerability is low with a high probability of success (hydrological conditions, water quality, adjacent land uses not a factor; vulnerability to colonization of undesirable invasive exotics is low; vulnerability to undesirable plant communities is low).

Lake Ingraham and the Interior Wetlands: The time lag (the period of time between when the functions are lost at the impact site and when the functions are achieved at the mitigation sites) was determined to be immediate (less than one year) resulting in a T-factor score of 1.0 due to the following immediately derived benefits:

- Lake Ingraham
  - The plug would slow the rate of sediment deposition in Lake Ingraham as a result of loss of sediment and nutrients from the interior brackish wetlands
  - The plug would improve habitat for wading birds, forage fish, and other wildlife within Lake Ingraham due to the decrease in sediment deposition rates
- Interior Wetlands

- The plug would restrict the unnatural flow of saltwater into brackish marshes north of the Cape Sable marl ridge through these canals
- The plug would reduce freshwater loss from brackish interior wetlands through Raulerson Canal
- The plug would slow the rate of loss of sediment and nutrients from the interior brackish wetlands
- The plug would improve nesting and juvenile habitat for crocodiles, wading birds, forage fish, and other wildlife within the brackish wetlands north of the marl ridge

The risk (the degree of uncertainty that the proposed conditions would be achieved resulting in a reduction in the ecological value of the mitigation sites) was determined to have a score of 1.25. The risk factor was determined based on the potential for scour during high tidal fluxes overtopping the marl ridge to erode new channels around the permanent riprap armor.

The mitigation functional gain was calculated as follows:

- A relative functional gain of 0.117 would result for the restoration of the temporary work zones for the Raulerson Canal. The actual mitigation functional gain provided by this onsite restoration is 0.032.
- A relative functional gain of 0.053 would result for the interior wetlands and 0.080 for Lake Ingraham. The actual mitigation functional gain provided by the mitigation sites was determined to be approximately 2,962.382 for the enhancement of approximately 55,894.00 acres of interior wetlands and approximately 149.040 for the enhancement of approximately 1,863 acres of Lake Ingraham.

Thus, for Raulerson Canal, the total calculated functional gain for onsite restoration of 0.027 acres and offsite enhancement of 57,757 acres of wetlands is 3,111.454; whereas, the total calculated functional loss for 0.017 acres of permanent impacts, 0.199 acres of mangrove trimming (for barge access) and 0.270 acres of temporary impacts to wetlands with implementing Alternative 4B is -0.313 showing that the overall benefit to local and regional wetlands in the greater Cape Sable area as a result of the construction of this alternative far outweighs the total calculated functional loss to wetlands associated with construction. Thus, no additional mitigation is warranted for proposed permanent and temporary impacts to onsite wetlands as a result of implementing Alternative 4B for Raulerson Canal.

2) Climate Change and Sea Level Rise. Vegetation and wetlands would be impacted by the increasing amount and duration of saltwater in the interior brackish wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate-term by the construction of the proposed plug structure. The plug would reduce the intensity and duration of saltwater entering the interior brackish Cape Sable wetlands via Raulerson Canal. The slowing or postponement of impacts by the construction of a plug structure would allow time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the failed plug and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. For Alternative 4B, construction activities would result in minor adverse, localized, direct effects on vegetation. However, this action alternative would provide an overall benefit to local and regional wetlands in the greater Cape Sable area, which far outweighs the minor direct impacts associated with construction. The conservation of the local and regional wetlands receiving the benefits derived from the project is (1) necessary to fulfill specific purposes identified in the establishing legislation of the park, (2) key to the natural or cultural integrity of the park or opportunities for enjoyment of the park, or (3) identified as a goal in the

park's master plan or other NPS planning documents. Alternative 4B would result in short-term, minor, adverse, and localized impacts as well as long-term beneficial effects.

3.5 WILDLIFE AND HABITAT

3.5.1 Affected Environment

The Everglades are a low, flat plain shaped by the action of water and weather, including fire, where slight changes in elevation, water salinity, and soils create a variety of different landscapes (NPS 2009). The Everglades is located at the transition zone between tropical and temperate climates and includes large expanses where fresh and saltwater mix. The mosaic of habitats found within the greater Everglades ecosystem supports an assemblage of plant and animal species not found elsewhere on the planet. Distinct wet and dry seasons create natural cycles of fire, drought, and tropical storms. These landscapes each support their own community of plants and wildlife. The extraordinary biological richness of the Everglades has been well documented, particularly the spectacular wading birds, alligators, crocodiles, snail kites, and mangrove species. Not all of these animals or plant communities occur in the project area, so the following sections focus on the wildlife, including aquatic species, and vegetation that may be affected.

The habitats that support this rich assemblage of species include major community types such as marine and estuarine communities, mangrove forests, cypress swamps, coastal salt marshes, coastal prairies, sloughs, marl prairies, pine rocklands, and hardwood hammocks. The distinguishing characteristics and ecological importance of each habitat are discussed below. This section also reviews the status and impact of invasive non-native plant species in the park.

3.5.1.1 Vegetative Communities

Mangroves occur in an estuary system that is a valuable nursery for shrimp and fish, and provide foraging and nesting habitat for many birds (NPS 2003, 2009). Mangrove communities are abundant in the Cape Sable area and occur along the ditches and canals surrounding Lake Ingraham.

Marine and Estuarine Communities. The brackish interface between freshwater and Florida Bay provide for a combination of habitats with complex physical, chemical, and biological interactions. Varying salinity and nutrient levels, shallow depths, and energy input from open seas provide a range of conditions with varying fluctuations in salinity and water level. In EVER, the marine environment has highly productive plankton and submerged aquatic vegetation, but is dominated by relatively few plant species such as seagrasses (Livingston 1990).

Combined, these habitats support wildlife species, many of which have been determined by the federal government or the state to be endangered, threatened, or a species of special concern. Those "listed species" are addressed in **Section 3.7**, Special Status Species. Some of the more common fish and wildlife species observed in the project areas include birds, mammals, reptiles, and fish (see **Table 3.11**).

3.5.1.2 Common Wildlife

TABLE 3.11 - COMMON WILDLIFE IN THE CAPE SABLE AREA

Common Name	Scientific Name
Mammals	
Grey fox	*Urocyon cineroargenteus*
Marsh rabbit	*Sylvilagus palustris*
Raccoon	*Procyon lotor*
River otter	*Lutra canadensis*
White-tailed deer	*Odocoileus virginianus*
Birds	
Black-bellied plover	*Pluvialis squatarola*
Black-crowned night-heron	*Nycticorax nycticorax*
Double-crested cormorant	*Phalacrocorax auritus*
Forster's tern	*Sterna forsteri*
Gray kingbird	*Tyrannus dominicensis*
Great blue heron	*Ardea herodias*
Great egret	*Ardea albus*
Green heron	*Butorides virescens*
Killdeer	*Charadrius vociferus*
Mangrove cuckoo	*Coccyzus minor*
Red-shouldered hawk	*Buteo lineatus*
Ring-billed gull	*Larus delawarensis*
Reptiles	
Brown anole	*Anolis sagrei*
Corn snake	*Elaphe guttata guttata*
Green anole	*Anolis carolinensis*
Mangrove salt marsh snake	*Nerodia clarkii compressicauda*
Diamondback terrapin	*Malaclemys terrapin*
Rat snake	*Elaphe obsoleta rossalleni*
Southeastern five-lined skink	*Eumeces inexpectatus*
Southern Racer	*Coluber constrictor priapus*
Florida Kingsnake	*Lampropeltis getula floridana*
Gopher tortoise	*Gopherus Polyphemus*
Florida box turtle	*Terrapene Carolina bauri*
Fish	
Black drum	*Pogonias cromis*
Common snook	*Centropomus undecimalis*
Crevalle jack	*Caranx hippos*
Goldspotted killifish	*Floridichthys carpio*
Grunts	*Haemulon spp.*
Ladyfish	*Elops saurus*
Mangrove snapper	*Lutjanus griseus*
Mullet	*Mugil spp.*
Rainwater killifish	*Lucania parva*
Red drum	*Sciaenops ocellatus*
Southern puffer	*Sphoeroides nephelus*
Southern stingray	*Dasyatis americana*
Spotted seatrout	*Cynoscion nebulosus*
Tarpon	*Megalops atlanticus*

3.5.1.3 Invasive Exotic Species

In addition to native wildlife, many non-native animals also occur within the park. Plants and animals are considered non-native (i.e., alien, exotic, foreign, introduced, non-indigenous) when they occur artificially in locations beyond their known historical natural ranges. Non-native can refer to species brought in from other continents, regions, ecosystems, and even other habitats. The following plants are invasive exotic found in EVER (NPS 2016a):

- Australian Pine (*Casuarina equisetifolia*)
- Brazilian Pepper (*Schinus terebinthifolius*)
- Latherleaf (*Columbrina asiatica*)
- Melaleuca (*Melaleuca quinquenervia*)
- Old World Climbing Fern (*Lygodium microphyllum*)
- Seaside Mahoe (*Thespesia populnea*)

Invasive exotic species include pets that have been turned loose such as pythons and parrots. Aquatic environments have also been invaded by non-native species, including lionfish (*Pterois volitan*), blue and spotted tilapias (*Oreochromis aureus* and *Tilapia mariae*, respectively), oscars (*Astronotus ocellatus*), and Mayan cichlids (*Cichlasoma urophthalmus*) (FWC 2016a).

The interactions between native and non-native species are driven by local environmental conditions that include habitat and water temperature. Environmental disturbances including hurricanes, tropical storms, and water control measures would elevate water levels in the park and increase the distribution of these non-native species (Trexler 2000). No native species extinctions or widespread species community disruptions resulting from the introduction of exotics were noted. However, it should not be inferred that exotic species have no effect on native communities; over time, it is possible that non-native species could adversely impact native communities (NPS 2016b).

3.5.2 Environmental Consequences

3.5.2.1 Assumptions, Methodology, and Intensity Thresholds.

Maps showing vegetation cover within the Cape Sable area and communications with NPS staff were used to identify baseline conditions for wildlife, wildlife habitat, and vegetation. Available information was also taken from other NPS and non-NPS resources to describe these resources in more detail.

In general, it was assumed that there would be impacts to wildlife and wildlife habitat that occur from the construction phase of the action alternatives, as well as post-construction effects. The primary steps taken in assessing impacts on wildlife and wildlife habitat (including vegetation) included determining:

- Which species are found in areas likely to be affected by management actions described in the alternatives;
- Habitat/vegetation loss or alteration caused by the alternatives; and
- Displacement and disturbance potential of the actions and the species' potential to be affected by construction or future use and management activities.

Analysis area: The focus of this analysis is the primary Cape Sable area adjacent to the existing eroded and failed plugs along the Old Ingraham Highway that would be directly affected by the

proposed actions; however, impacts to wildlife in the expanded area of analysis in the greater Cape Sable area originating at the plug sites are also discussed.

Intensity thresholds:

- *Negligible:* There would be no observable or measurable impacts to native species, their habitats, or the natural processes sustaining them. Impacts would be well within natural fluctuations.
- *Minor:* A change in effects on wildlife and habitats would be localized within a small area. The change would be measurable or perceptible in terms of abundance, distribution, quantity, or quality of populations. While the mortality of individual animals might occur, the viability of wildlife populations would not be affected and the community, if left alone, would recover. Impacts would be detectable and are expected to be outside the natural range of variability.
- *Moderate:* A change in effects on wildlife and habitats would occur over a relatively large area. The change would be readily measurable in terms of abundance, distribution, quantity, or quality of populations. Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and would be outside the natural range of variability. Disruptions to key ecosystem processes that would be outside natural variation might occur, but the ecosystem would soon return to natural conditions. Mitigation measures would probably be necessary to compensate for adverse effects and would likely be successful.
- *Major:* A change in effects on wildlife and habitats would be readily apparent, and would substantially change wildlife populations over a large area in and out of the park. Impacts on native species, their habitats, or the natural processes sustaining them would be detectable, and would be expected to be outside the natural range of variability or be permanent. Key ecosystem processes might be disrupted. Loss of habitat might affect the viability of at least some native species. Extensive mitigation would be needed to compensate for adverse effects, and its success would not be assured.

3.5.2.2 Impacts of the Alternatives.

3.5.2.2.1 No Action Alternatives

1) Analysis. Under the No Action Alternative for House and Slagle Ditches and for Raulerson Canal, no construction would take place and current conditions would continue. There would be no direct adverse effect from construction on existing wildlife and wildlife habitat within the project areas.

However, taking no action to address the issues associated with the continuing erosion at House and Slagle Ditches and the failed plug at Raulerson Canal would only prolong the erosional impacts as they continue to increase within these waterways and to the greater Cape Sable area. Related erosion and channel widening would be expected to continue resulting in long-term degradation of adjacent and downstream wildlife habitats.

2) Climate Change and Sea Level Rise. Wildlife and habitat would be impacted by the increasing amount and duration of saltwater in the interior wetland Cape Sable wetlands.

3) Conclusion. No direct impacts to wildlife and wildlife habitat areas would result under the No Action Alternative. No beneficial effects to wildlife are anticipated as a result of No Action

Alternative. The No Action Alternative would produce long-term minor to moderate adverse impacts on wildlife and habitat resources.

3.5.2.2.2 Action Alternatives - Alternative 2: Re-backfill Eroded Plug Areas at House and Slagle Ditches; Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection; Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection; and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. Under the Action Alternatives, the areas directly adjacent to the restored plug sites at House and Slagle Ditches and Raulerson Canal would experience temporary impacts related to construction including increased noise, vegetation removal, and presence of people. It is anticipated that construction activities would temporarily displace some wildlife in adjacent habitats but it is not likely that changes to the overall community or population would occur. Displaced wildlife could increase competition between individuals in the surrounding habitats. Mitigation measures would be taken to minimize potential harm to wildlife (e.g., removing individuals that get trapped). Aquatic wildlife in the construction area would be displaced.

Temporary loss of habitat during construction would be expected to occur. During construction, there would be the potential for erosion and sedimentation to occur, as well as petroleum spills from equipment, which would contribute to turbidity and pollution in surface waters. However, implementing erosion control BMPs (e.g., the installation and inspection of silt fences, turbidity barriers, etc.) would minimize impacts. Post-construction mitigation would include the revegetation of temporarily disturbed areas.

The potential to introduce non-native species would be minimized during and after construction. The introduction of non-native species could affect the composition of wildlife habitat. Mitigation efforts would include washing equipment before entering the park; minimizing disturbances; revegetating disturbed areas immediately after construction; salvaging topsoil and native vegetation from the area, and limiting the amount of topsoil imported; revegetating with native species; and implementing exotic species control as necessary. The permanent footprints for the rehabilitated plugs are not expected to significantly increase as compared to the No Action Alternative. However, following completion of the project, wildlife would be expected to reoccupy all available habitat within and adjacent to the sites.

Over the long term, beneficial impacts to wildlife are anticipated resulting from decrease in saltwater intrusion. Since the project is relatively small in scale, detectable improvements in wildlife habitat conditions would not likely be measurable. The rehabilitation of the plug would result in a minor, adverse effect and direct loss of useable habitat by wildlife within the plugs footprints. It is anticipated that the project would result in a temporary loss of resting, shelter, and foraging sites for local wildlife. The restored plugs would be expected to provide a type of artificial habitat similar to the ditch/canal banks. Impacts on native invertebrates in the

construction area would be minor and adversely affected over the long-term by the placement of the plug. Based on the relatively small scale of the project compared to the overall existing habitat in the area, it is estimated that the rehabilitation of the plugs would produce adverse, local, minor, short-term effects in the immediate work zone. However, in the long term the quality of the habitat would improve throughout the Cape Sable area and would provide beneficial long-term impacts to wildlife.

2) Climate Change and Sea Level Rise. Wildlife and habitat would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the reconstruction of the eroding plug structures and House and Slagle Ditches and reconstruction of a new plug along Raulerson Canal. The plugs would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via these waterways beyond the benefits realized with the recent construction of the plugs within the East Cape and Homestead Canals. The slowing or postponement of impacts by the repair/reconstruction of the plugs would allow additional time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the breached and currently eroding plugs and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. The Action Alternatives would result in minor short-term adverse impacts from construction activities but beneficial long-term effects on wildlife and wildlife habitat from improved hydrologic conditions and reduced saltwater intrusion.

3.6 MARINE RESOURCES AND ESSENTIAL FISH HABITAT

3.6.1 Affected Environment

Florida Bay, a large, shallow, subtropical estuary covering about 850 square miles, is the largest waterbody within EVER and is the largest estuary in Florida. More than 20 commercially or recreationally important aquatic species are known to use Florida Bay as a nursery ground. The marine and estuarine resources of the Cape Sable area include important park elements such as submerged aquatic vegetation (SAV; i.e., seagrass communities), mangroves, wading birds, crocodiles, manatees, and wetlands. All waters within EVER, including the surface waters in and around Cape Sable, are classified by the state as OFWs. As previously mentioned, an OFW is water designated worthy of special protection because of its natural attributes. This special designation is intended to protect existing good water quality (FDEP 2015). Therefore, per Rule 62-302 F.A.C., no degradation of surface water quality is permitted. Due to their high quality, the surface waters of the Cape Sable area are particularly susceptible to degradation. Typically, within OFWs, onshore or in-water activities with the potential to create turbidity are restricted to maintain conditions within zero NTU above ambient conditions. Surface waters located within the Cape Sable study area include several natural tidal creeks and Lake Ingraham.

Prior to canal construction in the 1920s, Lake Ingraham was an isolated fresh to brackish lake within the coastal system. From the north, Little Sable Creek extended to Lake Ingraham over a long distance. From the south, saline water would have entered only during storm tides (Wanless and Vlaswinkel 2005). However, once the canals were constructed, large volumes of sediment were transported into Lake Ingraham, slowly filling it high enough in the intertidal zone for mangroves to colonize and now nearly the entire delta is emergent at low tide. Despite the high rate of sedimentation, there are abundant algae and cyanobacteria, burrowing worms,

and other animal species, which still provide a desirable feeding habitat for many wetland and wading birds species.

Also prior to canal construction, the interior of Cape Sable was a freshwater marsh with patches of brackish marsh and swamp. The marl ridge provided a natural boundary between Florida Bay and the interior. The beaches and capes provided a second, western barrier between the Gulf of Mexico and the interior. With the construction of the man-made canals, by the early 1950s, the freshwater levels in the interior wetlands were physically lowered creating saltwater intrusion and triggering an ecological collapse of the area (Wanless and Vlaswinkel 2005). Further, the massive 1935 Labor Day Hurricane exacerbated impacts with a six-foot storm surge across Cape Sable which destroyed much of the marsh areas (Wanless and Vlaswinkel 2005).

3.6.1.1 Essential Fish Habitat.

Fish require healthy surroundings to survive and reproduce. Essential Fish Habitat (EFH) includes all types of aquatic habitat — wetlands, coral reefs, seagrasses, rivers — necessary for managed fish to complete their life cycle — spawn, breed, feed, and grow to maturity. EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act (the Magnuson-Stevens Act) as "…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities. "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (NOAA 2009b).

NOAA Fisheries works with the regional Fishery Management Councils (FMC) to use the best available scientific information to describe and identify EFH for federally managed species; attempt to minimize the extent of adverse effects on habitat caused by fishing and non-fishing activities; and identify actions to encourage habitat conservation and enhancement. EFH in EVER is composed of estuarine waters and substrates (i.e., mud, sand, shell, rock) and includes submerged vegetation (i.e., seagrasses, algae), marshes and mangroves, and oyster shell reefs or banks.

EFH within EVER is comprised of estuarine waters and substrates (mud, sand, shell, rock, and associated biological communities) including submerged vegetation (seagrasses and algae), marshes and mangroves, and oyster shell (GMFMC 2010).

- **Seagrass** meadows provide substrates and environmental conditions that are essential to the feeding, spawning, and growth of several managed species. Juvenile and adult invertebrates and fishes, as well as their food sources, utilize seagrass beds extensively.

- **Benthic algae** occur in both estuarine and marine environments and are used as habitat by managed species, such as the queen conch and early-life history stages of the spiny lobster. Federally listed sea turtles utilize some benthic algae species directly as food. This habitat is also inhabited by invertebrate species, including mollusks and crustaceans, which are eaten by various fishes.

- **Mangroves and marshes** provide essential habitat for many managed species, serving as nursery grounds for larvae, post-larvae, juveniles, and adults. Mangrove habitats, particularly riverine, overwash, and fringe forests, provide shelter for larval, juvenile

and adult fish, and invertebrates. Along with providing habitat for fish during various life-cycle stages, mangroves and wetland marshes provide inputs of dissolved and particulate organic detritus to estuarine food webs. Since mangroves act as both habitat and as a food resource, mangroves are important exporters of material to coastal systems, as well as to terrestrial systems by providing shelter, foraging grounds, and nursery/rookery areas for terrestrial organisms. The root system binds sediments, thereby contributing to sediment stabilization.

- **Hard bottoms and hard banks** often possess high species diversity but may lack hermatypic corals, the supporting coralline structure, or some of the associated biota. Hard bottoms are usually of low relief and on the continental shelf. In deeper waters, large, elongated mounds often support a rich fauna compared with adjacent areas.

- **Corals and coral reefs** support a wide array of hermatypic and ahermatypic corals, finfish, invertebrates, plants, and microorganisms.

- **Sand/shell and soft bottom** habitats are common throughout Florida and the Caribbean. These habitats are characterized as being high energy and extremely dynamic. However, buffering by reefs and seagrasses allows some salt-tolerant plants to colonize the beach periphery. Birds, sea turtles, crabs, clams, worms, and urchins use the intertidal areas. The sand/mud subsystem includes all non-live bottom habitats or those with low percent cover (less than 10%). Sandy and mud bottom habitats are widely distributed, found in coastal and shelf areas, and include inshore, sandy areas separating living reefs from turtle grass beds and shorelines, rocky bottoms near rocky shorelines, and mud substrates along mangrove shorelines. Sand/shell habitat is utilized for foraging by abundant fishes and as substrate for solitary corals.

- **Oyster and shell** EFH is defined as the natural structures found between (intertidal) and beneath (subtidal) tide lines that are composed of oyster shell, live oysters, and other organisms. Oyster communities are critical to a healthy ecosystem; they remove large amounts of particulates from the water column and release large quantities of nutrients. Oysters have often been described as the "keystone" species in an estuary since they provide habitat, food, and protection, and contribute to its value as a critical fisheries habitat.

- The **pelagic** subsystem explicitly includes the habitat of pelagic fishes. Pelagic habitat is associated with open waters beyond the direct influence of coastal systems. In general, primary productivity in this zone is low and patchily distributed, being higher in nearshore areas as opposed to offshore areas. The pelagic system is inhabited by the eggs and larval stages of many reef fishes, highly migratory fishes, and invertebrates, some of which, like the spiny lobster, are commercially important.

The Gulf of Mexico Fisheries Management Council (GMFMC) identified areas within EVER that contain EFH dominated by mangrove islands and mangrove forests, including marsh areas and areas of SAV (submerged aquatic vegetation; e.g., seagrass). Collectively these areas are referred to as the Florida Bay and Ten Thousand Islands that are located both within and outside of the park's boundaries.

The proposed projects are located in an area for which the GMFMC has designated EFH for species managed under five fishery management plans (FMPs): penaeid shrimp, red drum, reef fish, spiny lobster, and highly migratory pelagic species, including the following species and life stages:

- **Shrimp FMP:** post-larval and juvenile pink shrimp, and post-larval, juvenile, and sub-adult white, royal red and brown shrimp
- **Red drum FMP:** post-larval, juvenile, and adult red drum
- **Reef fish:** gray snapper, red snapper, lane snapper, yellowtail snapper, and vermilion snapper
- **Spiny lobster FMP:** Larval, post-larval, juvenile, and adult spiny lobster and the incidental species: spotted spiny lobster; smooth tail lobster; and Spanish lobster
- **Highly migratory pelagic species:** bluefish, larval cobia, adult Spanish mackerel, King mackerel, cero, little tunny, and dolphin

EFH provides forage, and nursing and spawning areas for shrimp, sawfish, red drum, spiny lobster, reef fish, and mackerels (see **Table 3.12;** GMFMC 2012). EFH for the highly migratory pelagic species is restricted to the water column; EFH for the remaining species also includes the non-vegetated bottom. Relevant categories of EFH that would be affected by the proposed projects include the water column and non-vegetated bottom (e.g., mud, sand, and rock substrates).

TABLE 3.12 - FEDERALLY MANAGED FISH SPECIES USING EFH WITHIN EVER

Common Name	Scientific Name	Habitat
Red Drum		
Red Drum	*Sciaenops ocellatus*	Marine planktonic, SAV, mud bottom, marsh
Reef Fish		
Queen snapper	*Etelis oculatus*	Rock outcrops, gravel, reefs
Mutton snapper	*Lutjanus analis*	Rock outcrops, gravel, reefs
Blackfin snapper	*Lutjanus buccanella*	Continental shelf
Red snapper	*Lutjanus campechanus*	Sand, mud, rock outcrops, gravel
Cubera snapper	*Lutjanus cyanopterus*	Reefs
Gray (mangrove) snapper	*Lutjanus griseus*	Marine planktonic, SAV, mangrove, mud
Lane snapper	*Lutjanus synagris*	SAV, mangrove, mud, sand, reefs
Silk snapper	*Lutjanus vivanus*	Rock outcrops, gravel, reefs
Yellowtail snapper	*Ocyurus chrysurus*	SAV, mangrove, mud, sand, reefs
Wenchman	*Pristipomoides aquilonaris*	Sand, reefs, hard bottoms
Vermilion snapper	*Rhomboplites aurorubens*	SAV, mangrove, mud, sand, reefs
Speckled hind	*Epinephelus drummondhayi*	Rock outcrops, gravel
Red grouper	*Epinephelus morio*	Marine planktonic, SAV, hard bottoms
Black grouper	*Mycteroperca bonaci*	Marine planktonic, SAV, hard bottoms
Yellowmouth grouper	*Mycteroperca interstitialis*	Rock outcrops, gravel, reefs
Gag	*Mycteroperca microlepis*	Marine planktonic, SAV, hard bottoms
Scamp	*Mycteroperca phenax*	Hard bottoms, reefs
Yellowfin grouper	*Mycteroperca venenosa*	Reefs
Goldeneye tilefish	*Caulolatilus chrysops*	Hard bottoms, rock outcrops
Blueline tilefish	*Caulolatilus microps*	Canyons, mud, sand
Tilefish	*Lopholatilus chamaeleonticeps*	Canyons
Greater amberjack	*Seriola dumerili*	Floating plants, pelagic
Lesser amberjack	*Seriola fasciata*	Floating plants, pelagic

Common Name	Scientific Name	Habitat
Almaco jack	*Seriola rivoliana*	Pelagic
Banded rudderfish	*Seriola zonata*	Hard bottoms, floating plants
Gray triggerfish	*Balistes capriscus*	Marine sand, floating plants, mangroves
Hogfish	*Lachnolaimus maximus*	Gravel, sand, reefs
Coastal Migratory Pelagic		
King mackerel	*Scomberomorus cavalla*	Pelagic
Spanish mackerel	*Scomberomorus maculates*	Pelagic
Cobia	*Rachycentron canadum*	Coastal
Cero	*Scomberomorus regalis*	Pelagic
Little tunny	*Euthynnus alletteratus*	Estuaries, pelagic
Dolphin	*Coryphaena hippurus*	Epipelagic
Bluefish	*Pomatomus saltatrix*	Estuaries, pelagic
Sawfish		
Smalltooth sawfish	*Pristis pectinata*	Mud, sand, mangrove
Shrimp		
Brown shrimp	*Penaeus aztecus*	Marsh, mud
White shrimp	*Penaeus setiferus*	Marsh, mud
Pink shrimp	*Penaeus duorarum*	Sand
Royal red shrimp	*Pleoticus robustus*	SAV
Spiny Lobster		
Caribbean spiny lobster	*Panulirus argus*	Hard bottoms

3.6.1.2 Habitat Areas of Particular Concern

EFH is described and identified for each species and life stage in the fisheries management unit; similarly, habitat areas of particular concern (HAPC) are identified on the basis of the condition of the habitat. A HAPC is expected to be a localized area of an EFH that is especially ecologically important, sensitive, stressed, or rare, when compared to the rest of the EFH (NOAA 2009a). The designation of HAPC is intended to identify those areas of EFH considered to be of the highest importance in the life cycles of managed species and most in need of protection. The following considerations must be given in the designation of HAPCs (50 CFR 600.815 (a)(8)):

- The importance of the ecological function provided by the habitat;
- The extent to which the habitat is sensitive to human-induced environmental degradation;
- Whether, and to what extent, development activities are, or would be, stressing the habitat; and
- The rarity of the habitat type.

Within EVER, Florida Bay has been identified as a HAPC. Mangrove-covered islands and SAV within the bay provide important habitat for many of the fisheries, such as pink shrimp, red drum, and spiny lobster.

Critical habitat is for the smalltooth sawfish is discussed under Section 3.7.

3.6.2 Environmental Consequences

3.6.2.1 Assumptions, Methodology, and Intensity Thresholds.

The CEQ guidelines for implementing NEPA require an analysis of resources that would be considered ecologically critical areas. Within EVER, ecologically critical areas include: EFH, as identified by the Gulf of Mexico Fisheries Management Council (GMFMC 2010), and habitat areas of particular concern (HAPC), as defined by the NOAA and mapped by the Fisheries Management Council.

The Magnuson-Stevens Act requires federal agencies to consult with NOAA Fisheries about actions that have the potential to damage EFH (NOAA 2009b). The 1996 Sustainable Fisheries Act made significant amendments to strengthen the conservation of the Magnuson-Stevens Act. Specifically, the Act required that fishery management plans identify as EFH those areas that are necessary to fish for their basic life functions. The law provides for the protection of estuarine systems (mangroves and salt marshes), seagrasses, and hard-bottom habitats that provide refuge, foraging, and breeding areas for fish and invertebrates.

Analysis area: The focus of this analysis is the primary Cape Sable area adjacent to and along the marl ridge that would be directly affected by the proposed actions; however, impacts to EFH in the expanded area of analysis in the greater Cape Sable area are also discussed, and include the estuarine habitat including the salt marshes and mangroves, seagrass beds, hard bottom areas, and sand/soft bottom areas.

The following impact thresholds were used to determine the magnitude of impacts on EFH:

- *Negligible:* The waters and substrates that define the EFH would not be affected or the effects would be at or below the level of detection, and the changes would be so slight that they would not be of any measurable or perceptible consequence to the EFH. Fisheries or invertebrate species that depend upon these habitats would not be affected.
- *Minor:* Effects to waters and substrates that define the EFH would be detectable, although the effects would be localized, and would be small and essential habitat would not be lost in the area. The function of the habitat for fisheries or invertebrate species would not be affected. Although some individuals may avoid areas that are affected, populations of the fish and invertebrate species that use these habitats would not be affected.
- *Moderate:* Effects to waters and substrates that define the EFH would be readily detectable resulting in a loss of small portions of habitat and it would lose some of its function for fisheries or invertebrate species that depend upon it. This would result in a decline in populations of these fish or invertebrates in the local area.
- *Major:* Effects to waters and substrates that define the EFH would be widespread. The effects result in the loss of EFH over a large area and would result in a loss of function of the habitat to support fisheries and invertebrate populations resulting in a substantial decline in fisheries or invertebrate populations that rely upon that habitat.

Duration: Short-term impacts occur during all or part of alternative implementation; long-term impacts extend beyond implementation of the alternative.

3.6.2.2 Impacts of the Alternatives.

3.6.2.2.1 No Action Alternative

1) Analysis. Allowing erosion to continue at House and Slagle Ditches and not replacing the failed plug at Raulerson Canal would allow the waterways to continue to widen through an accelerated erosional processes and would fail to accomplish federal goals of the NPS and the USFWS, which are to preserve, protect, and/or improve fish and wildlife habitat.

Without rehabilitating the plugs, further erosion of the Old Ingraham Highway would continue to occur at House and Slagle Ditches plug areas and saltwater would continue to encroach into interior wetlands north of the marl ridge via Raulerson Canal, which serves as EFH for many federally regulated species. Marine resources and EFH would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. The continuation of saltwater intrusion and sedimentation into Lake Ingraham from the existing tidal flushing and loss of freshwater through the breached plug would result in long-term minor to moderate adverse effects to EFH.

2) Climate Change and Sea Level Rise. Marine resources and EFH would be adversely impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable.

3) Conclusion. Under the No Action Alternative, no construction would take place and current conditions and processes would continue. However, taking no action to address the issues associated with the eroding earthen plugs at House and Slagle Ditches and failed plug at Raulerson Canal would only prolong impacts on erosional processes within the waterways and the greater Cape Sable area. The No Action Alternative would result in long-term minor to moderate adverse impacts on EFH.

3.6.2.2.2 Alternative 2: Re-Backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-Backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection, and Sand Drain for Seepage Protection

1) Analysis. Direct permanent impacts of approximately 0.014 acres and approximately 0.026 acres within surface waters at House and Slagle Ditches as result of implementing Alternative 2 and 3 are unavoidable. This would affect a small area of non-vegetated bottom habitat which might constitute EFH for some of the species listed above. These impacts are a direct result of the placement of the additional earthen fill and, for Alternative 3 only, riprap for stabilization. However, the area of non-vegetated bottom affected by the proposed projects is relatively small compared to the area of other suitable habitats available to these species in the vicinity of the proposed project. These disturbances might also have indirect effects on federally managed species through the loss of benthic prey species found in the non-vegetated bottom habitats. Most of these prey species, however, are expected to re-colonize the affected areas within a few seasons following construction.

Since canal access as well as space would be limited for Alternatives 2 and 3, a helicopter would be used to import suitable fill material and equipment from an offsite staging area (exact

location undefined at this time). The material/equipment would be placed within the limits of the helicopter drop area and then transported to the plug sites along the designated accessways using small equipment and manual labor. Prior to construction activities, BMPs would be employed to minimize impacts to adjacent wetlands. A designated work zone would also be established within the work zone of each plug which equipment would be staged for use during construction.

The rehabilitated plugs would maintain the habitat for fish and invertebrates within Lake Ingraham. The reinforced plugs would help to limit the unnatural flow of saltwater into the interior Cape Sable wetlands north of the marl ridge and reduce freshwater loss through House and Slagle Ditches. Populations of fish and invertebrates in the wetlands behind the plug would not become isolated, since there are multiple natural channels through the marl ridge that would continue to provide access to Lake Ingraham, Florida Bay. Fish and invertebrates can also access Whitewater Bay through numerous small channels.

Construction activities that disturb the bottom are also likely to re-suspend sediments, temporarily increasing turbidity in the estuarine/marine water column. Temporarily elevated levels of suspended sediment would have an adverse effect on federally managed species including species avoidance of the impact area, minor physiological effects (i.e., abrasion of surface membranes and interference with respiratory functions; fine particulate material could clog sensitive gill structures, decrease their resistance to disease, prevent proper egg and larval development, and potentially interfere with particle feeding activities), and indirect effects related to the temporary reduction of light (i.e., reducing the photic zone and interference with feeding of visually oriented predators; if light penetration is reduced substantially, macrophyte growth may be decreased which would, in turn, impact the organisms dependent upon them for food and cover). However, most of the sediments suspended by the proposed project are expected to settle within or near the impact area shortly after plug reconstruction is complete, resulting in only minor, temporary impacts to EFH or federally managed species.

Turbidity/suspended soil resulting from work within the plug work areas would be contained within the construction footprint using staked and/or floating turbidity curtains or other suitable barriers to minimize the potential for turbidity beyond the limits of construction. The barriers would be installed prior to commencement of construction activities and remain in place and regularly inspected throughout the construction phase of the project. To ensure compliance with water quality standards in OFWs, a turbidity monitoring plan would be implemented during construction. If monitoring reveals that turbidity levels exceed the standards, construction activities shall cease immediately and shall not resume until corrective measures are successfully implemented (e.g., the use of additional barriers, timing construction activities with tidal cycles, modifications to equipment).

2) Climate Change and Sea Level Rise. Marine resources and EFH would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short-term to intermediate-term by the restoration of the eroded plugs. The plugs would reduce the potential for increased intensity and duration of saltwater entering the interior Cape Sable wetlands via House and Slagle Ditches. The slowing or postponement of impacts by the reinforcement of the plug structures would allow additional time for the interior Cape Sable wetlands to restabilize and recover from the current impacts caused by the eroding plugs and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Alternative 2 or 3 would result in some short-term, minor, unavoidable adverse impacts to habitats designated as EFH for several federally managed species. No long-term adverse EFH impacts are anticipated. EFH and other marine resources would benefit from improved hydrologic conditions and reduced saltwater intrusion. Alternatives 2 and 3 would result in short-term minor adverse effects and long-term beneficial impacts to EFH.

3.6.2.2.3 Alternative 4A: Construct A New Sheet Pile Plug At Raulerson Canal And Fill Plug With Riprap Erosion Protection and Alternative 4B: Construct A New Sheet Pile Raulerson Canal And Fill Plug With Riprap Erosion Protection And An Option For A Canoe Ramp

1) Analysis. The reconstruction of the failed plug structure at Raulerson Canal would result in filling of approximately 0.017 acres of wetlands and 0.130 acres of surface waters for Alternative 4A, and approximately 0.017 acres of wetlands and 0.120 acres of surface waters for Alternative 4B. These filling impacts are a direct result of the placement of the new sheetpile, fill, and riprap for the plug's stabilization, and armoring. Since canal access would be limited for Alternatives 4A and 4B, a small barge would be used to import suitable fill material from an offsite staging area. There would be no dredging and no hydraulic pumping involved in either Alternative 4A or 4B. The material would be transferred within the limits of the area to be filled and graded using small equipment and manual labor. Prior to construction, BMPs would be implemented to avoid and minimize impacts to adjacent wetlands.

Under both Alternative 4A and 4B, the reconstructed plug would decrease the sediment deposition rates and thereby improve the habitat for fish and invertebrates within Lake Ingraham that may constitute EFH for some of the species listed above. The rehabilitated plug would limit the unnatural flow of saltwater into the interior wetlands of Cape Sable north of the marl ridge through Raulerson Canal and reduce freshwater loss through Raulerson Canal. The reduction of saltwater intrusion and loss of freshwater through the breaches plug would result in long-term beneficial effects to EFH.

Populations of fish and invertebrates in the wetlands behind the plug would not become isolated, since there are multiple natural channels through the marl ridge that provide access to Lake Ingraham and Florida Bay (e.g., East Side Creek). The small loss of habitat through the plug placement would be permanent (long term) but minor. The reduction of saltwater intrusion and loss of freshwater through the breached plug, and the reduction of illegal motorized boaters would result in long-term beneficial effects to EFH.

For Alternative 4B only, approximately 40 square feet (0.001 acres) of permanent shading impacts to Raulerson Canal would occur under Alternative 4B as a result of the proposed non-motorized boat (canoe/kayak) portage system (i.e., placement of the floating platform/dock). However, since this number is relatively small compared to the overall length of Raulerson Canal, this new shading impact is negligible.

2) Climate Change and Sea Level Rise. Marine resources and EFH would be impacted by the increasing amount and duration of saltwater in the interior Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the reconstruction of the failed plug structure. The plug would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands. The slowing or postponement of impacts by the reconstruction of the plug structure would allow

time for the interior wetlands of Cape Sable to restabilize and recover from the current impacts caused by the breached plugs and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. This alternative would result in some long-term minor unavoidable adverse impacts to habitats designated as EFH for federally managed species. This includes a small loss of habitat, and temporary disturbance to a small area of non-vegetated bottom and temporary degradation of the estuarine/marine water column due to an increase in suspended sediment concentrations. Alternative 4A or 4B would result in short-term minor adverse effects and long-term beneficial impacts to EFH.

3.7 SPECIAL STATUS SPECIES

3.7.1 Affected Environment

This section provides a summary of the threatened and endangered species and species of special concern found within EVER that may occur in the Cape Sable study area.

Plants and animals federally classified as endangered or threatened are protected under the ESA. "Endangered" refers to any in danger of extinction throughout all or a substantial part of its range. A "threatened species" is any species likely to become an endangered species in the foreseeable future throughout all or a substantial part of its range. "Proposed Species" are species of animal or plant proposed in the Federal Register to be listed under Section 4 of the ESA. State listed species are protected by Chapter 68A-27 F.A.C.

No federally listed plant species occur in the Cape Sable study area. The nearest occurrences of federally listed plant species are of Garber's spurge (*Chamaesyce garberi*) which occurs in beach dune communities of East, Middle, and Northwest Cape Sable and Cape Sable thoroughwort (*Chromolaena frustrata*), which occurs in buttonwood hammocks and coastal hardwood hammocks to the east of the study area around Clubhouse Beach. Suitable habitat for these species or any other federally listed plant species known from EVER is not found within the project area. Critical habitat for federally listed plant species does not occur within the project area.

No federally listed invertebrates are known to occur within the project area. Miami blue butterfly (*Cyclargus thomasi bethunebakeri*) previously inhabited tropical coastal hammocks, pine rocklands, and coastal areas in Everglades National Park. This species was first reported to be no longer present within EVER in 1980. Reintroduction of this species was attempted in 2004 in several locations, including Buttonwood Canal to the east of the project area. The last observation of a Miami blue butterfly in EVER was made in January 2005 near one of the reintroduction sites. The reintroduction attempt is believed to have been unsuccessful and this species is considered to be extirpated from EVER.

Federally and state-listed threatened and endangered animal species with the potential to occur in and around the project area are shown in **Table 3.13 and Table 3.14** (USFWS 2016a; NPS 2016c).

TABLE 3.13 - FEDERALLY LISTED SPECIES WITH POTENTIAL TO OCCUR IN AND AROUND THE CAPE SABLE PROJECT AREA

Common Name	Scientific Name	Federal Status	Federally Designated Critical Habitat in Park
Mammals			
Florida bonneted bat	*Eumops floridanus*	Endangered	No critical habitat rules have been published for the Florida bonneted bat.
Florida panther	*Puma concolor coryi*	Endangered	No critical habitat rules have been published for the Florida panther. USFWS-designated panther focus areas have been designated in EVER however the Cape Sable project area is not located within a panther focus area.
West Indian manatee	*Trichechus manatus*	Endangered	Portions of EVER are within federally designated critical habitat. Cape Sable is not within critical habitat.
Birds			
Bald eagle**	*Haliaeetus leucocephalus*	Delisted	No federally designated critical habitat
Red knot	*Calidris canutus* spp. *rufa*	Threatened	No critical habitat rules have been published for the red knot.
Roseate tern	*Sterna dougallii*	Threatened	No critical habitat rules have been published for the roseate tern.
Snail kite	*Rostrhamus sociabilis plumbeus*	Endangered	Portions of EVER are within federally designated critical habitat. Cape Sable is not within critical habitat.
Wood stork	*Mycteria americana*	Threatened	No critical habitat rules have been published for the wood stork.
Reptiles			
American crocodile	*Crocodylus acutus*	Threatened	Yes; Portions of EVER are within federally designated critical habitat, including the Cape Sable project area.
Eastern indigo snake	*Drymarchon corais couperi*	Threatened	No critical habitat rules have been published for the eastern indigo snake.

Common Name	Scientific Name	Federal Status	Federally Designated Critical Habitat in Park
Green sea turtle	*Chelonia mydas*	Endangered	No designated critical habitat in EVER
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	No designated critical habitat in EVER
Kemp's Ridley sea turtle	*Lepidochelys kempii*	Endangered	No designated critical habitat in EVER
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	No designated critical habitat in EVER
Loggerhead sea turtle	*Caretta caretta*	Threatened	Yes; federally designated critical habitat (nearshore reproductive) has been designated within EVER (in beach dune communities of East, Middle and Northwest Cape Sable as well as Highland Beach).
Fish			
Smalltooth sawfish	*Pristis pectinata*	Endangered	Yes; Portions of EVER are within federally designated critical habitat, including the Cape Sable project area

** Note: The bald eagle is not protected under the ESA but is afforded protection under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA).

3.7.1.1 American Crocodile.

A large lizard-shaped reptile, the American crocodile closely resembles the alligator. Their backs are covered with rigid bony scales while their bellies are smooth in texture (Van Meter 1992). In Florida, males reach 15 feet long while females range from 8 to 12 feet (Van Meter 1992). Florida crocodiles may be distinguished from alligators by their more slender build and their snout that tapers forward from the eyes. The adult's diet includes fish, crabs, birds, turtles, snakes, and small mammals. The young feed chiefly on aquatic invertebrates and small fish (USFWS 2016b).

In Florida Bay, American crocodile habitat includes mangrove-lined ponds, creeks, and shorelines, and associated features (Kushlan 1989b; Van Meter 1992). Their nesting habitat consists of elevated well-drained soils in coastal habitats. Nests themselves may be either holes dug into or mounds built on these elevated banks and beaches; nesting typically occurs between March and September (Kushlan 1989b).

The American crocodile is jeopardized primarily by habitat loss due to expansion of a rapidly growing human population along the coastal areas of south Florida (Mazzotti 1983). Crocodiles now occur in most of the remaining suitable habitat in southern Florida (Mazzotti et al. 2007). A portion of their designated critical habitat exists within EVER (CFR 50 Parts 1 to 199, revised October 1, 2000).

The distribution and abundance of estuarine crocodiles is dependent upon the timing, amount, and location of freshwater flow (Dunson 1989; Mazzotti and Dunson 1989). Due to their small

size, hatchling and juvenile crocodiles are vulnerable to environmental stressors, such as high levels of salinity; therefore, their survival is dependent upon access to freshwater (Mazzotti et al. 2007; Schubert 1996; Mazzotti 1999). Restoring a more natural pattern of freshwater flow is likely to benefit the crocodile population in the long term (USFWS 1999). Although hatchlings and juveniles may be the most affected, all stage classes are impacted by hydrologic conditions (Mazzotti 1999; Mazzotti et al. 2007). The majority of crocodile sightings occur in water with a salinity of less than 20 parts per thousand (Mazzotti et al. 2007).

Aquatic species directly dependent on a specific range of salinity levels and water depths include the small bottom-feeding fish that are a major component of the crocodile diet (Lorenz 1999). Crocodile growth and dispersal is linked to the distribution and availability of these small prey fish that live within the mangroves.

As top predators, crocodiles are a balancing part of the ecosystem; their borrows provide shelter and water and they hunt weak or sick animals to keep prey populations healthy. The crocodile is being used as an indicator species to assess the ecological conditions and evaluate the impact of CERP restoration efforts (Everglades Restoration 2010). Crocodiles were chosen because of their reliance upon estuarine environments characterized by appropriate salinity regimes and adequate freshwater inflows. The desired restoration condition for crocodiles under CERP is to restore freshwater flow volume and frequency in order to lower salinities in Florida Bay throughout the hatchling period for optimal growth and survival of juvenile crocodiles (Everglades Restoration 2010).

3.7.1.2 Florida Panther.

The Florida panther is a large, unspotted, and long tailed felid. The Florida panther is the last subspecies of *Puma concolor* (also known as mountain lion, cougar, or puma) still surviving in the eastern US. Adults are unspotted and typically tan in overall coloration but may be darker brown to rust-colored along the midline of the back (USFWS 2016c). Adult male panthers average between 130 and 160 pounds with an average length of 7 feet. Adult female panthers weigh between 70 and 100 pounds and have an average length of 6 feet (USFWS 2016c). Panthers are wide ranging, secretive, and occur at low densities.

The Florida panther primarily utilizes upper dry land habitats such as hardwood hammocks, pine flatwoods, and thicket swamps near wetlands. Although they do not prefer extremely wet places, they do transverse highly aquatic habitats and waterways to find food or drier land. A panther's main diet is white-tailed deer but they can also subsist on wild hogs and raccoons. The average male panther has a home range of approximately 150 up to 200 square miles.

Historically this species ranged throughout most of the southeastern US. The only known self-sustaining population occurs in south Florida, generally within Lee, Collier, Hendry, Dade, and Monroe counties (USFWS 2016c). Florida panthers are one of six or less currently accepted sub-species of puma, it is estimated that 130-180 adult and juvenile panthers remain in the wild (FWC 2016d). Since it is distinct from other subspecies and is a small, isolated relic population, the Florida panther is listed as a federal and state endangered species (USFWS 2016c).

The USFWS developed the Florida panther final interim Standard Local Operating Procedures (SLOPES) for Endangered Species (USFWS 2000). The Florida panther SLOPES also included a consultation area map that identified an action area where the Service believed land alteration projects may affect the Florida panther and recommendations to minimize these potential impacts. Consequently, the USFWS designated a Panther Focus Area that includes designated

conservation lands such as national preserves (Big Cypress), national wildlife refuges (Florida Panther), national parks (Everglades), state lands (Florida Forever Program), and others (USFWS 2010). The House and Slagle Ditches and Raulerson Canal project areas are located outside of the Panther Focus Areas.

3.7.1.3 West Indian Manatee.

The West Indian manatee (*Trichechus manatus*) is a fully aquatic herbivorous mammal. These gentle, aquatic mammals move slowly through the water as they feed on plants, and often are unable to move out of the way of fast-moving boats, whose propellers can wound or even kill them. They are typically found in coastal or estuarine waters, bays, rivers, and lakes, but may be found in inland canals during winter months as they search for warmer waters (USFWS 2016d); they are also found within EVER. Manatees are grazers and require sheltered coves for feeding, resting, and calving. Manatees spend about 5 hours a day feeding primarily on submerged aquatic vegetation, such as seagrasses. Although manatees appear to tolerate marine and hypersaline conditions, they are most frequently found in fresh or brackish waters. Changes in freshwater flow and salinity patterns, submerged vegetation, and the overall quality of the foraging habitat in Florida Bay and elsewhere in the park are, along with water temperature, important influences on the distribution and abundance of manatees in the area (USFWS 2016d). Increases in salinity are generally considered to result in less favorable conditions for manatees, although manatees move freely through a wide range of salinities. Manatees are frequently reported drinking freshwater from natural sources as well as hoses, sewage outfalls, and culverts in marine and estuarine areas. The potential for manatees exists within House and Slagle Ditches and Raulerson Canal, which are tidally connected to the waters of Florida Bay and the Gulf of Mexico.

3.7.1.4 Wood Stork.

The wood stork (*Mycteria americana*) is a large, wading bird whose statuesque form and slow stalking methods make it a favorite of photographers and bird watchers. The wood stork is a large, long-legged wading bird, standing about 50 inches tall, with a wingspan over 60 inches. It has white plumage and a short, black tail. Their bill is black, thick at the base, and curved. Their US range consists of parts of Florida, Georgia, and South Carolina. Wood storks use thermal drafts for soaring, and may travel 80 miles from nest to feeding areas (USFWS 2016e). The wood stork forages mainly in shallow water (no more than about 10 inches deep) in freshwater marshes, swamps, lagoons, ponds, tidal creeks, flooded pastures and ditches, where they are attracted to falling water levels that concentrate food sources (mainly small fish). Highly social, these birds nest in large rookeries and feed in flocks. They are long-lived and first breed at 4 years old. In south Florida, nesting occurs as early as October, with young leaving the nest in February or March. The project areas are located within the designated core foraging area (CFA) of a nesting wood stork colony. The decline in wood stork populations is attributed mostly to loss of habitat by destruction of wetlands and control of water flows (USFWS 2016e). To minimize adverse effects to the wood stork due to any loss of wetlands, the USFWS recommends that any lost foraging habitat resulting from the project be replaced within the CFA of the affected nesting colony.

3.7.1.5 Red Knot.

The red knot (*Calidris canutus* spp. *Rufa*) is a medium sized shorebird with a rather anonymous look in winter plumage, but it is easily recognized in the spring during its breeding season, when it wears robin-red on its chest. It nests in the far north, mostly well above the Arctic Circle; its winter range includes shorelines around the world. In migration and winter, it is found on coastal mudflats and tidal zones, sometimes on open sandy beaches. It was recently listed as threatened in 2015; the reason for listing was due to loss of both breeding and nonbreeding habitat (79 FR 73705 73748). The red knot was observed at Lake Ingraham on March 18, 2015 (ebird 2016). Foraging activity is largely dictated by tidal conditions typically nests near ponds or streams and forages mostly by probing in the mud with its bill on mud flats, finding food by touch. On dry sand and on tundra breeding grounds, the red knot forages mostly by sight, picking items from the surface.

3.7.1.6 Bald Eagle.

The bald eagle (*Haliaeetus leucocephalus*) is one of the largest birds of prey found in North America. Its range includes most of Canada and Alaska, all of the contiguous United States, and northern Mexico. It is most commonly seen along coasts and near other large bodies of open water with an abundance of fish. The bald eagle prefers old growth and mature stands of coniferous or hardwood trees for perching, roosting, and nesting. Its diet is opportunistic and varied, but most feed mainly on fish. Once abundant in North America, the species became rare in the mid-to-late 1900s—the victim of trapping, shooting, and poisoning as well as pesticide-caused reproductive failures. Once listed for protection under the ESA, since 1980, gentler treatment by humans along with the banning of the chemical dichloro-diphenyl-trichloroethane. (DDT; the bird's main pesticide threat) has led to a dramatic resurgence. Although no longer listed under the Endangered Species list, it is still protected under the *MBTA* and the *BGEPA*.

3.7.1.7 Roseate Tern.

The roseate tern (s*terna dougallii*) is a medium-sized, gull-like tern about 15 inches long that eats almost exclusively small fish, primarily the American sand lance in northeastern populations. It captures food mainly by plunge-diving, completely submerging its body underwater to catch prey, but it also feeds in shallow waters and even steals food from common terns. Strictly a coastal species, this bird is usually observed foraging in nearshore surf. In the winter, the roseate tern is pelagic in its habits. Open sandy beaches isolated from human activity are optimal nesting habitat for the roseate tern. A variety of substrates, including pea gravel, open sand, overhanging rocks, and salt marshes are used. The roseate tern is a federally protected and endangered seabird that is mainly found in the Northern Hemisphere on the northeastern coast of North America, extending from Nova Scotia to the southern tip of Florida, as well as several islands in the Caribbean Sea. Populations in the northeastern US greatly declined in the late 19th century as it was hunted for its feathers. In the 1930s the population rebounded and became protected under the MBTA but since then, population numbers have declined and stayed in the low range of 2,500 to 3,300 (USFWS 2011).

3.7.1.8 Snail Kite.

Now officially known as simply a snail kite, the subspecies from Florida and Cuba (*Rostrhamus sociabilis plumbeus*) formerly known as the Everglade snail kite was listed as endangered in 1967. The range of the Florida population of snail kites is restricted to watersheds in the central and southern part of the state. Because of a highly specific diet composed almost entirely of apple snails (*Pomacea paludosa*), survival of the snail kite depends directly on the hydrology and water quality of these watersheds, each of which has experienced pervasive degradation as a result of urban development and agricultural activities. The principal threat to the snail kite is the loss or degradation of wetlands in central and south Florida. The present-day system of canals, levees, and water-control structures has disrupted the volume, timing, distribution, and velocity of freshwater flow. The loss of freshwater to seepage, flood-control releases to tidal waters, and extraction for irrigation and urban water supply has led to salt-water intrusion in some places. Regulation of water stages in lakes and canals is particularly important to maintain the balance of vegetative communities required to sustain snail kites (NPS 2016d).

3.7.1.9 Florida Bonneted Bat.

The Florida bonneted bat (*Eumops floridanus*) is the largest species of bat in Florida (Belwood 1992); it can reach up to 6.5 inches in length with a wingspan of 20 inches. The name "bonneted bat" originates from its large, broad ears, which project forward over the eyes. Its fur ranges in color from dark gray to brownish-gray (NPS 2016e). Very little life history information is available for this species; there is limited knowledge about habitat needs and preferences (FWC 2016b). Their diet primarily consists of flying insects, beetles, and flies. The Florida bonneted bat uses forests, wetlands, and other natural habitats. It roosts in cliff crevices, tree cavities, and buildings. It is present in rural as well as residential and urban areas (NPS 2016e). Because of its extremely limited range and low numbers, the Florida bonneted bat is vulnerable to a wide array of natural and human-related threats. Habitat loss, degradation, and modification from human population growth and the associated development and agriculture are major threats to this species (NPS 2016e). This species is active year-round and endemic to south Florida; they are non-migratory. To date, Florida bonneted bats have only been found in the south Florida counties of Lee, Collier, Charlotte, and Miami-Dade (FWC 2016b). The project areas are located out of the USFWS-designated Consultation Area as well as outside of the Focal Area.

3.7.1.10 Eastern Indigo Snake.

The Eastern indigo snake (*Drymarchon corais couperi*) is a large, non-venomous snake that may reach up to eight feet in length. The snake gets its name from its shiny, blue-black color. Its diet consists mainly of other snakes, amphibians, small mammals, and occasionally birds. The species occurs throughout Florida and along the coastal plain of Georgia. Although their preferred habitat is dry pineland bordered by water, the eastern indigo snake is found in a variety of habitats and has also been known to occur in and around hardwood hammocks and have shown no preference for disturbed sites (USFWS 2016f). Large expanses of wetland, such as those found throughout the project areas, are not particularly attractive as habitat. The decline in populations is attributed to loss of habitat due to agriculture as well as collecting for the pet trade (USFWS 2016f). Little is known about the specific habits and niche of the Eastern indigo snake in the park; very little recent data is available. However, mangrove areas appear to be the most common habitat within EVER where NPS has received positive confirmations of this species in recent years. Additionally, eastern indigo snakes have a strong association with both

elevated levees in wetland areas and gopher tortoise burrows (which are common in the higher ground behind beach areas on Cape Sable, although outside of the project area). Eastern indigo snake protection measures have also established by the USFWS for construction activities.

3.7.1.11 Loggerhead Sea Turtle.

Loggerhead sea turtles (*Caretta caretta*) are characterized by a large head with blunt jaws. Their shell and flippers are a reddish-brown color. Loggerhead sea turtles typically occur over the continental shelf and in bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers (NMFS and USFWS 2008). Nesting primarily occurs from about May to August on barrier islands adjacent to continental landmasses in warm-temperate and sub-tropical waters (NMFS and USFWS 2008). Nest sites are typically located on high-energy, open sandy beaches above the mean high tide and seaward of well-developed dunes (NMFS and USFWS 2008). Threats to this species include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; disease; and incidental take from commercial trawling, long line, and gill net fisheries. These sea turtles nest on the beaches at Cape Sable, but no suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA Fisheries for construction projects.

3.7.1.12 Green Sea Turtle.

The green turtle (*Chelonia mydas*) grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, single-clawed flippers, and its color varies. The nesting season is approximately June to September (USFWS 2016g). The green sea turtle is dependent upon three basic habitat types: high-energy beaches for nesting; open sea habitats as juveniles, and benthic feeding grounds (i.e., seagrass meadows) as adults. In the southeastern US, green sea turtle forage in shallow coastal and estuarine waters with an abundance of macroalgae or seagrass. Green sea turtles have strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches. Threats to this species include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations (USFWS 2016g). No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA Fisheries for construction projects.

3.7.1.13 Hawksbill Sea Turtle.

The hawksbill sea turtle (*Eretmochelys imbricata*) is a small to medium-sized animal with an elongated oval shell, a relatively small head, a distinctive hawk-like beak, and flippers with two claws. General coloration is brown with numerous splashes of yellow, orange, or reddish-brown on the shell. Nesting typically occurs between April and November and may occur on almost any undisturbed deep-sand beach in the tropics (USFWS 2016h). In contrast to all other sea turtle species, hawksbills nest in low densities on scattered small beaches. Hawksbills inhabit coastal reefs, bays, rocky areas, estuaries, and lagoons and are generally found at depths of 70 feet or less. They typically forage on coral reefs, although hawksbills may also occupy other hard-

bottom communities and occasionally mangrove-fringed bays (USFWS 2016h). Threats to this species include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA Fisheries for construction projects.

3.7.1.14 Kemp's Ridley Sea Turtle.

The Kemp's Ridley sea turtle (*Lepidochelys kempii*) is the smallest of the sea turtles, with adults reaching about 2 feet in length and weighing up to 100 pounds (USFWS 2016i). The adult Kemp's Ridley has an oval shell that is almost as wide as it is long and is usually olive-gray in color. They inhabit shallow coastal and estuarine waters over sand or mud bottoms. This turtle is a shallow water benthic feeder with a diet consisting primarily of crabs (USFWS 2016i). Adults are restricted to the Gulf of Mexico; however, the pelagic juveniles also occur in the Atlantic Ocean (USFWS 2016i). The preferred sections of nesting beach are backed up by extensive swamps or large bodies of open water having seasonal, narrow ocean connections. The decline of this species is primarily due to human activities, including the direct harvest of adults and eggs and incidental capture in commercial fishing operations. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA Fisheries for construction projects.

3.7.1.15 Leatherback Sea Turtle.

Leatherback sea turtles (*Dermochelys coriacea*) are the largest, deepest diving, most migratory, and widest ranging of all sea turtles. Adults reach four to eight feet long and 500 to 2,000 pounds in weight. Nesting occurs from February to July with sites located from Georgia to the US Virgin Islands. Of all the sea turtles, the leatherback spends the most time in the open ocean, entering coastal waters only when nesting and/or feeding. No designated critical habitat for the leatherback is located within EVER. Adult females require sandy beaches for nesting backed with vegetation and sloped sufficiently so the crawl to dry sand is not too far. The preferred beaches have proximity to deep water and generally rough seas (NOAA Fisheries 2007a). Threats to this species include loss or degradation of nesting habitat from coastal development; disorientation of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; and watercraft strikes. No suitable nesting habitat exists within the project limits. Sea turtle protection measures have been established by NOAA Fisheries.

3.7.1.16 Smalltooth Sawfish.

The smalltooth sawfish can exist both in saltwater and freshwater, tending to prefer fairly shallow water with muddy or sandy bottoms such as rivers, streams, lakes, creeks, bays, lagoons, and estuaries. In the US, smalltooth sawfish (*Pristis pectinate*) are generally shallow water marine fish of inshore bars, mangrove edges, and seagrass beds. Very small individuals maintain fidelity to shallow mud or sand banks in water less than one foot deep for extensive periods of time (Simpfendorfer 2003). Small and very small individuals also utilize red mangrove prop root habitats especially during periods of high tide (Simpfendorfer 2005).

Smalltooth sawfish are generally found in shallow water throughout the northern Gulf of Mexico. Adult smalltooth sawfish are opportunistic feeders and subsist chiefly on whatever small schooling fish may be abundant locally, such as mullets and clupeids, and various crustacean species. They are generally 2 feet long at birth and may grow to a length of 18 feet.

Over the past century, the population of smalltooth sawfish has been reduced by fishing, habitat alteration, and habitat degradation. Currently smalltooth sawfish are only found with regularity in the lagoons, bays, mangroves, and nearshore reefs in south Florida from Charlotte Harbor to Florida Bay (Simpfendorfer 2005). Today, recreational catches of sawfish are very rare and, for the most part, poorly documented except within the park. Surveys in the EVER indicate that a sustaining population still exists there, with consistent annual catches by private recreational anglers and guide boats (NOAA 2000).

The US distinct population of smalltooth sawfish was listed as federally endangered on April 1, 2003 (68 FR 15674). On November 20, 2008 (73 FR 70290) NOAA Fisheries proposed to designate critical habitat for the US distinct population of smalltooth sawfish. The proposed critical habitat is located in southwest Florida and consists of two units: the Charlotte Harbor Estuary Unit and the Ten Thousand Islands/Everglades Unit which includes the Cape Sable project area. Smalltooth sawfish protection measures have been created by NOAA Fisheries for in-water construction projects to ensure that no adverse impacts to this species occur.

3.7.1.17 State-Listed Species.

The state of Florida lists a variety of plant and animal species as endangered, threatened, species of special concern, or commercially exploited (Title 28, F.S. Section 372.072). “Commercially exploited” plants are defined as native species which are subject to being removed in substantial numbers and sold or transported for sale (F.S. Section 581.185).

3.7.1.17.1 Animals

State listed species are protected by Chapter 68A-27 of Florida’s Administrative Code. The FACE list includes 146 animal species - 32 mammals, 36 birds, 24 reptiles, 6 amphibians, and 14 species of fish (see **Table 3.14**; FWC 2016c).

These species are defined as follows:

- “Endangered species” are defined as any species of fish and wildlife naturally occurring in Florida, whose prospects of survival are in jeopardy due to modification or loss of habitat; over utilization for commercial, sporting, scientific, or educational purposes; disease; predation; inadequacy of regulatory mechanisms; or other natural or manmade factors affecting its continued existence.
- A “threatened species” is any species of fish and wildlife naturally occurring in Florida which may not be in immediate danger of extinction, but which exists in such small populations as to become endangered if it is subjected to increased stress as a result of further modification of its environment.
- A “species of special concern” is defined as a population which warrants special protection, recognition, or consideration because it has an inherent significant vulnerability to habitat modification, environmental alteration, human disturbance, or substantial human exploitation which, in the foreseeable future, may result in its becoming a threatened species.

TABLE 3.14 - STATE-LISTED ANIMAL SPECIES WITH POTENTIAL TO OCCUR IN AND AROUND THE CAPE SABLE STUDY AREA

Common Name	Scientific Name	State Status
Brown pelican	*Pelecanus occidentalis*	Species of Special Concern
The brown pelican is a large, brown water bird, with a white head and neck. Young brown pelicans have a gray head and neck and white underbelly. This species reaches up to 8 pounds and has a wingspan of over 7 feet. In Florida, brown pelicans are widespread along the coast; they nest in colonies on coastal islands. Nests are generally built in mangrove trees. The eastern subspecies nests in early spring or summer. Brown pelicans are commonly observed in the Lake Ingraham area. It is protected by the MBTA.		
Little blue heron	*Egretta caerula*	Species of Special Concern
The little blue heron is a small wading bird found along the Atlantic coast but is most abundant along the Gulf of Mexico. This species ranges up to 30 inches in height and has a wingspread of 3 feet. Adults have a purple head and neck, with a slate-gray body. The long neck is held in an "S" curve at rest and in flight. Young are white, with a blue bill and green legs. Their diets primarily consist of fish, insects, shrimp, and amphibians. Little blue herons feed alone, usually along freshwater systems and on floating vegetation. The long bill is used to jab and eat the prey. Little blue herons inhabit fresh, salt, and brackish water environments in Florida including swamps, estuaries, ponds, lakes, and rivers (Rodgers 1995). Little blue herons are common throughout the Cape sable area. It is protected by the MBTA.		
Reddish egret	*Egretta rufescens*	Species of Special Concern
The reddish egret, which is rare in the Cape Sable region, breeds in scattered areas along the Gulf of Mexico, the Caribbean, and west Mexico. Reddish egrets stand about 30 inches tall and have a wingspan of 4 feet. They construct nests on mangrove keys and dredge spoiled islands atop a platform of sticks located 10 to 20 feet above the ground in bushes or trees. In the early 1900s, most populations of reddish egrets were exterminated by plume hunters. Protection from plume hunters has helped reestablish populations, but coastal development is now a current threat to their survival. It is protected by the MBTA.		
Snowy egret	*Egretta thula*	Species of Special Concern
The snowy egret is a small white heron, about 2 feet tall, with a 3-foot wingspan, and weighing just less than 1 pound. This species is distinguished by its white body, black bill and legs, and bright yellow feet. Both male and female have the same coloring. Snowy egrets breed in shared colonies in salt marshes, ponds, and shallow bays. Prey includes aquatic organisms such as shrimp, fish, frogs, and insects. They forage by walking slowly or standing motionless and striking at the prey. The species was reduced from common to rare by 20th century plume hunting. Snowy egrets commonly prefer shallow estuarine areas including mangroves, shallow bays, saltmarsh pools, and tidal channels (Parsons and Master 2000). Snowy egrets are extremely common throughout the Cape Sable area. It is protected by the MBTA.		
Tricolored heron	*Egretta tricolor*	Species of Special Concern
The tricolored heron is a wading bird found from Massachusetts to the Gulf Coast. Reaching 30 inches in height, and weighing up to one pound, its slate-gray plumage is complemented by a white belly and a white chin stripe. During most of the year, the bill is yellow with a black tip and its legs are yellow. During mating season, the bill turns bright blue and the legs are bright pink. Its diet consists primarily of fish. This species usually breeds in brackish and saltwater coastal areas, in mixed colonies with other herons. Nests are close to the ground. Tricolored herons are widespread, permanent residents in Florida and are common throughout the Cape sable area. It is protected by the MBTA.		
White ibis	*Eudocimus albus*	Species of Special Concern
The white ibis is a medium-sized wading bird. Its feathers are entirely white, except for dark wing		

Common Name	Scientific Name	State Status
tips. The face is bare and pink, blending into a long, curved bill. It has long pink legs and webbed toes. Barriers, marshes, coastal islands, and inland lakes are the preferred habitat and nesting sites. White ibis probe for aquatic crustaceans and insects using their bill. White ibis are found throughout Florida and are common in the Cape Sable study area. They are threatened by loss of wetland habitat and are protected by the MBTA.		
Roseate spoonbill	*Ajaia ajaja*	Species of Special Concern
Roseate spoonbills are found in the coastal marshes, mudflats, and mangrove keys from Florida to coastal Texas. These large wading birds stand almost 3 feet tall and have a wingspan in excess of 4 feet. The term “roseate” refers to the brilliant pink color of the adult bird. To feed, roseate spoonbills immerse their large spoon-shaped bill in water and swing their heads from side to side. Their diet consists of small fishes, crustaceans, mollusks, slugs and aquatic insects. Roseate spoonbills often nest in rookeries with herons, ibis, and other wading birds. They construct their nests of sticks, in trees or bushes, 5 - 15 feet off the ground. Early in the 20th century, this species was depleted by the feather trade. Since protective laws have been enacted in Florida, their numbers have risen. Roseate spoonbills commonly utilize the tidal flats for feeding in the vicinity of the study area. They nest on islands in Florida Bay and are protected by the MBTA.		
Osprey	*Pandion haliaetus*	Species of Special Concern
The project area is inhabited by the osprey, a large, long-winged raptor that is brown above, white below, and has a white head with a dark eye stripe. The wing has a distinctive bend at the "wrist" and from a distance would resemble a gull. This species ranges from Alaska eastward to Newfoundland and south to Arizona and Florida. They inhabit suitable nesting sites along large lakes, rivers, and coastal areas. They fish by hovering over the water; when they sight prey then dive talons first into the water. The nest is a mass of sticks and debris placed in large living or dead trees and man-made structures. Low nesting sites are common, particularly in mangrove swamps. The use of pesticides devastated osprey populations as they declined dramatically in the 1950s and 1960s, but since then the species has recovered substantially. They are protected by the MBTA.		
White crowned pigeon	*Columba leucophala*	Species of Special Concern
The white crowned pigeon are permanent residents in Florida, but their population numbers are highly seasonal. In south Florida, the white-crowned pigeon is common in summer and uncommon in winter. The birds feed in hardwoods, such as fig, pigeon plum, poisonwood, and other fruit-bearing trees. Nesting on mainland Florida is rare; more than half of the Florida population nests in Florida Bay, in EVER. They prefer low-lying forest habitats with ample fruiting trees. Nesting requires mangrove covered islands that are free of raccoons and human disturbance. The diet of the white-crowned pigeons primarily consists of tropical hardwood tree fruits. These areas are found on artificial high ground such as the slightly elevated relict soil banks adjacent to the canals. White-crowned pigeons also face threats to their food supply as tropical hammocks continue to be destroyed in the Keys. They are protected by the MBTA.		
Mangrove rivulus	*Rivuulus marmoratus*	Species of Special Concern
Mangrove rivulus are small, slender, dark brown to green in color with speckles of orange and black. They are found throughout the Caribbean and along both coasts of south/central Florida. They are amphibious fish with rounded fins to propel them through the water and a tail fin that helps them to flip on land. Mangrove rivulus eat smaller fish, crabs, insects, snails, and worms. Mangrove rivulus are usually found in mangrove forests, particularly in stagnant pools. Within the Everglades, this fish occurs in stagnant seasonal ponds over marly muck, sloughs, and mosquito ditches within mangrove habitats. Mangrove rivulus in Florida are listed as a Species of Concern due to vulnerability to habitat degradation and alteration, development, and mosquito control impoundment construction.		

Common Name	Scientific Name	State Status
Gopher tortoise	*Gopherus polyphemus*	Species of Special Concern
Gopher tortoises are long-lived reptiles that occupy upland habitat throughout Florida including forests and pastures. They prefer dry, sandy uplands, such as oak-sandhills, scrub, pine flatwoods and coastal dunes of the southeastern United States. Gopher tortoises have shovel-like front legs that help them to dig, and their back legs are strong and sturdy. Gopher tortoises grow to be up to 15 inches long and weigh from eight to 15 pounds. They dig deep burrows for shelter and forage on low-growing plants. Habitat destruction is a significant threat to gopher tortoises. Threats to the gopher tortoise also include habitat fragmentation and degradation.		

3.7.1.17.2 Plants

The Florida Department of Agriculture and Consumer Services (FDACS), Division of Plant Industry identifies the list of Florida's native plants that are most in need of conservation efforts includes 441 endangered, 118 threatened and eight commercially exploited species (FDACS 2015). Forty-nine of these species are on the federal list of endangered plant species and 11 are on the federal list of threatened species. The Florida Endangered Plant Advisory Council (EPAC) reviews these lists each year to make needed changes.

These species are defined as follows:

- "Endangered plants" means species of plants native to Florida that are in imminent danger of extinction within the state, the survival of which is unlikely if the causes of a decline in the number of plants continue, and includes all species listed as endangered or threatened by the state of Florida Rule 5B-40 or endangered or threatened by the ESA.
- "Threatened plants" means species native to the state that are in rapid decline in the number of plants within the state, but which have not decreased so much as to cause them to be endangered.
- "Commercially exploited plants" means species native to the state that are subject to being removed in significant numbers from native habitats in the state and sold or transported for sale.

Botanical surveys were conducted at both Slagle and House Ditch plug sites as well as Raulerson Canal on January 20, 2015. A small population of *Evolvulus convolvuloides* (State Endangered) was observed and vouchered at Slagle Ditch by an EVER botanist. Site-specific surveys for state listed plant species have not been carried out in the remainder of the project area.

However, according to the FDACS, statutory protection of state-listed plants is not applicable if the clearing of land is performed by a public agency (such as the NPS) when acting in the performance of its obligation to provide service to the public (Section 581.185(8) F.S.). However, individual state-listed plant species (as listed in Rule 5B-40.0055 F.A.C.) would be avoided wherever possible during construction using best management practices.

3.7.2 Environmental Consequences

3.7.2.1 Assumptions, Methodology, and Intensity Thresholds.

The NPS both proactively conserves ESA-listed species and prevents detrimental effects on these and other native species that are of special management concern to parks such as rare, declining, sensitive, or unique species and their habitats (NPS 2006). As previously discussed, Section 7 of the ESA requires that a federal agency consult with the USFWS and/or NOAA Fisheries on any action that has the potential to affect endangered or threatened species or that may result in adverse modification of critical habitat.

The USFWS and NOAA Fisheries guidance for implementing Section 7 consultation under the ESA uses the following terminology to assess impacts to listed species (USFWS NMFS 1998):

- **"No effect"** – the appropriate conclusion when the action agency determines its proposed action would not affect a listed species or designated critical habitat."

- "**Is not likely to adversely affect"** – the appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. **Beneficial effects** are contemporaneous positive effects without any adverse effects on the species. **Insignificant effects** relate to the size of the impact and should never reach the scale where take occurs. **Discountable effects** are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect or evaluate insignificant effects; or (2) expect discountable effects to occur."

- **"May affect"** - the appropriate conclusion when a proposed action may pose any effects on listed species or designated critical habitat. When the federal agency proposing the action determines that a "may affect" situation exists, then they must either initiate formal consultation or seek written concurrence from the Services that the action "is not likely to adversely affect."

- "**Is likely to adversely affect"** – the appropriate finding in a biological assessment (or conclusion during informal consultation) if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial (see definition of "is not likely to adversely affect"). In the event the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made. An "is likely to adversely affect" determination requires the initiation of Section 7 consultation."

Based on this, the impact thresholds for threatened and endangered species are as follows:

- *Negligible:* There would be no observable or measurable impacts to federally listed species, their habitats, or the natural processes sustaining them in the proposed project area. This impact intensity would equate to a determination of "**no effect**" under Section 7 of the ESA.
- *Minor:* Individuals may temporarily avoid areas. Impacts would not affect critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat. This impact intensity would equate to a determination of "**may affect, not likely to adversely affect**" under Section 7 of the ESA.

- *Moderate:* Individuals may be impacted by disturbances that interfere with critical periods (e.g., breeding, nesting, denning, feeding, resting) or habitat; however, the level of impact would not result in a physical injury, mortality, or extirpation from the park. This impact intensity would equate to a determination of "**likely to adversely affect**" under Section 7 of the ESA.
- *Major:* Individuals may suffer physical injury or mortality or populations may be extirpated from the park. This impact intensity would equate to a determination of "**likely to adversely affect**" under Section 7 of the ESA.

3.7.2.2 Impacts of the Alternatives.

NPS will initiate Section 7 consultation with the USFWS and the NOAA Fisheries with the submittal of this EA to these agencies for review during the public comment period. Initial comments have been received from the NOAA Fisheries through the Public Scoping process (see Section 4). If NPS determines that any federally listed plant or animal species would be directly impacted by the selected alternative, consultation with USFWS would occur.

3.7.2.2.1 No Action Alternative

1) Analysis. Under the No Action Alternative, no construction would take place and current conditions would persist. There would be no direct adverse effect from construction on federally listed species or their habitat.

Taking no action to address the issues associated with the continuing erosion at House and Slagle Ditches and failed earthen plug at Raulerson Canal would only prolong the impacts on erosional processes within these waterways and the greater Cape Sable area. The open tidal exchanges through Raulerson Canal have influenced general ecological conditions in the area, including critical wildlife populations north of the marl ridge. Loss of freshwater has accelerated the change from brackish or freshwater wetlands to a brackish or marine ecosystem. Juvenile crocodiles require nearby waters of lower salinity to thrive. Intruding salt water separates higher nesting areas from suitable habitat required by young crocodiles. Fresh to brackish water systems produce more abundant stocks of small prey fish and invertebrates than marine systems and these species are food for wading birds (e.g., rosette spoonbills, wood storks), crocodiles, and large game fish.

However, taking no action to address the issues associated with the eroding plugs at House and Slagle Ditches and failed plug on Raulerson Canal would only prolong the impacts on erosional processes within these waterways and the greater Cape Sable area. These processes would continue to act at current or potentially increasing rates. Related erosion and ditch/channel widening would continue as a result of the daily influx of tidal waters moving via the waterways. Soil would continue to be lost and wetlands would continue to convert to a mosaic of mangrove communities with saline open water habitats. Other impacts specific to federally listed species are discussed below.

3.7.2.2.1.1 American Crocodile

Related erosion and ditch/channel widening would result in the potential for continued loss of American crocodile nesting habitat along the banks of the waterways. Increasing salinity in the

southern interior wetlands would adversely affect juvenile American crocodiles which require low salinity levels for survival. Though adults are tolerant of a wide salinity range because of their ability to osmoregulate, juvenile crocodiles lack this ability (Mazzotti and Dunson 1989). Hatchling crocodiles are particularly susceptible to osmoregulatory stress and may need to have brackish to freshwater available at least once per week to increase growth (Mazzotti et al. 1989). Therefore, the No Action Alternative may adversely affect the American crocodile.

3.7.2.2.1.2 Florida Panther

The House and Slagle Ditches and Raulerson Canal project areas are located outside of the Panther Focus Area. Although no evidence has been found of panthers inhabiting the wetlands of the Cape Sable area, the panther has the potential to occur within the area. Therefore, due to the potential for loss of habitat from the continuing erosional processes of the canals/ditches, the No Action Alternative **may affect, but is not likely to adversely affect** the Florida panther.

3.7.2.2.1.3 West Indian Manatee

House and Slagle Ditches and Raulerson Canal are tidally connected to the waters of Florida Bay and the Gulf of Mexico therefore the potential for manatees to occur within the project area exists. There is a minimal potential for manatees to become injured by the existing failed earthen plug at Raulerson Canal. However, the existing conditions allow the manatees passage through the canals. This alternative is expected to have minimal adverse impact on manatees. Therefore, the No Action Alternative **may affect, but is not likely to adversely affect** manatees.

3.7.2.2.1.4 Wood Stork

USFWS database records (2015) indicate that the proposed projects are located within the wood stork's core foraging area (CFA) for three active nesting locations (Eastern River Nest – 13.63 miles North, Cuthbert Lake Nest – 16.57 miles North and Pavrotis Pond Nest – 17.01 miles North), meaning that one or more active nesting colonies are located nearby. Under the No Action Alternative, the interior Cape Sable wetlands have the potential over the long term to degrade in ecological quality (see Section 3.4.2). Therefore, the No Action Alternative **may affect, but is not likely to adversely affect** the wood stork.

3.7.2.2.1.5 Red Knot

The potential exists for the red knot to occur within the project area. Under the No Action Alternative, the interior Cape Sable wetlands have the potential over the long term to degrade in ecological quality. Therefore, the No Action Alternative **may affect, but is not likely to adversely affect** the red knot.

3.7.2.2.1.6 Bald Eagle

The potential exists for the bald eagle to occur within the project area. It is most commonly seen along coasts and near other large bodies of open water with an abundance of fish. Although the

No Action Alternative would not directly impact the bald eagle, the continued degrading of the Cape Sable wetlands would adversely affect this species' habitat. Therefore, the No Action Alternative **may affect, but is not likely to adversely affect** the bald eagle.

3.7.2.2.1.7 Roseate Tern

As discussed, the roseate tern is a coastal species and is usually observed foraging in nearshore surf; no suitable nesting habitat exists within the project areas. Since the project locations lack the preferred habitat, there is a relatively low potential for the No Action Alternative to impact the roseate tern. Therefore, the No Action Alternative is expected to have **no effect** on the roseate tern.

3.7.2.2.1.8 Snail Kite

As previously discussed, the snail kite depends directly on the hydrology and water quality of south Florida watersheds and is sensitive to the loss or degradation of wetlands. Under the No Action Alternative, the continued degradation of wetland habitat has the potential to adversely impact this species. Therefore, the No Action Alternative **may affect, but is not likely to adversely** the snail kite.

3.7.2.2.1.9 Florida Bonneted Bat

The habit for the Florida bonneted bat includes forests, wetlands, and other natural habitats (NPS 2016e). The No Action Alternative could degrade potential wetland habitat for this species. However the proposed project areas are located outside the limits of both the Consultation Area and the Focal Area for this species. In addition, the project locations lack the preferred habitat and there is a relatively low potential for the No Action Alternative to impact the Florida bonneted bat. Therefore, the No Action Alternative is expected to have **no effect** on the Florida bonneted bat.

3.7.2.2.1.10 Eastern Indigo Snake

The project areas consist of large expanses of wetland, which are not particularly attractive as habitat to this snake. Because the project areas lack the preferred habitat, there is a relatively low potential for the eastern indigo snake to occur within the project areas. Implementation of No Action Alternative is not anticipated to adversely affect this species. Therefore, the No Action Alternative is expected to have **no effect** on the Eastern indigo snake.

3.7.2.2.1.11 Loggerhead Sea Turtle

Loggerhead turtle nest sites are typically located on high-energy, open sandy beaches above the mean high tide and seaward of well-developed dunes; no suitable nesting habitat exists within the project areas. Since the project locations lack the preferred habitat, there is a relatively low potential for the No Action Alternative to impact the loggerhead turtle. Implementation of this alternative is not anticipated to adversely affect this species. Therefore, the No Action Alternative is expected to have **no effect** on the loggerhead sea turtle.

3.7.2.2.1.12 Green Sea Turtle

Green sea turtles might temporarily utilize habitat within the project area; however, no suitable nesting habitat exists within the project limits. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the green sea turtle. Implementation of the No Action Alternative is not anticipated to adversely affect this species. Therefore, the No Action Alternative is expected to have **no effect** on the green sea turtle.

3.7.2.2.1.13 Hawksbill Sea Turtle

No suitable nesting habitat for the Atlantic hawksbill turtle exists within the project areas. Since the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the Atlantic hawksbill sea turtle. Implementation of the No Action Alternative is not anticipated to adversely affect this species. Therefore, the No Action Alternative is expected to have **no effect** on the hawksbill sea turtle.

3.7.2.2.1.14 Kemp's Ridley Sea Turtle

Kemp's Ridley sea turtles might temporarily forage in the open water areas in the vicinity of the proposed project; however, no suitable nesting habitat exists within the project limits. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the Kemp's Ridley sea turtle. Implementation of the No Action Alternative is not anticipated to adversely affect this species. Therefore, the No Action Alternative is expected to have **no effect** on the Kemp's Ridley sea turtle.

3.7.2.2.1.15 Leatherback Sea Turtle

Leatherbacks may temporarily forage in the open water areas in the vicinity of the proposed projects; however, no suitable nesting habitat exists within the project areas. Since the project areas lack suitable nesting habitat, there is a relatively low potential for this alternative to impact the leatherback sea turtle. Implementation of the No Action Alternative is not anticipated to adversely affect this species. Therefore, the No Action Alternative is expected to have **no effect** on the leatherback sea turtle.

3.7.2.2.1.16 Smalltooth Sawfish

The potential exists for the smalltooth sawfish to occur within the project area. Without rehabilitating the plugs and current conditions would persist, saltwater would continue to encroach into the interior Cape Sable wetlands and surrounding areas, which serve as critical habitat for this species. The continuation of saltwater intrusion, sedimentation in Lake Ingraham from the existing tidal flushing, and loss of freshwater through the eroded plugs at House and Slagle Ditches and failed plug at Raulerson Canal would essentially enhance the proliferation of red mangrove growth in the interior wetlands which is the preferred habitat for juvenile sawfish. Therefore, the No Action Alternative may is expected to have **no effect** on this species.

2) Climate Change and Sea Level Rise. Most special status species would be negatively impacted by continuing the existing conditions as it would increase the amount and duration of saltwater in the interior wetlands of Cape Sable over the long term.

3) Conclusion. Under the No Action Alternative, no construction would take place and current conditions would persist. There would be no direct adverse effect from construction on federally listed species or their habitat; however taking no action to address the issues associated with the continuing erosion at House and Slagle Ditches and failed earthen plug at Raulerson Canal would only prolong the impacts on erosional processes within these waterways and the greater Cape Sable area. The No Action Alternative may potentially result in long-term minor to moderate adverse impacts to the American crocodile and other species and their habitats within the local project area.

3.7.2.2.2 Action Alternatives: Alternative 2: Re-backfill Eroded Plug Areas at House and Slagle Ditches; Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection; Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection; and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. Impacts to the majority of federally listed species and impacts to species of special concern as a whole would be nearly identical under each of the action alternatives. Each of the federally listed species with the potential to occur in the project areas would benefit from improved hydrologic conditions and reduced saltwater intrusion. The Action Alternatives would address the issues associated with the eroding plugs at House and Slagle Ditches and failed sheetpile plug on Raulerson Canal and would result in reducing the erosional processes within these waterways and the greater Cape Sable area. For each of the species below, Construction activities could affect the individual's behavior, causing them to avoid the project areas. However, such impacts would be minimal (affecting a relatively small area), temporary (lasting only for the duration of construction), and are not expected to jeopardize the continued existence of the species within the greater Cape Sable area. No measurable long-term effects are anticipated during operation of these facilities. Other impacts specific to federally listed species are discussed below.

3.7.2.2.2.1 American Crocodile

The implementation of the Action Alternatives would provide a beneficial impact to the crocodiles by reducing the saltwater intrusion into the interior wetlands. The limitation of saltwater intrusion would have a beneficial long-term effect on juvenile crocodile growth and survival. Short-term impacts would consist of temporary disruption of feeding during construction. Construction activities for the proposed project would be limited to the months of October through February, during which no American crocodile nesting activity is expected to occur. In addition, reduced salinity in the restored area is not anticipated to negatively impact

crocodiles. Therefore, due to the limiting construction timeframe of work not being performed during the nesting season, the proposed project **may affect but is not likely to adversely affect** the American crocodile (refer to the above discussion relating to potential impacts to designated Critical Habitat of the American crocodile for additional details).

American Crocodile Critical Habitat. Erosion and channel widening has resulted in the loss of American crocodile nesting habitat along the banks of the Raulerson Canal and will likely begin to occur along House and Slagle Ditches if erosion of the existing plugs is not repaired. Increasing salinity in the southern interior wetlands is also potentially adversely affecting juvenile American crocodiles, which require low salinity levels for survival. Though adults are tolerant of a wide salinity range because of their ability to osmoregulate, juvenile crocodiles lack this ability. The construction of the plug along the Raulerson Canal would result in a disturbance/alteration of approximately 200 linear feet of potential crocodile nesting habitat on each side of the canal. However, this habitat would be replaced with new habitat within the fill area along the plug. Additionally, by constructing the plug structures, saltwater intrusion into the interior wetlands would be limited to overtopping during high water events. Limiting saltwater intrusion would have a beneficial long-term effect on juvenile crocodile growth and survival. Thus, the Action Alternatives would result in beneficial effects to the designated critical habitat of the American crocodile. In addition, impacts to the critical habitat of the crocodile are insignificant; approximately 0.000006% of designated critical habitat would be affected.

3.7.2.2.2.2 Florida Panther

The House and Slagle Ditches and Raulerson Canal project areas are located outside of the Panther Focus Area. However, the panther does have the potential to occur within the project area. Anecdotally NPS biologists have reported a panther sighting near Slagle Ditch. However, the Florida panther has been infrequently sighted by biologists in the Cape Sable region and its occurrence is believed to be extremely rare and seasonal in nature (M. Parry, personal communication). Therefore, due to the potential for loss of habitat from the continuing erosional processes of the canals/ditches, the Action Alternatives **may affect, but is not likely to adversely affect** the Florida panther.

3.7.2.2.2.3 West Indian Manatee

House and Slagle Ditches and Raulerson Canal are tidally connected to the waters of Florida Bay and the Gulf of Mexico therefore the potential for manatees to occur within the project area exists. Although portions of the ditches/canal would be disturbed by each of the proposed action alternatives, the FWC's standard manatee protection measures would be utilized prior to and during all in-water construction activities to ensure that no adverse impacts to the West Indian manatee would result. Manatees would not become trapped in the wetlands behind the plug since there are multiple natural channels through the marl ridge that provide access to Lake Ingraham and Florida Bay (e.g., East Side Creek). In addition, the reduction of illegal motorized boaters moving through the Raulerson Canal would result in long-term beneficial effects to the manatees, reducing the risk of injury or death due to boat collisions. Therefore, the implementation of the Action Alternatives **may affect, but is not likely to adversely affect** this species.

3.7.2.2.2.4 Wood Stork

USFWS database records (2015) indicate that the proposed projects are located within the wood stork's CFA for three active nesting locations (Eastern River Nest - 13.63 miles North, Cuthbert Lake Nest – 16.57 miles North, and Pavrotis Pond Nest – 17.01 miles North), meaning that one or more active nesting colonies are located nearby. To minimize adverse effects to the wood stork due to loss of wetlands or CFA, the USFWS recommends that any lost foraging habitat be replaced within the CFA of the affected nesting colonies. Since these proposed activities are part of a habitat restoration effort, the resulting conditions would be expected to enhance the habitat potential for the wood stork (i.e., lessen the rates of saltwater intrusion). Therefore, it has been determined that the implementation of the Action Alternatives **may affect, but is not likely to adversely affect** the wood stork.

3.7.2.2.2.5 Red Knot

The potential exists for the red knot to occur within the project area. Although the proposed plug sites may provide foraging habitat for the red knot, the project will not significantly reduce available foraging. Also, since no nesting habitat was observed within the project limits for the red knot, the project is not anticipated to impact any nesting habitat. However, since this species has the potential to occur within the project limits, the Action Alternatives **may affect, but is not likely to adversely affect** the red knot.

3.7.2.2.2.6 Bald Eagle

The potential exists for the bald eagle to occur within the project area. This species is most commonly seen along coasts and near other large bodies of open water with an abundance of fish. The bald eagle prefers old growth and mature stands of coniferous or hardwood trees for perching, roosting, and nesting. The bald eagle would benefit from the plug restoration activities, as it would improve the ecological quality of the waters and wetlands of the greater Cape Sable area. Therefore, the Action Alternatives **may affect, but is not likely to adversely affect** the bald eagle.

3.7.2.2.2.7 Roseate Tern

As discussed, the roseate tern is a coastal species and is usually observed foraging in nearshore surf; no suitable nesting habitat exists within the project areas. Since the project locations lack the preferred habitat, there is a relatively low potential for the Action Alternatives to impact the roseate tern. Therefore, the Action Alternatives are expected to have **no effect** on the roseate tern.

3.7.2.2.2.8 Snail Kite

The snail kite has the potential to exist within the project areas. As discussed, because of a highly specific diet composed almost entirely of apple snails (*Pomacea paludosa*), survival of the snail kite depends directly on the hydrology and water quality. Under the Action Alternatives the hydrology and water quality of the project areas would directly benefit and the ecological

quality of the wetlands would improve. Therefore, the Action Alternatives **may affect, but is not likely to adversely affect** the snail kite.

3.7.2.2.2.9 Florida Bonneted Bat

The Action Alternatives do not proposed to impact potential roost sites, neither natural (such as tree cavities) nor man-made (buildings, bridges, overpasses and other artificial structures). Further, the project areas are located out of the USFWS-designated Consultation Area as well as outside of the Focal Area. Therefore implementation of the Action Alternatives is not anticipated to adversely affect this species. The Action Alternatives are expected to have **no effect** on the Florida bonneted bat.

3.7.2.2.2.10 Eastern Indigo Snake

The project areas consist of large expanses of wetland, which are not particularly attractive as habitat to this snake. Because the project areas lack the preferred habitat, there is a relatively low potential for the eastern indigo snake to occur within the project areas. Construction activities may be temporarily disruptive to individual snakes; therefore, it is anticipated that any individual snake would relocate away from the construction work zone during construction activities. To avoid and minimize potential impacts, Eastern indigo snake protection measures established by the USFWS would be employed during all construction activities. Implementation of the Action Alternatives is not anticipated to adversely affect this species. Therefore, based on the minimal potential for this snake to be present, and the implementation of these protection measures, the Action Alternatives **may affect, but is not likely to adversely affect** the eastern indigo snake.

3.7.2.2.2.11 Loggerhead Sea Turtle

Loggerhead turtle nest sites are typically located on high-energy, open sandy beaches above the mean high tide and seaward of well-developed dunes; no suitable nesting habitat exists within the project areas. Since the project locations lack the preferred habitat, there is a relatively low potential for the Action Alternatives to impact the loggerhead turtle. Also, sea turtle protection measures established by NOAA Fisheries would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, implementation of the Action Alternatives is not anticipated to adversely affect this species. Therefore, the Action Alternatives **may affect but is not likely to adversely affect** the loggerhead sea turtle.

3.7.2.2.2.12 Leatherback Sea Turtle

Leatherbacks may temporarily forage in the open water areas in the vicinity of the proposed projects; however, no suitable nesting habitat exists within the project areas. Since the project areas lack suitable nesting habitat, there is a relatively low potential for these alternatives to impact the leatherback sea turtle. Also, sea turtle protection measures established by NOAA Fisheries would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. Federally designated critical habitat (nearshore reproductive) has been designated within EVER by USFWS for the loggerhead sea turtle. The

critical habitat is located in beach dune communities of East, Middle, and Northwest Cape Sable as well as Highland Beach also within Cape Sable (79 FR 39755). However, none of these areas are located within the project area and the project is anticipated to have no effect on federally designated critical habitat for the loggerhead sea turtle. As a result of these precaution measures, the implementation of the Action Alternatives **may affect, but is not likely to adversely affect** this species.

3.7.2.2.2.13 Hawksbill Sea Turtle

No suitable nesting habitat for the hawksbill turtle exists within the project areas. Since the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the hawksbill sea turtle. Also, sea turtle protection measures established by NOAA Fisheries would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, implementation of Action Alternatives is not anticipated to adversely affect this species. Therefore, the Action Alternatives **may affect, but is not likely to adversely affect** the hawksbill sea turtle.

3.7.2.2.2.14 Kemp's Ridley Sea Turtle

Kemp's Ridley sea turtles might temporarily forage in the open water areas in the vicinity of the proposed project; however, no suitable nesting habitat exists within the project limits. Since the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the Kemp's Ridley sea turtle. Also, sea turtle protection measures established by NOAA Fisheries would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, implementation of the Action Alternatives is not anticipated to adversely affect this species. Therefore, the Action Alternatives **may affect, but is not likely to adversely affect** the Kemp's Ridley sea turtle.

3.7.2.2.2.15 Green Sea Turtle

Green sea turtles might temporarily utilize habitat within the project area; however, no suitable nesting habitat exists within the project limits. Because the project location lacks suitable nesting habitat, there is a relatively low potential for this project to impact the green sea turtle. Also, sea turtle protection measures established by NOAA Fisheries would be employed during all in-water construction activities to ensure that no adverse impacts to this species would occur. As a result of these precaution measures, implementation of the Action Alternatives is not anticipated to adversely affect this species. Therefore, the Action Alternatives **may affect, but is not likely to adversely affect** the green sea turtle.

3.7.2.2.2.16 Smalltooth Sawfish

The potential exists for the smalltooth sawfish to occur within the project areas; therefore construction activities could affect the sawfish's behavior by causing them to avoid the construction areas. However, these impacts can be considered temporary (lasting only for the duration of construction) and are not expected to jeopardize the continued existence of the

smalltooth sawfish within the greater Cape Sable area. Furthermore, standard smalltooth sawfish protection measures, as established by NOAA Fisheries, would be implemented during construction to ensure that no adverse impacts smalltooth sawfish occur.

Smalltooth Sawfish Critical Habitat. NOAA Fisheries recently (2008) designated critical habitat for the endangered smalltooth sawfish. The critical habitat consists of two units: the Charlotte Harbor Estuary Unit, which comprises approximately 221,500 acres of coastal habitat; and the Ten Thousand Islands/Everglades Unit which comprises approximately 619,000 acres of coastal habitat, including the Cape Sable project area. The inundated red mangrove prop-root habitats in and around Cape Sable are designated as critical habitat for the smalltooth sawfish.

It has been documented that juveniles utilize the red mangrove prop root habitats for protection and foraging. Shallow depths and red mangrove root systems are important in helping the endangered smalltooth sawfish avoid predators (Simpfendorfer 2003). As juveniles spend the vast majority of their time on shallow mud or sand banks that are less than 1 foot deep, these very shallow areas are inaccessible to their predators (mostly sharks) and increase the sawfish's survival. Their compressed body shape helps them in inhabiting these shallow areas, and they can often be observed swimming in only a few inches of water. The use of red mangrove prop root habitat is also likely to aid very small sawfish in avoiding predators (Simpfendorfer 2003). The complexity of the red mangrove prop root habitat likely restricts the access of predators and protects the sawfish. Smalltooth sawfish protection measures have been developed by NOAA Fisheries for in-water construction projects to minimize the potential for adverse impacts to this species.

Juvenile smalltooth sawfish prefer to reside under red mangrove prop roots mainly during incoming high tides, especially when the substrate inundation is greater than one foot in depth. Inundation of mangroves along the accessways/waterways is dependent upon the diurnal tidal cycles (two lows and two highs) present in Florida Bay. Utilizing data collected from USGS monitoring stations located in the vicinity of the project along with data from the recent topographic/bathymetric survey, it was determined that complete inundation of the red mangrove prop roots (with an average 10.2 inch prop root height) occurs less than 50% of the time. This data indicates the area may be considered less than optimum habitat for the smalltooth sawfish due to the limitations on habitat availability; specifically, the periods of inundation, or lack thereof.

A survey/assessment of red mangroves and their associated prop root systems was conducted within the footprints of the proposed viable alternative plug sites and accessways/staging areas (where applicable) for Raulerson Canal, House Ditch, and Slagle Ditch. Approximate prop root aerial coverage (diameter or length-by-width) and approximate average height of the prop roots above the substrate were hand measured. The height of the trees and approximate canopy width were also noted.

For Raulerson Canal, a total of 81 red mangrove trees were identified within the footprint of the viable alternative plug location (Location 2) with corresponding cumulative prop root aerial coverage of approximately 1,860 square feet. In addition, along the potential accessway (includes both banks of Little Sable Creek and Raulerson Canal) to the Raulerson Canal plug site, a total of 119 red mangroves were identified which may require removal to facilitate site access (additional red mangroves will require trimming but no impacts to the prop roots are expected to occur). Removal activities will include 80 red mangroves along Little Sable Creek with corresponding cumulative prop root aerial coverage of approximately 755.17 square feet and 39 red mangroves along Raulerson Canal (outside the limits of the proposed footprint of the plug work zone) with corresponding cumulative prop root aerial coverage of approximately 1,182.8 square feet.

For House Ditch, a total of 5 red mangrove trees were identified within the limits of the viable alternative plug site in the vicinity of the eroded earthen berm along the Old Ingraham Highway with corresponding cumulative prop root coverage of approximately 450 square feet. Barge access was not an option for this viable alternative plug site. Access would be obtained through overland routes by helicopter, foot, or other means. No red mangrove tree prop roots are located within the designated helicopter drop area or accessway for this plug.

For Slagle Ditch, a total of 42 red mangrove trees were identified within the limits of the viable alternative plug site in the vicinity of the eroded earthen berm along the Old Ingraham Highway with corresponding cumulative prop root coverage of approximately 1,833.83 square feet. Barge access was not an option for this viable alternative plug site. Access would be obtained through overland routes by helicopter, foot, or other means. No red mangrove tree prop roots are located within the designated helicopter drop area or accessway for this plug.

These impacts will be compensated through the planting of red mangrove trees within the temporarily impacted work zones around the proposed plugs at each of the plug location, where feasible. In addition, the proposed project will result in the enhancement of approximately 55,894 acres of interior wetlands and approximately 1,863 acres of Lake Ingraham, both of which are part of the critical habitat of the smalltooth sawfish. As a result of these measures, the proposed project **may affect, but is not likely to adversely affect** the smalltooth sawfish.

2) Climate Change and Sea Level Rise. Special status species would be adversely impacted by the increasing amount and duration of saltwater in the interior Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short term to intermediate term by the repair/reconstruction of the plug structures. The plugs would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via House and Slagle Ditches and Raulerson Canal. The slowing or postponement of impacts by the restoration and/or re-construction of the plug structures would allow for the interior Cape Sable wetlands to restabilize and recover over time. Further, it would also allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Under the Action Alternatives, any direct adverse effect from construction on federally listed species or their habitat would be temporary in nature. The Action Alternatives would provide indirect long-term beneficial effects to the habitats of federally listed species. The Action Alternatives would not likely adversely affect other special status species.

3.8 WILDERNESS

3.8.1 Affected Environment

The Wilderness Act, passed on September 3, 1964, established a National Wilderness Preservation System, “administered for the use and enjoyment of the American people in such manner as would leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness” (16 USC § 1131).

Congress defined wilderness in section 2(c) of the Wilderness Act as:

> *A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value.*

While Congress defined Wilderness in the Wilderness Act of 1964, the act never formally defined wilderness character, although it is referenced multiple times throughout the Act. In 2008, an interagency team took the definition of wilderness described in the Wilderness Act and developed four qualities of wilderness character that allow park managers to make quantitative judgements of how administrative activities impact wilderness (interagency developed national framework, NPS 2014). This guidance was updated in 2015 (USDA 2015), and has been accepted by all federal land management agencies, including NPS. These four qualities are:

Untrammeled: Wilderness is "an area where the earth and its community of life are untrammeled by man." This quality is a measurement of how "wild" the wilderness is, and is primarily focused on the intentional manipulations of the biophysical environment that are generally broad in scale or impact. This quality is influenced by any activity or action that intentionally controls or manipulates the components or processes of ecological systems inside wilderness. It is supported or preserved when such management actions are not taken" (NPS 2014).

Early in the last century, seven canals/waterways were dug through this marl ridge on Cape Sable in an attempt to drain and reclaim land for development, agriculture, and cattle grazing. Five of these canals/waterways (Homestead Canal, East Cape Canal, Raulerson Canal, and House and Slagle Ditches) were plugged by EVER at the marl ridge with earthen plugs in the 1950s. While the canals and existing plugs are considered intentional manipulations in their own right, those manipulations occurred prior to wilderness designation. The concept of trammeling applies only to manipulations that have occurred since the time of designation because the mandates of the Wilderness Act don't apply prior to designation. Several of the plugs have been replaced since the early 1980s, and are currently located on East Cape Canal and Homestead Canal.

Undeveloped: Wilderness is "an area of undeveloped federal land retaining its primeval character and influence, without permanent improvements or human habitation. " As indicated in the Wilderness Act, wilderness is to be in contrast to other areas of "growing mechanization," and "the imprint of man's work will remain substantially unnoticeable." This quality is influenced by what are commonly called the "section 4(c) prohibited uses." Thus, this quality is degraded by the presence of structures, installations, habitations, and by the use of motor vehicles, motorized equipment, or mechanical transport that increases people's ability to occupy or modify the environment.

The interior of Cape Sable is largely undeveloped. Early in the 20th century, there was an attempt to establish Cape Sable as an agricultural community. A road, parts of which are now the Old Ingraham Highway, extended to East Cape. There were houses, agricultural fields, and a

clubhouse. Most of the development on the Cape was destroyed by the 1929 hurricane, and was never reestablished. EVER was designated by Congress in 1947, and although the park had plans to establish a visitor's center, they never came to fruition.

Current development on the Cape largely consists of visitor and scientific structures. There are several signs on the Old Ingraham Highway, which now extends as far as Clubhouse Beach. There are four campgrounds on Cape Sable, located at Clubhouse Beach, East Cape, Middle Cape, and Northwest Cape. These are unimproved and have no amenities. There are several monitoring stations on Cape Sable. These are small structures which collect hydrologic and biological data. Two plugs were installed in the Homestead and East Cape Canals in 2010-2011. These plugs are vegetated, with a dock on the downstream side for motor boats, and a ramp for canoes and kayaks to access the upstream side. An asphalt path connects the two ends of the plug and is intended as a portage for canoes and kayaks to access the wilderness. Two earthen plugs still exist on House and Slagle Ditches.

Natural: Wilderness is "protected and managed so as to preserve its natural conditions." This quality is affected by intended or unintended effects of modern civilization on the ecological systems inside the wilderness. This means that the indigenous species composition, structures, and functions of the ecological systems in wilderness are protected and allowed to be on their own, without the planned intervention or the unintended effects of modern civilization.
The canals have impacted the ecology of Cape Sable. Once a plug fails, incoming tides would be able to push marine water into the interior Cape Sable wetlands through the canals (Wanless and Vlaswinkel 2005). Outgoing tides drain rainwater from the wetlands north of the marl ridge. The constant tidal action erodes the banks of the canals, quickly increasing the canal cross section and thereby increasing the influence of the canal on interior wetlands. Raulerson Canal has widened five-fold since the plug was breached in 2007 (from 8 to 40 feet).

The canals allow the transport of sediment into and out of the wetlands behind the marl ridge, causing high turbidity and building mud banks in areas of previously open water. An average of 4,000 metric tons of sediment per year is being transported from the interior wetlands of Cape Sable to Florida Bay through East Side Creek (Boudreau and Zucker 2010). Although numbers are not yet available for Raulerson Canal, the concentration of sediment in the water is likely to be similar. In addition to negatively impacting the wetlands of Cape Sable, increased turbidity caused by the erosion impacts the downstream waters (Lee et al. 2002). Sediment transport will increase further as the canal size increases over time.

Increased salinity in the interior wetlands has also reduced the quality of wildlife habitat. American crocodiles, a species protected by the Endangered Species Act, rely on Cape Sable as habitat for significant portions of their life cycle (Mazzotti et al. 2007). Cape Sable is one of the most significant nesting areas for crocodiles in south Florida (Mazzotti et al. 2007). High salinity in interior wetlands reduces habitat suitability for juvenile crocodiles (Kushlan and Mazzotti 1989b). Even temporarily improved salinity conditions could enable a long-term recovery of the species. Crocodile nesting in the East Cape Canal area increased following plugging of East Cape Canal (Mazzotti et al. 2007). More research is needed to determine the extent that each of these factors influences crocodile nesting success.

Seawater incursions, loss of freshwater, sedimentation in the lakes and wetlands, and tidal action have caused physical and chemical changes that are compromising the function of coastal habitats for endangered species, recreational fishes, and other plants and animals that depend on Cape Sable for survival. Rising sea level will significantly impact biological resources on Cape Sable over the life of this project. However, restoring the function of the marl ridge by plugging the man-made canals will enhance community resilience by slowing the rate of change early in

the process. As the canals on Cape Sable continue to widen, the rate of change is expected to accelerate further, emphasizing the need for timely corrective action.

Solitude or Primitive and Unconfined Recreation: Wilderness is an area which "has outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is comprised of 3 sub-parts: (1) opportunities for solitude, (2) opportunities for primitive recreation, and (3) opportunities for unconfined recreation. This quality concerns the opportunity for people to experience wilderness, and is impacted by settings that affect these opportunities including recreational facilities, motorized transportation, and other signs of civilization.

Cape Sable is very remote region of EVER. It is primarily reachable from Flamingo, which is located 38 miles from the entrance of the park. The interior regions are accessible to canoeist and kayakers, with many fishermen accessing the backcountry. There are four primitive campgrounds on Cape Sable. The Clubhouse Beach campground is at the western extent of the Old Ingraham Highway, one of the few wilderness hiking trails in EVER. The plug at Slagle Ditch acts as a bridge on the Old Ingraham Highway, allowing hikers to cross the ditch. All of the campgrounds can also be accessed by motor boats, since Florida Bay and the Gulf Coast are submerged wilderness. Two additional plugs at Homestead and East Cape Canals include motorboat docks on the downstream side and canoe/kayak ramps on the upstream side. While these features facilitate the opportunity for primitive recreation in the interior of Cape Sable, they are considered agency-provided recreation facilities in wilderness, and impact the experience and settings visitors associate with the wilderness.

The sounds from marine boats and helicopter activities affect the qualities of solitude. The proposed plug locations are on the edge of wilderness, and often motor boat activities are allowed adjacent to or near the plugs. House and Slagle Ditches are motor boat accessible up to the plugs; Raulerson Canal is not accessible to the proposed plug location, but motor boat activity is allowed in Little Sable Creek, approximately 150 feet from the proposed plug location.

Marjory Stoneman Douglas Wilderness

Congress designated 1.3 million acres of EVER as wilderness in 1978. Wilderness area comprises 86 percent of the park, with another 82,000 acres designated at "Potential Wilderness." The wilderness area was originally named "Everglades Wilderness" but the name was changed to "Marjory Stoneman Douglas Wilderness" in 1997. It is the largest wilderness area east of the Rocky Mountains. The Marjory Stoneman Douglas Wilderness includes most of the park's undeveloped lands and inland waters, as well as including marine areas as a special "submerged wilderness" designation.

Approximately 530,000 acres of wilderness in EVER are designated Submerged Wilderness. Most marine waters and many of the inland estuarine lakes and bays within the wilderness boundary are considered submerged wilderness, including all areas underwater during high tide in Florida Bay and along the Gulf Coast within the park boundary. The submerged wilderness designation gives wilderness protection to the bottom, but not the water column nor the water surface (NPS 2016f). This designation prevents large developments while allowing motorized recreation to continue (NPS 2015c). Two additional plugs at Homestead and East Cape Canals include motorboat docks on the downstream side and canoe/kayak ramps on the upstream side. While these features facilitate the opportunity for primitive recreation in the interior of Cape Sable, they are considered agency-provided recreation facilities in wilderness, and impact the experience and settings visitors associate with the wilderness.

The entirety of Cape Sable is included in the Marjory Stoneman Douglas Wilderness. All of the land area and much of the water is designated wilderness. The notable exceptions include Slagle and House Ditch from Florida Bay to the currently existing plugs, Little Sable Creek, and Lake Ingraham, which are categorized as submerged wilderness.

3.8.2 Environmental Consequences

3.8.2.1 Assumptions, Methodology, and Intensity Thresholds.

NPS' management of wilderness areas is governed by the Wilderness Act, NPS Management Policies 2006, and DO #41, "Wilderness Preservation and Management." Wilderness policies prohibit commercial enterprises, physical developments, and the use of certain tools. Prohibited physical developments are permanent and temporary roads, structures, and installations. Prohibited tools include motor vehicles, motorized equipment, motorboats, landing of aircraft, and mechanical transportation such as bicycles and wheelbarrows. However, there are special provisions that allow for the use of these prohibited uses (with the exception of permanent roads) when necessary for the administration of the wilderness area.

NPS Management Policies (NPS 2006) also mandate the use of the minimum requirements concept. The minimum requirements analysis is a documented process to determine if management actions taken by NPS are necessary for the administration of wilderness, and if those actions are necessary, determine how best to minimize the impacts to wilderness character from prohibited uses. A minimum requirements analysis identifies and considers all the aspects of an action to determine the action with the least amount of impact on the wilderness character.

NPS Management Policies (NPS 2006) mandates that projects with the potential to impact wilderness resources will be evaluated in accordance with NPS procedures for implementing NEPA. Managers contemplating the use of mechanized or motorized equipment or transport must consider the impacts to wilderness before considering the costs or efficiency. NPS needs to take the following three things into account when considering the impact of an action to the wilderness: 1) wilderness characteristics and values, including the primeval character and influence of the wilderness; 2) the preservation of natural conditions (including the lack of man-made noise); and 3) assurances that there will be outstanding opportunities for solitude, that the public will be provided with a primitive and unconfined type of recreational experience, and that wilderness will be preserved and used in an unimpaired condition.

According to DO #41, lands designated as wilderness must be managed to preserve their wilderness character and value. This document uses the minimum requirements analysis to assess impacts to the Marjory Stoneman Douglas Wilderness from the repair or replacement of three plugs in canals on Cape Sable. This analysis is in accordance with NPS Management Policies 2006 and DO #41: Wilderness Stewardship. The first step of a minimum requirements analysis is to determine if the action is necessary. If the action is determined to be necessary, the minimum requirements analysis considers how the four qualities of wilderness character are affected by the various alternatives. Cumulative impacts and the amount of time that the action will impact the wilderness must also be considered. An alternative is chosen by weighting the impacts and determine how the actions would change the character from the current condition.

Minimum Requirements Analysis

NPS determined that as this project is a rather unique situation (i.e., proposing construction in a NPS Wilderness Area) and since the environmental effects of each of the Action Alternatives would be relatively similar, there would be no additional benefit in conducting a separate Choosing by Advantages process. However, because the Action Alternatives may have different impacts on wilderness character in the Marjory Stoneman Douglas Wilderness, the park opted to have the project reviewed by the EVER wilderness committee. The role of the Wilderness Committee is to evaluate the various alternatives that are presented, including providing improvements to those alternatives where appropriate, to determine the least impacting way to accomplish the project from a wilderness perspective.

A completed Minimum Requirements Decision Guide Workbook was provided to the Wilderness Committee for their review. This workbook provided a description of the situation that would necessitate action in the wilderness, as well as providing information on each of the project alternatives and several proposed methodologies to complete the construction. The committee reviewed the provided information and met on October 28, 2015 and November 3, 2015 to discuss the project. The committee's report containing recommendations was provided to the park superintendent, who then provided guidance to the interdisciplinary team on which alternatives to move forward for analysis. The Cape Sable Minimum Requirements Analysis may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

Of the alternatives presented in the MRDG, the wilderness committee recommended Alternative 4A at Raulerson Canal and Alternative 2 at Slagle Ditch. At House Ditch, the committee has recommended that the park monitor the condition of the plug, and if it degrades to the extent currently experienced at Slagle Ditch, Alternative 2 would be the selected repair method.

Analysis Area: The focus of this analysis is the greater Cape Sable region. This includes areas adjacent to the failed plug on Raulerson Canal and the existing plugs on House and Slagle Ditches. The analysis area also includes the wetland areas throughout the Cape Sable area.

Determine if the Action is Necessary: The natural character of wilderness has been and continues to be degraded due to the presence of canals in the Cape Sable region. Evaluation of alternatives to reduce these impacts through restoration of the marl ridge is a priority based on the scale of the impacts and the potential for those impacts to become worse over time. The proposed restoration projects would contribute to wilderness character by improving natural conditions within and adjacent to Cape Sable by restoring the function of the marl ridge at Raulerson Canal. Reinforcing the plugs at House and Slagle Ditches should improve their resistance to failure and reduce the chance for subsequent impacts to the upstream wetlands and marine resources. Preventing failure and thereby preventing the widening of the canals would allow for smaller, less hardened plugs than is necessary on the canals that have been widened by tidal action.

The intensity thresholds for wilderness are:

- *Negligible:* There would be little or no effect on wilderness character or wilderness experience. The effect on wilderness character would be so small that it would not be of any measurable or perceptible consequence.
- *Minor:* An effect on one or more qualities of wilderness character and wilderness experience and associated values would occur; it would be slightly detectable and highly localized.

- *Moderate:* Attributes of wilderness character and wilderness experience would be affected in a substantial way in a single distinct area, or the impact would affect multiple areas but would not be permanent and would not affect an entire visitor season.
- *Major:* One or more qualities of wilderness character and wilderness experience would be affected substantially across more than one distinct area of the park on either a permanent or frequent but temporary basis during the course of an entire visitor season.

3.8.2.2 Impacts of the Alternatives.

3.8.2.2.1 No Action Alternative

1) Analysis. The No-Action Alternative involves leaving the plugs at House and Slagle Ditches in their current condition and allowing the plugs to continue to be exposed to the current and future erosional processes impacting the plugs. Eventually, at some uncertain date, the plugs would become breached and tidal flows would be capable of moving through the marl ridge into the interior Cape Sable wetlands. Future erosion would accelerate along the current ditch alignments down into the very soft lime mud soils and the ditches would erode significantly by widening and deepening therein creating a significant path for tidal waters to transport sediment to the interior Cape Sable wetlands as well as to Florida Bay and the Gulf of Mexico. The unnatural exchange of saltwater and freshwater would degrade the habitat for wading birds, juvenile crocodiles, and other wildlife.

The No Action Alternative for Raulerson Canal involves leaving the failed plug in its present condition and allowing the canal to continue to erode, widen, and transport suspended sediment to the interior Cape Sable wetlands as well as to Florida Bay and the Gulf of Mexico. The unnatural exchange of fresh and saltwater would continue within the wetlands, and the value of habitat for wading birds, juvenile crocodiles, and other wildlife would remain degraded.

There would be no direct adverse effect to the untrammeled or to the undeveloped qualities of wilderness at any of the three locations. As long as the plugs remain intact at House and Slagle Ditches, there would be no impact to the natural nor any impact to the Solitude or Primitive and Unconfined Recreation qualities. However, the plug on Slagle Ditch is highly eroded and the plug on House Ditch has some erosion. Without preventative maintenance, they could breach at an undeterminable point which would expose the canal, as well as the interior of Cape Sable, to the conditions experienced at other failed plug sites. The plugs on East Cape, Homestead, and Raulerson Canals were similar to those at House and Slagle Ditches and eventually failed; the plug on Raulerson going from 10 feet wide to failure in approximately one year (November 2006 to December 2007). Once the plugs have failed, the canals widen quickly, making repair much more difficult and requiring hardened materials. The loss of the plug on Slagle Ditch would also impact the ability of hikers to use the Old Ingraham Highway. The plug on Slagle Ditch currently works as a bridge over the ditch. If the plug fails, the ditch would widen, and fast currents would make the ditch largely impassible.

At Raulerson Canal, the natural quality of wilderness continues to be affected by the loss of the plug in the canal. By conducting no action, Raulerson Canal would continue to erode, widen, and transport suspended sediment to the interior Cape Sable wetlands as well as to Florida Bay and the Gulf of Mexico. The unnatural exchange of fresh and saltwater would continue within the wetlands on the interior of Cape Sable, and the value of habitat for wading birds, juvenile crocodiles, and other wildlife would remain degraded. The solitude or primitive and unconfined

recreation quality would also be unaltered by taking no action at Raulerson Canal. However, it is noted that unauthorized motorboat access into the wilderness is possible through this canal; it is unknown how much this is an issue, and there are other natural creeks that could allow the same access.

2) Climate Change and Sea Level Rise. The natural quality of wilderness would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. Higher sea levels may promote increased erosion of interior sediments as well as an increased rate of erosion to canal banks. The plugs at House and Slagle Ditches would fail, allowing marine water to enter and leave the interior of Cape Sable through these two waterways. Large sediment loads would be discharged twice daily directly to western Florida Bay.

3) Conclusion. Effects of the no action alternative would have similar impacts at House and Slagle Ditch and Raulerson canal for the untrammeled, undeveloped, and solitude or primitive and unconfined recreation qualities of wilderness. The no action alternative would have negligible effects on the untrammeled and undeveloped qualities and minor impacts to the solitude or primitive and unconfined recreation quality of wilderness. At Raulerson Canal, where the plug has already been breached, moderate impacts to the natural quality of wilderness would continue. While the plug at House Ditch remains structurally sound, there is no impact to the natural quality. The plug at Slagle Ditch is currently experiencing lateral seepage through the plug, a negligible impact to the natural quality of wilderness. When the plugs on House and Slagle Ditches fail, a breach would be expected to cause long-term moderate to major adverse impacts to the natural quality of wilderness.

3.8.2.2.2 Alternative 2: Re-backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection

1) Analysis. The effects on the untrammeled quality include construction activities and the continued presence of the plugs in the wilderness. While landing of helicopters and limited clearing of vegetation could have a minor adverse impact to the untrammeled quality, their intent is not to manipulate "the earth and its community of life," and the impacts are confined to a small area or are temporary and would have only a very small and inconsequential impact. Reinforcement of the plugs would not hinder the biophysical environment any more than current conditions; however, it would extend the life of the plugs.

The undeveloped quality would be affected by the transportation necessary for supplies and equipment and the presence of the plugs in the wilderness. Transportation via motorboat above submerged wilderness would have no effect upon this quality; however, the use of a helicopter and motorized compactor are clear prohibitions as indicated by the Wilderness Act and thus are considered a negative for this quality. The backfilling of the plug to its original extent as well as installation of additional erosion protection would both be considered a negative on this quality because the footprint would be expanded beyond current conditions and the existence of an installation in wilderness would be prolonged.

Effects on the natural quality of wilderness would occur during construction and by preventing breaching of the plugs. Limited vegetation clearing would have negligible adverse impacts in the immediate vicinity of the plugs. Turbidity/suspended soil would be contained within the

construction footprint using turbidity curtains or other suitable barriers. To ensure compliance with water quality standards in OFW (see Section 3.4.1) a turbidity monitoring plan would be implemented during construction. If monitoring reveals that turbidity levels exceed OFW standards, construction activities would cease and not resume until corrective measures are implemented. Impacts during construction would be short-term, negligible to minor and localized. Reinforcing the plugs would have no immediate beneficial effect on natural quality, but could prevent future breaching which may expose the canal, as well as the interior of Cape Sable, to the conditions experienced at other failed plug sites. While House Ditch seems to be holding with only slight erosion, Slagle is showing signs that water is already passing through the plug, which is a precursor to failing. Preventing breaching of the plugs would result in substantial long-term beneficial effects on natural quality in the Cape Sable area.

There would be both beneficial and adverse effects on the solitude or primitive and unconfined recreation quality of wilderness. The use of a helicopter and motorized compactor would remind visitors of the modern world, and would have a short-term minor adverse effect upon opportunities for solitude, particularly for visitors walking the Old Ingraham Highway. In addition to fill, the reinforced plug would contain erosion protection features which may be more visible to park visitors, particularly when water levels are lower during the dry season when visitation is higher. It is debatable whether or not reinforcement of the plug would have a benefit to the quality of solitude or primitive and unconfined recreation. The continued existence of the plug at Slagle Ditch provides an earthen bridge by which visitors can cross while walking the Old Ingraham Highway to Club House Beach, which provides primitive recreation opportunities in the form of hiking and camping; one of the only places in which this can be accomplished in the park let alone the wilderness. Similar to the natural quality, there would be no immediate effect by reinforcing the plug. However, should this plug be breached in the future, the path to Club House Beach would be impeded by the canal. As previously mentioned, Slagle Ditch is showing signs that water is already passing through the plug, which is a precursor to failing. While this could provide an opportunity for self-discovery in the form of unconfined recreation by finding individual, alternative ways to cross the canal, safety and resource management factors, including impacts to the natural quality of wilderness character, also have to be considered. For these reasons, reinforcing the plug would have an overall benefit.

2) Climate Change and Sea Level Rise. Wilderness would be adversely impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. The impacts to wilderness from sea level rise would be mitigated in the short to intermediate term by the construction of the reinforced plug structures at House and Slagle Ditches. The restored plugs would further reduce the possibility of saltwater entering the interior Cape Sable wetlands via House and Slagle Ditches beyond the benefits realized with the recent construction of the plugs within the East Cape and Homestead Canals. The slowing or postponement of impacts by the reconstruction of the plugs would allow additional time for the interior Cape Sable wetlands to restabilize and recover from the current impacts caused by the breached and currently eroding plugs and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Alternatives 2 and 3 would have minor adverse effects on the untrammeled and solitude or primitive and unconfined recreation wilderness qualities at House and Slagle Ditches. The small footprint and natural materials used for alternatives 2 and 3 would have minor impacts to the undeveloped quality of wilderness. The additional armoring included as part of Alternative 3 would result in highly localized minor to moderate adverse impacts to the undeveloped quality. The natural quality of wilderness would experience minor adverse impacts during construction, but the effects of preventing breaching would be long-term and beneficial to the Cape Sable area.

3.8.2.2.3 Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. While the use of motorboats and other mechanical equipment as well as limited clearing of vegetation could have a minor impact to the untrammeled quality, their intent is not to manipulate "the earth and its community of life," and the impacts are confined to a small area or are temporary and would have only a very small and inconsequential impact. However, the use of a temporary dam to cease flow of water through the canal during construction activities and the presence of a permanent plug once construction is complete would adversely impact the untrammeled quality.

Impacts to the undeveloped quality include transportation to the construction location and the installation of the plug. While some motorboat transportation would occur above submerged wilderness, once the boat leaves Little Sable Creek and enters Raulerson Canal, the boat would be operating within designated wilderness resulting in a localized short-term adverse effect. Construction activities such as installation of a temporary plug, mechanical excavation of the failed plug, mechanical installation of sheet piles, and installation of fill and erosion protection would have short-term minor adverse effects on the undeveloped quality. The existence of a permanent plug once construction is completed would have a long-term, localized, minor to moderate adverse effect upon this undeveloped quality.

Effects on the natural quality would occur from construction activities and the presence of a new plug. BMPs would be implemented to avoid and minimize impacts to adjacent wilderness. Limited vegetation clearing would have negligible adverse impacts in the vicinity of the plug. Where required, the disturbed areas would be replanted with native wetland vegetation to reduce the potential for erosion. The area is expected to return to pre-existing conditions within five years. As a precaution, a monitoring/maintenance program would be initiated by the NPS in order to monitor and maintain the planted wetland vegetation in this area for a period of up to five years. Erosion control measures, as well as the spill prevention, control, and countermeasure procedures would minimize the potential effects of erosion, sedimentation, and discharge of pollutants during construction. As a result, these activities would have short-term, negligible indirect adverse impacts on submerged wilderness. No long-term adverse impacts to the submerged wilderness are anticipated to occur as a result, only short-term restrictions in access during construction. Plugging Raulerson Canal would result in substantial long-term beneficial effects on the natural environment of the inland Cape Sable wetlands. The unnatural exchange of fresh and saltwater would cease, and the quality of habitat for wading birds, juvenile crocodiles, and other wildlife would be expected to improve.

The project will have short and long-term impacts to the wilderness quality of solitude or primitive and unconfined recreation. Some motorboat transportation would occur above submerged wilderness; however once on site, the boat would continue to operate within designated wilderness. As such, this would have an adverse effect upon this quality. Furthermore, the installation of a temporary dam, mechanical excavation, and mechanical installation of sheet piles, installation of fill and erosion protection, and existence of permanent plug once construction is completed would remind visitors of the modern world, and would have an adverse effect upon opportunities for solitude. Some of these impacts would last much longer than others. The presence of a canoe ramp could be perceived in different ways with regards to this quality. The canoe portage features would facilitate an opportunity for primitive

recreation within the wilderness, however, these features would require improvements to the plug design that would resemble, and most likely be considered, an agency-provided recreation facility which would negatively impact opportunities for unconfined recreation. The plugs at East Cape Canal and Homestead Canal both provide canoe access to the interior of Cape Sable. These locations may make an additional boat dock and canoe ramp on Raulerson Canal unnecessary.

2) Climate Change and Sea Level Rise. Wilderness would be impacted by the increasing amount and duration of saltwater in the interior Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the reconstruction of the plug structure. The plug would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via Raulerson Canal. The slowing or postponement of impacts by the reconstruction of a plug would allow time for the interior Cape Sable wetlands to recover from the current impacts caused by the breached plug and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Impacts to the untrammeled quality of wilderness as a result of Alternatives 4A and 4B would be minor and adverse. Alternative 4A or 4B would have minor adverse impacts to the natural quality during construction. However, installation of a new plug would result in significant long-term beneficial effects on the natural environment of the interior Cape Sable wetlands. Alternative 4A would have localized moderate adverse impacts to the undeveloped quality and minor adverse impacts to the solitude or primitive and unconfined recreation quality of wilderness. The canoe ramp and boat dock included in Alternative 4B would have localized moderate impacts to the undeveloped quality, and minor to moderate impacts to the solitude or primitive and unconfined recreation quality.

3.9 CULTURAL RESOURCES

Under the NHPA, “historic properties” are buildings, structures, objects, sites, and districts that are listed in or eligible for listing in the National Register of Historic Places. This EA assesses the potential impacts to historic structures and districts.

3.9.1 Affected Environment

Significant growth, driven by northern businessmen and entrepreneurs, began in south Florida during the last decade of the 19th century, most notably Henry Flagler’s Florida East Coast Railroad. In addition to railroad construction, the state of Florida saw the drainage and development of the Everglades as a way to promote growth. Built between 1915 and 1922, the Ingraham Highway was the first road to provide access into the area that is now EVER. As part of the highway’s construction, a series of associated canals were built to provide road fill and drainage for the area.

The Area of Potential Effects (APE) for this project included three locations: the Raulerson Brothers Canal (aka the Raulerson Canal), House Ditch, and Slagle Ditch. A field survey was completed on September 9-10, 2015 by qualified professionals under ARPA Permit EVER 2015-01. Three historic structures were identified: Raulerson Brothers Canal (8MO2350), House Ditch and plug (8MO2351), and Slagle Ditch and plug (8MO2352). No prehistoric resources were identified within the APE.

The Raulerson Brothers Canal (8MO2350) is recommended as eligible to the NRHP under Criterion A and B. This is based on its possible association with the Raulerson brothers and early 20th century cattle grazing, and on its known association with the 20th century development of the Cape Sable region. There is some confusion regarding the specific date of construction for the Raulerson Brothers Canal. However, historic aerial photography depict construction was definitely completed prior to 1928.

Slagle Ditch and House Ditch date to the 1920s and reflect efforts at reclaiming the marshy Cape Sable area for agriculture and land development (Wanless and Vlaswinkel 2005; Zucker 2010). The ditches cut through the marl ridge along the southwest and south margins of Cape Sable and connect the interior wetlands to Lake Ingraham and Florida Bay. House and Slagle Ditches were built by the Model Land Company, a holding of the Florida East Coast Railroad, which was the largest landowner in the Cape Sable area during the early 20th century.

8MO2351 (House Ditch and plug) and 8MO2352 (Slagle Ditch and plug) are both recommended as eligible to the NRHP under Criterion A. This is based on their association with the 20th century development of the Cape Sable region and with the mid-20th century conservation efforts of EVER.

There is ambivalence regarding the legacy of these structures (the road and canals) when viewed in the context of their environmental impacts, but portions of the Old Ingraham Highway are still used by visitors and managers to provide access into the vast wetland wilderness of the park. While the original intent was to drain and develop the area, the structures played a determining role in the establishment of the park. Once the park was established, it was recognized that in order for the ecosystem to function, the historic linear features would have to be modified. These modifications, too, have historical significance, under the historic themes of conservation and science. Moreover, as these themes continue their evolution, proposed undertakings are consistent with this broad pattern of history.

Since the initial completion of the canals, tides, currents, and erosional processes have continually widened the waterways. The construction of these structures exposed Lake Ingraham to tidal influences and changed its environment from brackish freshwater to one of high salinity. Saltwater intrusion began occurring as early as the late 1940s. To counteract these effects, EVER tried blocking the canals with earthen plugs in the 1950s and 1960s to minimize saltwater intrusion into the formerly freshwater interior marshes north of the Old Ingraham Highway. After these failed by the early 1990s, sheet pile plugs were installed, which have since also failed (Wanless and Vlaswinkel 2005; Zucker 2010).

3.9.2 Environmental Consequences

3.9.2.1 Assumptions, Methodology, and Intensity Thresholds.

Impacts to historic structures and districts are described here in terms of type, context, duration, and intensity, which is consistent with the CEQ regulations implementing NEPA. These impact analyses are intended to comply with the requirements of both NEPA and Section 106 of the NHPA. In accordance with 36 CFR Part 800, impacts to historic structures and buildings are identified and evaluated by: (1) determining the area of potential effects (APE); (2) identifying cultural resources present in the area of potential effects that are either listed in or eligible to be listed in the NRHP; (3) applying the criteria of adverse effect to affected cultural resources either listed in or eligible to be listed in the NRHP; and (4) considering ways to avoid, minimize, or mitigate adverse effects.

Under the Advisory Council's regulations, a determination of either "adverse effect" or "no adverse effect" must also be made for affected, NRHP-eligible cultural resources. An adverse effect occurs whenever an impact alters, directly or indirectly, any characteristic of a cultural resource that qualify it for inclusion in the NRHP (e.g., diminishing the integrity of the resource's location, design, setting, materials, workmanship, feeling, or association). Adverse effects also include reasonably foreseeable effects caused by the preferred alternative that would occur later in time, be farther removed in distance, or be cumulative (36 CFR Part 800.5). A determination of no adverse effect means there is an effect, but the effect would not diminish in any way the characteristics of the cultural resource that qualify it for inclusion in the NRHP.

CEQ regulations and the NPS' DO #12 also call for a discussion of the appropriateness of mitigation, as well as an analysis of how effective the mitigation would be in reducing the intensity of a potential impact. Any resultant reduction in intensity of impact due to mitigation, however, is an estimate of the effectiveness of mitigation under NEPA only. It does not suggest that the level of effect as defined by Section 106 is similarly reduced. Although adverse effects under Section 106 may be mitigated, the effect remains adverse.

A Section 106 summary for historic buildings and districts is included at the end of the impact analysis sections. The Section 106 summary is intended to meet the requirements of Section 106 and addresses the potential effect of the undertaking (implementation of the alternatives) on cultural resources, based upon the criteria of effect and adverse effect found in the Advisory Council's regulations.

The following impact thresholds were used for cultural resources:

- *Negligible:* Impact(s) would be at the lowest levels of detection - barely perceptible and not measurable. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- *Minor:* Impact would not affect the character defining features of a NRHP-eligible or listed structure or building. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- *Moderate:* Impact would alter a character defining feature(s) of the structure or building but would not diminish the integrity of the resource to the extent that its NRHP-defining elements are diminished. For purposes of Section 106, the determination of effect would be *no adverse effect*.
- *Major:* Impact would alter a character defining feature(s) of the structure or building, diminishing the integrity of the resource to the extent that it is no longer eligible to be listed in the NRHP. For purposes of Section 106, the determination of effect would be *adverse effect*.

Since most cultural resources are non-renewable, impacts to most cultural resources are considered long-term, except those for the natural elements of cultural landscapes that would renew such as vegetation. Effects would be short term (three to five years) until natural components are replaced (i.e., new vegetation grows).

3.9.2.2 Impacts of the Alternatives.

3.9.2.2.1 No Action Alternative

1) Analysis. The constant movement of water within the Cape Sable area has led to the widening of several canals, resulting in a substantial loss of freshwater habitat. The expansion of

these canals has exacerbated sediment deposition in the cape's open waters and is converting Lake Ingraham into a tidal mud flat. Under the No Action Alternative, the current erosion at House and Slagle Ditches and Raulerson Canal would continue, gradually widening the waterways, further eroding the Old Ingraham Highway, and changing their historic integrity. The No Action Alternative would result in long-term minor to moderate adverse impacts to historic resources.

2) Climate Change and Sea Level Rise. Cultural resources would be impacted by the increasing amount and duration of saltwater in the interior wetland areas of Cape Sable. Ongoing erosion could threaten these historic features. This would likely be exacerbated by climate change due to projected increases in the frequency and intensity of storms, which can increase erosion and natural weathering processes. Historic structures may deteriorate faster if subjected to more extreme temperatures, seasonal variability in precipitation, and more intense storms caused by climate change.

3) Conclusion. Under the No Action Alternative, current existing conditions would continue to degrade, resulting in long-term minor to moderate adverse impacts to historic structures. The No Action Alternative would not result in major adverse impacts on cultural resources.

3.6.2.2.3 Action Alternatives: Alternative 2: Re-backfill Eroded Plug Areas at House and Slagle Ditches; Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection; Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection; and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. The implementation of Alternatives 2 or 3 and 4A or 4B would contribute to the deceleration of erosional processes at House and Slagle Ditches and Raulerson Canal and would not require dredging. The implementation of any of these Action Alternatives would not impact the character or function of these historic resources or affect their historic significance. However, since construction would occur within the overall footprint of the NRHP-eligible canals, construction would have minor adverse impacts on these historic structures. The Action Alternatives would result in short- and long-term minor to moderate adverse effects. The NPS would coordinate with the SHPO to ensure that no long-term adverse impacts occur to these structures as a result of construction activities related to plug restoration. The proposed construction measures would stabilize and preserve the historical integrity of the ditches and canal. The Action Alternatives (2 or 3 and 4A or 4B) would also have long-term beneficial impacts due to the deceleration of erosional processes.

Although the restoration activities would include changes to the physical integrity of these three properties, the improvements would not affect their significance with regard to its associations (the Raulerson brothers), or with cattle grazing, land development, or conservation efforts at Cape Sable. The proposed restoration would protect these resources through continued

maintenance. Therefore, it is anticipated that the proposed undertaking will have no adverse effect on these three historic properties.

2) Climate Change and Sea Level Rise. Cultural resources would be impacted by the increasing amount and duration of saltwater in the interior wetland areas of Cape Sable. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the reconstruction of the plug structures. The plugs would reduce the intensity and duration of saltwater entering the interior wetlands of Cape Sable via House and Slagle Ditches and Raulerson Canal. The slowing or postponement of impacts by the construction of plug structures would allow time for the interior wetlands of Cape Sable to re-stabilize and recover from the current impacts caused by the breached plugs and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise.

3) Conclusion. Construction would have minor adverse impacts on the NRHP-eligible plugs, ditches, and canal due to the construction occurring within the overall footprint of these historic structures. However, since there would be a deceleration of erosional processes, the action alternatives would result in long-term beneficial impacts to historic structures and a potential historic district.

3.9.2.3 Section 106 Summary.

Based on regional surveys, the low-lying interior Cape Sable wetlands and marl ridge have a low probability of containing archeological resources. The known archeological resources are on the high ground area on the Western coastline of the Cape. A variety of researchers has visited the Cape Sable area to locate and document the historic resources of Cape Sable (Tebeau 1968, Taylor 1985, Paige 1986). The project area has not been systematically surveyed for archeological resources. No archaeological resources have been found to date within the study area. However, prior to implementation of the preferred alternative, areas that have not been surveyed that would have ground disturbance in non-disturbed areas would be surveyed and archeological resources avoided to the greatest extent possible.

There are no designated cultural landscapes in the Cape Sable area. The history of EVER includes settlement and the use of waters for fishing for both sustenance and profit by both Native Americans and early settlers to the area. The Miccosukee and Seminole tribes claim the Everglades as a homeland and traditional use area before the park was officially established. Fishing for subsistence and profit has occurred at the park since the early 1900s and may be considered an ethnographic use. However, since the law prohibits commercial fishing, this ethnographic use (commercial fishing) has been terminated. Subsistence fishing would continue and would not be affected by the proposed project. Project actions would not interfere with any other ethnographic uses, and impacts from construction, if any, to ethnographic resources would be negligible. NPS will consult with tribes, the Florida Division of Historical Resources Bureau of Historic Preservation, the Advisory Council on Historic Preservation, and the Florida State Historic Preservation Officer (SHPO). This EA will be forwarded to each for review and comment.

This EA has described existing cultural resource conditions in the project area (including NHRP properties), and evaluated the potential environmental effects of the alternatives. Given these conditions and the mitigation measures, the assessment of effect for all alternatives discussed in this EA would be negligible for short term and long term. For purposes of Section 106, the determination of effect would be *no adverse effect*.

3.10 VISITOR USE AND EXPERIENCE

3.10.1 Affected Environment

According to NPS Management Policies (NPS 2006), the enjoyment of park resources and values by people is part of the fundamental purpose of all park units. The NPS is committed to providing appropriate, high-quality opportunities for visitors to enjoy the parks. Further, the NPS would provide opportunities for forms of enjoyment that are uniquely suited and appropriate to the superior natural and cultural resources found in the parks. The NPS policies also state that scenic views and visual resources are considered highly valued associated characteristics that the NPS should strive to protect (NPS 2006).

Visitor use patterns at the Everglades are, in part, influenced by the more than 6.3 million people living in South Florida. As of July 2014 (the most recent year for which data is available), population estimates for Miami-Dade County were 2,662,874, 1,869,235 for Broward County, 1,397,710 for Palm Beach County, and 348,777 for Collier County - this makes up nearly a third of the entire population of the state of Florida (USCB 2014).

In addition to visitation from people living in the surrounding area, the park is also receives visitation from vacationers in nearby urbanized areas. For example, an estimated, record-high, 14.6 million visitors spent at least one night in the greater Miami/Miami Beach area during 2014.

Of the 7.3 million domestic visitors to the greater Miami/Miami Beach area in 2014, an estimated 7.7% of them visited EVER – up from 1.3% in 2010 (see **Table 3.15**; Greater Miami Convention and Visitors Bureau 2014). On average, the park receives approximately one million visits each year (see **Table 3.16**, NPS 2016g). Approximately 50 percent of visitation occurs during the cooler months - between January and April.

TABLE 3.15 - PERCENTAGE OF DOMESTIC VISITORS TO GREATER MIAMI AND THE BEACHES TO VISIT THE EVERGLADES

Year	Number of Domestic Visitors (in thousands)	% That Visited EVER
2014	7,303.2	7.7%
2013	7,087.2	3.4%
2012	7,074.9	2.1%
2011	6,948.5	1.4%
2010	6,544.0	1.3%

TABLE 3.16 - EVERGLADES NATIONAL PARK VISITATION

Fiscal Year	Recreational	Non-Recreational	Total Visits*	Percentage Change**
2014	1,110,901	2,342	1,113,243	6.1
2013	1,047,116	2,003	1,049,119	-8.3
2012	1,141,906	2,273	1,144,179	21.8
2011	934,351	4,687	939,038	2.1
2010	915,538	4,518	920,056	1.8
2009	900,882	3,278	904,160	9.2
2008	822,118	5,521	827,639	--

* Total visits are the total of recreational and non-recreational visits.
** Percentage change applies to total visits only.

Wildlife viewing activities contributed approximately $3.1 billion in retail sales to the Florida economy in 2006 with a total estimated economic effect of $5.2 billion (Southwick and Allen 2008). It is estimated that south Florida has close to 2,000 species of birds, fish, mammals, and other animals (Estevez 1998). Viewing this diverse wildlife enhances the visitor experience for all tourists, even those who did not travel specifically to view wildlife. Travel specifically devoted to bird watching constitutes one of the largest wildlife viewing activities (Carver 2009), and the coastal wetlands and mangrove forests of the southwest coast provide prime opportunities for viewing the diverse community of birds and other animals that utilize the habitat (Estevez 1998; Montague and Wiegert 1990; Odum et al.1982). Waterfowl and birds of prey are the largest categories of birds watched away from the home, and these types of birds are abundant in the southwest coastal marshes (Carver 2009). In addition, numerous species of birds use the wetlands as wintering or stopover sites during their annual migration (Odum et al. 1982).

Mangroves provide a critical habitat in the life cycle of many important commercial and recreational fishes (Estevez 1998; Heald et al. 1984; Lugo and Snedaker 1974; Odum et al. 1982). Salt marshes also serve as important nursery and feeding grounds for estuarine animals (Montague and Wiegert 1990).

The current condition at the location of the failed plug in Raulerson Canal creates a safety hazard for visitors engaged in both canoeing/kayaking and fishing activities (submerged debris from the failed plug still exists in the waterway). Tidal waters flowing over the existing breached plug is causing turbulent currents in Raulerson Canal, making canoeing/kayaking and fishing in the backcountry areas unsafe for visitors. Additionally, the wilderness visitor experience is being hindered for such visitors by the presence of motorized boaters illegally trespassing into the backcountry past the breached plug.

3.10.2 Environmental Consequences

3.10.2.1 Assumptions, Methodology and Intensity, Thresholds.

The NPS seeks to provide for the "enjoyment of park resources and values by the people of the United States" as it is "part of the fundamental purpose of all parks" (NPS 2006). The NPS is committed to "providing appropriate, high-quality opportunities for visitors to enjoy the parks," by maintaining "an atmosphere that is open, inviting, and accessible" (NPS 2006). To be consistent with preserving park resources and providing visitor safety and high quality visitor experiences for all, the ABAAS and DO #42 require that buildings and facilities covered by the law meet standards for accessibility by disabled persons (NPS 2006).

Analysis Area: The area of analysis for visitor use and experience is the expanded greater Cape Sable area, since House and Slagle Ditches and Raulerson Canal have been used as an access point for surrounding areas in Cape Sable.

The following impact thresholds were used to assess impacts to visitor use and experience:

- *Negligible:* Visitors would not be affected and/or changes in the experience would be below levels of detection. Visitors would likely be unaware of any effects associated with implementation of the alternative. There would be no noticeable change in visitor use and experience or in any defined indicators of visitor satisfaction or behavior.
- *Minor:* Changes in visitor use and/or experience would be slight but detectable. The changes would not appreciably limit or enhance critical characteristics of the visitor experience. Visitors would be aware of the effects associated with the alternative, but the effects would be slight.
- *Moderate:* Some characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be altered. The visitor would be aware of the effects associated with implementation of the alternative and would likely be able to express an opinion about the changes. Visitor satisfaction would begin to change (either decline or increase) as a direct result of the effect.
- *Major:* Multiple critical characteristics of the desired visitor experience would change and/or the number of participants engaging in an activity would be greatly reduced or increased. The visitor would be aware of the effects associated with implementation of the alternative and would likely express a strong opinion about the change. Visitor satisfaction would markedly decline or increase.

3.10.2.2 Impacts of the Alternatives.

3.10.2.2.1 No Action Alternative

1) Analysis. As outlined in the NPS Management Policies 2006, the NPS agrees to conduct discretionary management activities in the park in order to protect human life and provide for injury-free visits to the degree that the management activities would not impair the park resources and values (NPS 2006). Taking no action in the interest of visitor safety and experience at the eroding plugs at House and Slagle Ditches (Old Ingraham Highway would eventually wash out and become impassable at these locations) and at the existing breached Raulerson Canal plugs would fail to meet the standards of the NPS. Additionally, if no action is taken, conditions at each of the waterways discussed would be expected to worsen, causing a more extreme safety hazard to visitors and further degrading the visitor experience in the wilderness area. As discussed in Section 3.4.2.2.2.1, the No Action Alternative would result in

increased sedimentation and decreased water quality. This would also adversely impact visitor use.

2) Climate Change and Sea Level Rise. Visitor use and experience would be impacted by the increasing amount and duration of saltwater in the interior wetlands of Cape Sable. Over the long term, the influences of climate change could alter seasonal visitor use patterns and trends. Climate change could bring higher annual temperatures and possibly extended hot spells in Florida. A higher frequency of heat waves may increase the number of heat-related illnesses and even deter visitors, particularly the elderly, from visiting the park in the summer. However, milder winters could increase visitation during the peak season. Types of visitor use may also change, such as a decrease in strenuous activities (e.g., backpacking) in the summer.

3) Conclusion. If no action is taken to rectify the existing unsafe and undesirable conditions at the eroding earthen plugs at House and Slagle Ditches and at the existing failed plug at Raulerson Canal, the visitor use and experience would decline. Conditions at the plug sites would be expected to worsen substantially within the next 50 years, causing a long-term, moderate, and adverse impact on visitor use and experience in the park.

3.10.2.2.2 Alternative 2: Re-Backfill Eroded Plug Areas at House and Slagle Ditches and Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection

1) Analysis. Under Alternative 2 and 3, the eroding earthen plugs at House and Slagle Ditches would be repaired. Conditions pertaining to visitor safety at the plug sites would improve. With an option for natural armoring of the plugs, visitors to the backcountry area may not be aware of the effects associated with the alternatives. Alternative 2 and 3 are unlikely to have a negative impact to fisherman. Slagle's Ditch plug is not currently accessible to motor boats. The plug on House Ditch can be accessed via the canal; however most repairs will occur on the northern side of the plug, and impacts to fishing areas on the southern side will be negligible. The effects on visitor use and experience would not differ between the locations at House and Slagle Ditches; therefore, they are discussed here together.

2) Climate Change and Sea Level Rise. Visitor use and experience would be impacted by the increasing amount and duration of saltwater in the interior Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be slowed in the short to intermediate term by the reconstruction of the proposed plug structures. The plugs would reduce the potential for increased intensity and duration of saltwater entering the interior Cape Sable wetlands via these waterways beyond the benefits realized with the recent construction of the plugs within the East Cape and Homestead Canals. The slowing or postponement of impacts by the construction of the plug structures would allow additional time for the interior Cape Sable wetlands to restabilize and recover from the current impacts caused by the previously breached plugs along East Cape and Homestead Canals and the currently breached plug along Raulerson Canal and allow more time for the system and resources to adjust to the changes caused by climate change and sea level rise. This would preserve the visitor experience for a longer time as compared to the No Action Alternative.

3) Conclusion. Under Alternative 2 or 3, the undesirable conditions at the eroding plug sites would be remedied. The integrity of Old Ingraham Highway will be restored at these locations

offering unhindered access to the backcountry area for park visitors. Impacts to visitor use and experience would be long-term and beneficial.

3.10.2.2.3 Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and Alternative 4B: Construct a New Sheet Pile Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. Under Alternatives 4A or 4B, the failed plug at Raulerson Canal would be replaced with a new sheet pile plug structure. Conditions pertaining to visitor safety at the plug sites would improve and visitors would not be subjected to the current rapid flows of water. During high water events during which water levels overtop the plug, water flows would be dissipated over the length of the plug. Alternatives 4A and 4B would prevent illegal motorized boat entry into the wilderness areas beyond the failed plug, ensuring that the experience of passive recreational visitors is not hindered. With an option for natural armoring of the plugs, visitors to the backcountry area may not be aware of the effects associated with the alternatives.

Sport fishing is a vital part of the local economy in the Florida Keys and Cape Sable is a favorite destination for fishermen. Increasing freshwater and reducing turbidity in the interior wetlands is expected to improve the visitor experience for fishermen, bird watchers, and boaters. Reducing interior salinity and restoring the Cape Sable wetlands would help to revitalize coastal and marine biological resources including species like crocodiles and wading birds.

Alternatives 4A and 4B would not limit visitor access to the interior wetlands of Cape Sable. Canoe portages currently exist at Homestead and East Cape plugs. These plugs are closer to Flamingo, and are more likely to be used by visitors than Raulerson Canal to access the backcountry. In addition, although there would be no dedicated ramp, paddlers would be able to cross the plug at Raulerson. The dock structure and ramp included in Alternative 4B would make the portage safer, and eliminate the slight erosion that may occur from visitors climbing in and out on the canal banks.

Impacts to visitor use and experience would occur during construction and would consist of temporarily blocked access to Raulerson Canal and construction-related noise. These impacts would be short-term and temporary and would not extend beyond the construction timeframe.

By improving both the conditions for safety and passive recreational experience with the repair of the Raulerson Canal plug, it would be expected that existing park visitors would continue to use Cape Sable area. The visitor experience would be very slightly hindered by the presence of the unnatural plug structure. However, the improvements to visitor safety and the natural environment far outweigh any detriment to the visitor experience.

2) Climate Change and Sea Level Rise. Visitor use and experience would be impacted by the increasing amount and duration of saltwater in the interior Cape Sable wetlands. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the construction of the proposed plug structure. The plug would reduce the intensity and duration of saltwater entering the interior Cape Sable wetlands via Raulerson Canal. The slowing or postponement of impacts by the construction of a plug structure would allow time for the interior Cape Sable wetlands to restabilize and recover from the current impacts caused by the breached plugs and allow more time for the system and

resources to adjust to the changes caused by climate change and sea level rise. This would preserve the visitor experience for a longer time than if no action is taken.

3) Conclusion. If Alternative 4A or 4B is implemented, the existing undesirable conditions at the existing failed plug site would be remedied, including the provision for a safe portage over the plug (under Alternative 4B). In addition to making the portage safer, the dock structure and ramp included in Alternative 4B would eliminate the slight erosion that may occur from visitors climbing in and out on the canal banks. These alternatives would not limit visitor access and would prevent motorized boats from illegally accessing the wilderness beyond the plug into the area. Impacts to visitor use and experience would be long term and beneficial.

3.11 PARK MANAGEMENT AND OPERATIONS

3.11.1 Affected Environment

Park management and operations at EVER is overseen by the superintendent, who is responsible for managing the staff, concessioners and residents, and park programs (NPS 2010b). Generally park management and resource protection are guided by the CFR (36 CFR Part 1). Further, NPS Superintendents have the option to develop more specific regulations to address unique management needs of their particular unit, referred to as the *Superintendent's Compendium*. In addition, the General Management Plan for EVER was recently approved (NPS 2015c). These publications help direct the park's management efforts to best serve the mission of the NPS and the needs of visitors. This topic also includes the operating budget necessary to conduct park operations.

The discussion of park management and operations at the proposed plug areas will be broken down into the following areas: education, maintenance, research, and enforcement.

3.11.1.1 Education and Interpretation.

One of the primary functions of EVER, and all national parks, is to serve educational purposes (NPS 2006). The NPS is committed to extending its leadership in education, building on what is in place, and pursuing new relationships and opportunities to make national parks even more meaningful in the life of the nation (NPS 2006). Within the rich learning environments of EVER and facilitation by NPS interpreters, visitors would be offered authentic experiences and opportunities to enjoy one of the most beautiful and historic places in America (NPS 2006). The NPS was created to conserve park resources and "provide for the enjoyment of the same in such manner and by such means as would leave them unimpaired for future generations." The purpose of NPS interpretive and educational programs is to advance this mission by providing memorable educational and recreational experiences that: (1) help the public understand the meaning and relevance of park resources and (2) foster development of a sense of stewardship (NPS 2006).

The park's interpretive program is in place to encourage dialogue and accept that visitors have their own individual points of view. Information presented is current, accurate, based on current scholarship and science, and delivered to convey park meanings, with the understanding that visitors would draw their own conclusions. The education and interpretive program is also designed to reach out to park neighbors, segments of the population that do not visit the park, and community decision-makers to stimulate discussions about the park and its meanings in

local, regional, and national contexts. In addition, interpretive services of the park are designed to help employees better understand the park's history, resources, processes, and visitors. The availability of the Cape Sable area to passive recreational visitors such as those wishing to canoe/kayak in the area is just a small part of the park's natural interpretive features.

The interpretative program at Flamingo offers a number of tours and educational talks on the resources in and around the area. This includes planned canoe, car, and walking tours, and a number of lectures on charismatic species such as manatees, crocodiles, and pythons. These activities last through the busy winter season, January to March. Although no programs have been offered directly on Cape Sable because of its remote location, most of the plant and animal species discussed are present in both locations. Interpretive rangers at Flamingo also provide information to visitors who walk the Coastal Prairie Trail and provide backcountry camping permits, which are necessary for all the campsites on Cape Sable.

3.11.1.2 Maintenance and Monitoring.

There is a maintenance responsibility and cost for every asset that is administered by the NPS. The plugs at House and Slagle Ditches and Raulerson Canal are no exception. The costs and the useful life associated with the plugs are directly related to the type and level of maintenance provided. Even though EVER has staff in the Maintenance Division, responsibility for the park's natural resources and accompanying features such as the plugs at House and Slagle Ditches and Raulerson Canal also falls on the park's many scientists, planners, and managers. Therefore, the NPS is committed to conducting a program of preventive and rehabilitative maintenance and preservation, including sustainable design (NPS 2006).

While the plugs on East Cape and Homestead repeatedly failed and were subsequently repaired, there is no documented evidence of any preventative maintenance on the plugs at House and Slagle Ditch or on the Raulerson Canal. While House and Slagle plugs have managed to survive with only moderate to severe erosion since the 1950s, Raulerson Canal plug failed in 2007. There were several attempts to replace the plug with sandbags and other engineered materials in 2008 and 2009, but those repairs did not last past the spring of 2010.

The maintenance division at EVER currently goes out to inspect the plugs at East Cape Canal and Homestead Canal after major storms. They inspect the plug, canoe ramps, signs, and floating dock for damage. Soon after it was installed, East Cape plug required extensive repair from an overtopping event. Since that repair, the maintenance division has only been required to repair a sign and clean up litter. There have also been some costs associated with maintaining the vegetation on the plug, but those costs have been minor. There is currently no official monitoring or maintenance going on at the plugs on House and Slagle. However, law enforcement and researchers visit the plugs somewhat regularly and report back on plug condition.

The park is proposing to institute a regular monitoring program for all of the plugs on Cape Sable. The plugs on Raulerson Canal, Homestead Canal, East Cape Canal, and House and Slagle Ditches would be inspected biannually and after all major storms. This would require several staff members to visit each plug and document conditions. It is estimated that staff will visit the plug sites four times per year. The annual cost of staff time and gas for a motor boat is approximately $2,100 per year.

Any problems with the structural integrity of the plugs would be reported by the monitoring team. Costs are likely to be greater than in the past; however structural damage to the plugs is

expected to come as a result of major storms. It is difficult to predict the frequency and intensity of storms, and the severity of the damage that will result.

3.11.1.3 Enforcement.

The law enforcement program is an important tool in carrying out the NPS mission. The objectives of the NPS law enforcement program are: (1) the prevention of criminal activities through resource education, public safety efforts, and deterrence; and (2) the detection and investigation of criminal activity and the apprehension and successful prosecution of criminal violators (NPS 2006). In carrying out the law enforcement program, NPS would make reasonable efforts to protect the natural and cultural resources entrusted to its care and to provide for the protection, safety, and security of park visitors, employees, concessioners, and public and private property (NPS 2006). Due to the remote site of the plugs at House and Slagle Ditches as well as at Raulerson Canal, enforcement activities are especially difficult and costly. Representative illegal activities that have occurred or may occur at the Cape Sable plug sites that may require enforcement consist of:

- Illegal motorized boaters trespassing into the Marjory Stoneman Douglas Wilderness Area;
- Vandalism to the plug structures;
- Littering;
- Motorized boat speeding in no-wake zones or manatee protection zones;
- Fishing violations; and
- Tampering with or disturbance of crocodile nests or eggs.

3.11.1.4 Research and Monitoring.

EVER contains one of the US' most treasured, but imperiled wetlands. It is the job of the South Florida Natural Resource Center (SFNRC) located at EVER to provide natural resource management advice, collect, and analyze inventory and monitoring data, and to conduct applied research. Monitoring and research activities are performed by park staff as well as a broad array of cooperators, including universities, other federal and state agencies, and nongovernmental organizations.

Most research and monitoring projects preformed out on the Cape are conducted through cooperative agreements. There have been five projects funded by the NPS that provide most of the information on current and past conditions on the Cape. These are the projects used to guide the restoration and to provide information on the success of the efforts. Several of the projects predate the installation of plugs on the Homestead and East Cape Canals in 2010. Others have been started or enlarged in an effort to monitor conditions after the plugs were installed, or to provide data prior to the start of the Cape Sable Phase II project.

As part of the first phase of the Cape Sable restoration, Dr. Harold Wanless and Brigitte Vlaswinkel from the University of Miami conducted a study titled *Coastal landscape, wetland, and tidal channel evolution affecting critical habitats of Cape Sable, Everglades National Park, Florida*. This project documented the nature, rates, and causes for historical change to the coastal, channel/canal and wetland systems of Cape Sable. In an effort to gain an understanding of natural and anthropogenic stressors, the project analyzed historical aerial photographs, performed paleoenvironmental and radiometric analysis of soft-sediment core borings, and

monitored the erosion/accretion processes in channels, wetlands, and subaqueous environments. This research project was completed in 2005, but remains the most comprehensive study of past and present conditions on Cape Sable.

Most of the long-term physical and biological data from Cape Sable has been collected by the Audubon Society. The Bear Lake hydro station (BL) began recording hourly water level, salinity, temperature, and rainfall in February of 2001. The Lake Ingraham station (LI) is located just north of the marl ridge and south of the Homestead Canal and began recording hourly data in July of 2005. Audubon scientists have been measuring forage fish abundance at each of these stations since their establishment and relating these data to Rosette Spoonbill nesting success and abundance.

The EVER Physical Monitoring Program established three new monitoring stations in the interior marshes of Cape Sable during March 2010. The purpose of these stations is to document physical conditions (salinity, water level, temperature, and rainfall) before during and after replacement of the failed plugs on the Homestead and East Cape Canals. The station northeast of Cattail Lakes (CS1) will become a permanent park monitoring station and the other two stations (CS2 and CS3), one northeast of Gator Lake near the Homestead Canal and the second northwest of the Homestead and East Cape Canal junction. Audubon is currently maintaining these monitoring stations as part of a cooperative agreement.

The USGS currently collects data on the Raulerson Canal and East Side Creek as part of an interagency agreement. Monitoring started prior to Cape Sable I on East Cape Canal (2008), Homestead Canal (2008), and East Side Creek (2009). The stations on East Cape and Homestead Canals were discontinued when the plugs were placed in the canals in 2010. Monitoring at East Side Creek has continued, and an additional site was added at Raulerson Canal (2011) when the park began making preparations to begin the EA process for the second phase of the restoration project. Continuous records of water level, water velocity, salinity, temperature, and turbidity are currently being collected. Net channel discharge and sediment load at East Side Creek and Raulerson Canal will be calculated using this data. The real-time data is currently available on the USGS website.

Dr. Frank Mazzotti from the University of Florida has been monitoring crocodiles throughout EVER since the late 1970s. Crocodile growth, survival, body condition, and relative density is measured by survey and capture efforts. Surveys are preformed 3 times per year, Jan-March, April-June, and October-December throughout coastal areas of south Florida including Cape Sable.

Vegetation on the plugs at Homestead and East Cape Canal are monitored by URS as part of the SFWMD and USACE permit conditions for the Cape Sable I project. Long-term vegetation monitoring plots were established in April 2011. Seven long-term sampling stations consisting of six 10-foot-by-10-foot quadrats and one 5-foot-by-20-foot quadrat were permanently established at each plug to monitor the regrowth of native vegetation. Six permanent quadrats were established on top of each plug, three on each side of the constructed pathway. One 5-foot by 20-foot permanent sampling quadrat was established in the temporary work zone restoration area at each plug site. These plots will be monitored for five years, or until the site is determined to be successfully restored. Success is defined as the mitigation areas having 80% coverage of desirable plant species after 3 years. If the coverage goal is not met after 3 years, native species must be planted. The goal at the end of the five-year monitoring plan is that both mitigation areas will contain 80% coverage of desirable plant species and less than 5% cover of invasive exotic species.

Hydrologic and biological monitoring currently in place will continue through construction and for a period of time after the project is complete (while funding remains available). This will allow the NPS to assess the impacts of the project and to monitor conditions, including the effects of sea level rise on the Cape Sable area.

3.11.2 Environmental Consequences

3.11.2.1 Assumptions, Methodology, and Intensity Thresholds.

Park management and operations, for the purpose of this analysis, refers to the quality and effectiveness of park staff to maintain and administer park resources and provide for an effective visitor experience. This includes an analysis of the projected need for NPS staff time and materials in relation to the visitor services provided under each of the alternatives. The analysis also considers possible staff changes necessary to address the actions proposed under the alternatives and details the adverse or beneficial impacts that may occur.

Analysis area: The study area for park management and operations is the primary study area adjacent to the plugs at House and Slagle Ditches as well as at Raulerson Canal.

The following thresholds were used for evaluating impacts on park operations and management:

- *Negligible*: Park operations would not be affected or an action would have no measurable impact on operations in the park unit.
- *Minor*: Effects to park operations would not be readily apparent. The impacts on park operations and budget would have little material effect on other ongoing park operations.
- *Moderate*: Effects to park operations would be readily apparent and would measurably affect park operations. The changes would be noticeable to park staff and visitors. Mitigation measures would probably be necessary to compensate for adverse effects and would likely be successful.
- *Major*: Effects to park operations would be readily apparent and would result in a substantial change to park operations. The changes would be noticeable to park staff and visitors and be markedly different from existing operations. Mitigation measures would be necessary to compensate for adverse effects, and their success would not be guaranteed.

3.11.2.2 Impacts of the Alternatives.

3.11.2.2.1 No Action Alternative

1) Analysis. Under the No Action Alternatives, NPS would not repair or replace the existing breached plug at Raulerson Canal or the eroding plugs at House and Slagle Ditches. NPS personnel would continue to be required to perform ongoing enforcement activities to ensure both the protection of the park's natural resources and the safety of park visitors. If the plug at Slagle's Ditch fails, the interpretive staff would be required to inform visitors that there is no access to Clubhouse Beach via the Old Ingraham Highway. There would be no increased maintenance costs. Research and monitoring would continue at present levels as funding is available.

2) Climate Change and Sea Level Rise. Sea level rise would cause increased erosional impacts to the plugs on House and Slagle Ditch. If the plug at Slagle Ditch would fail, the Old Ingraham Highway will be impassible. There would be an increased burden on the interpretative division to inform visitors that the trail would no longer be accessible to Clubhouse Beach. The impact to the interpretative and educational staff would be long term and negligible.

3) Conclusion. If no action is taken at the plug sites at House and Slagle Ditches and Raulerson Canal, maintenance, enforcement, and research activities would remain at their current levels. If the plug at Slagle Ditch fails, the interpretative division would be required to broadcast the information to visitors who use the Old Ingraham Highway. The impact of the No Action Alternative to park management and operations would be negligible.

3.11.2.2.2 Action Alternatives - Alternative 2: Re-backfill Eroded Plug Areas at House and Slagle Ditches; Alternative 3: Re-backfill Eroded Plug Areas at House and Slagle Ditches, Include Slope and Erosion Protection and Sand Drain for Seepage Protection; Alternative 4A: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection; and Alternative 4B: Construct a New Sheet Pile Plug at Raulerson Canal and Fill Plug with Riprap Erosion Protection and an Option for a Canoe Ramp

1) Analysis. The implementation of the action alternatives, repairing the eroding earthen plugs at House and Slagle Ditches and the failed plug at Raulerson Canal in their current locations, will increase the current burden on park resources and staff. Monitoring of the plugs on House, Slagle, and Raulerson will increase from the current level, to at least biannually with additional assessments after every major storm. Based on the 50-year design of the proposed structures, only minor to negligible maintenance may be required at the plug sites. However, in the case of a major storm or hurricane, repairs may be needed at any one or all three of the plugs. A number of factors make the maintenance costs unpredictable, storm return intervals, intensity, direction, and other factors will influence the severity of damage to the plug structures. Under Alternative 4B, the portage trail (articulated block mat riprap or similar) along the plug would be required to be maintained free of vegetation for easy passage by visitors carrying a canoe/kayak. Maintenance will increase in the long term, and effects would be negligible to major adverse.

Current enforcement concerns at the plug sites such as motorized boaters illegally trespassing into the wilderness beyond the plug will be eliminated. However, other concerns such as vandalism to the plug structures, littering, and tampering with or disturbance of crocodile nests or eggs may increase. Law enforcement may also be necessary to enforce closures during construction activities. Increased enforcement activities due to protection of crocodile eggs and nests and preventing vandalism on the new plugs would be short term and long term negligible.

During construction, the interpretative program will be required to keep the public informed on closures resulting from the restoration activities. These closures could impact the Old Ingraham Highway, Slagle's Ditch and House Ditch access, and Raulerson Canal access. Most of the staging for the House and Slagle Ditch repairs will be from Flamingo. The interpretative and enforcement staff will be required to inform the public and keep the visitors at a safe distance

from construction materials and equipment. Interpretative division impacts may increase in short term but decrease long term.

Funding for research would remain the same, although monitoring flow at Raulerson would cease once the plug was in place. Vegetation monitoring in disturbed areas and on top of the plugs would likely be a permit condition imposed by the US Army Corps of Engineers. Research would increase short term, but the effect would be negligible.

2) Climate Change and Sea Level Rise. The action alternatives will decrease the impacts of sea level rise on park maintenance and operations in the Cape Sable area. While slowing the rate of sea level rise is beyond the resources of the park, these impacts would be mitigated in the short to intermediate term by the construction of the proposed plug structures. Repairs to the plug on Slagle Ditch would increase its longevity, and maintain the integrity of the Old Ingraham Highway.

3) Conclusion. Under any of the Action Alternatives, impacts to park management and operations would be long term, minor, and adverse. Enforcement and interpretative activities would increase in the short term to provide the public information and enforce closures related to construction activities, this impact would be short term, minor, and adverse. Monitoring at the plugs will increase over current levels; this change will be long term, minor, and adverse. Maintenance would increase in the long term and effects would be negligible to major adverse.

Chapter 4

Consultation and Coordination

CHAPTER 4: CONSULTATION AND COORDINATION

Park staff place a high priority on meeting the intent of public and interested agency involvement, both internal and external, during the NEPA process. In addition to giving the public an opportunity to comment on proposed actions, comments from regulatory agencies, interested parties, and NPS staff familiar with the proposed project were highly encouraged. As part of the NPS NEPA process, issues associated with the action were identified during scoping meetings with NPS staff, coordination with other affected agencies, public meetings, and public comment.

During the development of the EA, the park has actively involved the public in the process. The park's goals for public participation include: acceptance of the EA by the public; substantive and valuable input to help guide park decisions; and minimization of conflicts through dissemination of information and initiating discussion.

The park places a high value on maintaining a meaningful dialogue with interested parties, agencies, and organizations. The park elicited public participation in the discussion of alternatives for the EA. Scoping, public and agency involvement efforts included a number of open house meetings, press releases, website posting, and dissemination of information and gathering of comment through the dedicated project website on PEPC.

The NPS requires the use of the PEPC system to facilitate compliance with NEPA, the NHPA, NPS DO #12 (Environmental Impact Analysis), and DO #28 (Cultural Resources Management). PEPC is an online collaborative tool designed to facilitate the project management process in conservation planning and environmental impact analysis. It assists NPS employees in making informed decisions with regard to a number of compliance issues throughout the planning, design, and construction process. PEPC system structures, streamlines, and tracks the compliance process for NPS projects. PEPC also helps the NPS collect, code, and respond to comments from the public about proposed projects.

4.1 SCOPING PROCESS AND PUBLIC INVOLVEMENT

The NPS divided the scoping process into three categories: internal scoping (NPS staff and individuals working directly on the project), external scoping (public), and agency/ organizational scoping (federal and state regulatory agency staff). Internal scoping for this EA involved discussions among the NPS, other federal and state agencies regarding the purpose and need for the project, issues, objectives, management alternatives, mitigation measures, appropriate level of documentation, lead and cooperating agency roles, and other related dialogue.

Public scoping is the early involvement of the interested and affected public in the environmental analysis process. The public scoping process helps ensure that individuals have been given an opportunity to comment and contribute early in the decision-making process.

4.1.1 Internal Scoping

Draft purpose, need, and objectives statements were developed by the contracting team (AECOM, formally URS Corporation) using the Cape Sable Plugs Restoration – Phase I project as a guide. The draft statements were presented to the internal scoping meeting attendees for

discussion and revision. The following project purpose, need, and objectives statements resulted from the internal scoping process to be carried forward into the agency/public scoping processes.

The purpose of internal NPS scoping activities was to develop a framework for the planning process and the fundamental foundation (e.g., purpose and need for the plan, plan objectives, area of effect) needed to prepare the environmental assessment for the repair or replacement of the failed sheetpile plugs in Cape Sable. This scoping supports the planning process by ensuring that the requirements of the NEPA and DO #12 (NPS 2011) would be fulfilled throughout the planning process.

The internal scoping meeting for this project was conducted on October 21, 2014, at the NPS South Florida Ecosystem Office (Krome Center) in Homestead, Florida. The objectives of the internal scoping meeting were as follows:

- Review project background
- Review NPS NEPA planning process
- Review/refine draft purpose, need, and objectives
- Review/refine draft alternatives
- Discuss preliminary construction means and methods and wilderness minimum tool discussion
- Complete ESF (impact topic discussion)
- Identify consultation needs and contacts
- Plan next steps

4.1.1.1Follow-Up Meeting – East Side Creek.

A follow-up meeting was conducted on November 6, 2014, to discuss the inclusion or exclusion of East Side Creek in the NEPA document. At the internal scoping meeting, the issue was brought up of whether East Side Creek should be included in the study since it is a natural waterway, as opposed to a man-made waterway like the other three waterways in the study (House Ditch, Slagle Ditch, and Raulerson Canal). Additional details of this issue are provided below.

4.1.1.2 Follow-Up Meeting – Climate Change and Sea Level Rise.

A follow-up meeting was conducted on December 3, 2014 to discuss climate change and sea level rise in reference to this project. The purpose of this meeting was to review/update the language on climate change and sea level rise that was prepared as part of the Phase I EA for use with the Phase II EA.

The scoping process was implemented by recording individual comments and responses to questions posed by the facilitator. The results of the internal scoping team's collaborative efforts are presented under the respective headings found in this chapter.

4.1.1.3 Issues and Impacts Identified in the Internal Scoping Meeting.

4.1.1.3.1 Issues

Issues are concerns or topics that need to be considered in the course of developing a successful management strategy that is consistent with governing laws, regulations, policies, and park resources. Issues need to be addressed in the analysis of the proposed management action and its alternatives. Although in some cases the issues may appear repetitive, internal scoping team members identified subtle differences. During the internal scoping meeting, the participants identified the issues listed below to be addressed during the NEPA process for the project.

4.1.1.3.2 Purpose and Need

Can quantifiable objectives be included in the project in order to be able to measure success?

- Not enough monitoring data is available to measure success of the plug projects.

Please not that this section only includes purpose and need related issues that were not able to be directly incorporated into the project purpose and need during the internal scoping process.

4.1.1.3.3 Alternatives

Costs should be considered in the alternative selection.

- An alternative to fully backfill all of the canals is not economically viable or logistically feasible (see Section 2.2, Alternatives Considered but Dismissed).

Please note that this section only includes alternatives related issues that were not able to be directly incorporated into the alternatives (or alternatives dismissed) during the internal scoping process.

4.1.1.3.4 Natural Resources

Tidal influence and the resulting erosional processes are causing increased saltwater intrusion into the interior brackish marshes, as well as sediment transport and freshwater loss.

- Middle Cape Canal is widening at a rate of approximately four feet per year due to tidal influence and erosional processes; the smaller canals and creeks in the Cape Sable region are widening at a rate of approximately two feet per year.
- In coordination with NPS staff, it has been determined that the existing plugs are overtopped approximately 80 times per year.
- The goal of the Cape Sable plugs projects is not to stop the erosional processes and resulting saltwater intrusion into the interior wetlands (since this would likely not be possible due to climate change and sea level rise), but to slow the process and allow time for the ecology of the interior Cape Sable wetlands to adapt to the changes.

Should a plug be placed on East Side Creek since it is a natural waterway?

- Is the widening of East Side Creek the result of human activities (i.e., has the tidal intrusion and erosion increased due to the cutting of the other canals in the region)?
- Was the breach of the marl ridge along East Side Creek likely to occur naturally?
- A review of historical data and aerials is needed to determine the historical conditions at East Side Creek.
- East Side Creek was not yet visible in the 1920s historical aerials.
- Based on the available historical evidence, EVER believes that the erosional processes occurring at East Side Creek are due, at least in part, to the presence and widening of the human-created canals in the region.

4.1.1.3.5 Wilderness

The impacts on qualities of wilderness character need to be considered early in the NEPA process.

- The aesthetic design of the plug structures should consider wilderness quality.
- The wilderness assessment process should have been done before the beginning of the NEPA process.
- The Wilderness Act should be considered in the alternatives development process.
- A minimum tool analysis will need to be conducted in conjunction with the NEPA process. If possible, heavy machinery should not be used in the wilderness areas.

4.1.1.3.6 Engineering

The new plug structures should be placed at the topographic high elevation along the marl ridge.

- Topographic survey data can be used to help determination potential plug location(s) (surveys are being conducted from November 2014 through January 2015 for this project)
- LIDAR data can be used to help determination elevations and potential plug location(s)

The design life of the plug structures should be at least 50 years.

- Additional stabilization options such as the rip-rap protection employed at the Homestead and East Cape Extension Canals should be considered in the design.
- A notched weir could potentially reduce erosional processes on the plug and allow for a longer life.

The design of any plug structures should be based on a hydrologic analysis and the dissipation of tidal wave energy of the structure.

- The length of any new fill plug structures, if used, should be based on a hydrologic analysis and the dissipation of tidal wave energy over the structure.
- The placement and height of sheet pile, if used, should be based on a hydrologic analysis and the dissipation of tidal wave energy over the structure.

4.1.1.3.7 Agency/Public Involvement Issues

Section 7 consultation and close coordination with NOAA Fisheries will need to occur.

- The Section 7 concurrence for the Phase I project included an agreement that the smalltooth sawfish had an ingress/egress route via East Side Creek.
- Any notched weir option should include consultation with NOAA Fisheries (e.g., smalltooth sawfish and manatee passage).
- Would the smalltooth sawfish use a notched weir since they are typically a bottom dwelling species?

Public involvement/controversy is not expected to be a major issue with this project.

- The Phase I project comments were almost entirely in favor of the project.

4.1.1.3.8 Park Management

EVER staff and funding resources should be considered in the NEPA decision-making process.

- The NPS needs to take future maintenance needs into account with the design of the proposed plugs
  - Structure maintenance
  - Exotic plant removal/treatment

4.1.1.3.9 Impacts

Discussions during internal scoping examined the range of potential issues and resources that might be of concern or might be affected during the planning and impact assessment processes.

The impact topics from the NPS ESF were reviewed, as well as any additional applicable impact topics. In total, 31 impact topics were reviewed; 25 impact topics were retained for further consideration in the NEPA document and six impact topics were dismissed from further analysis. The rationale for the anticipated impact will be presented in the NEPA document for the project. Decisions regarding the anticipated impact topics are subject to change as the planning process continues. The impact topics retained below may be later dismissed or combined based on additional data.

During internal scoping, the following 25 impact topics were retained for further consideration in the NEPA document.

- Geologic resources – soils, bedrock, streambeds, etc.
- Air quality
- Soundscapes
- Water quality or quantity
- Streamflow characteristics
- Marine or estuarine resources
- Floodplains or wetlands
- Land use, including occupancy, income, values, ownership, type of use
- Species of special concern (plant or animal; state or federal listed or proposed for listing) or their habitat

- Unique ecosystems, biosphere reserves, World Heritage Sites
- Unique or important wildlife or wildlife habitat
- Unique, essential, or important fish or fish habitat
- Introduce or promote non-native species (plant or animal)
- Recreation resources, including supply, demand, visitation, activities, etc.
- Visitor experience, aesthetic resources
- Archeological resources
- Prehistoric/historic structures
- Cultural landscapes
- Ethnographic resources
- Socioeconomics, including employment, occupation, income changes, tax base, infrastructure, concessions
- Other agency or tribal use plans or policies
- Resource, including energy, conservation potential, sustainability
- Long-term management of resources or land/resource productivity
- Other – Park management and operations
- Other – Wilderness

The following six impact topics were dismissed from further analysis during internal scoping:

- Geohazards
- Rare or unusual vegetation – old growth timber, riparian, alpine
- Museum collections (objects, specimens, and archival and manuscript collections)
- Minority and low-income populations, ethnography, size, migration patterns, etc.
- Energy resources
- Urban quality, gateway communities, etc.

4.1.2 Public Scoping

Public scoping is an early and open process to determine public concerns in relation to a proposed action. Public involvement is an important requirement of the NEPA, especially in determining the appropriate scope of the analysis. In accordance with DO #12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* and NPS Management Policies (NPS 2006), the NPS conducted public scoping for the Cape Sable Plugs Restoration Phase II EA to ensure input from all interested parties. This section documents the result of the public scoping for this project.

The Cape Sable Plugs Restoration Phase II project was first announced to the public on September 2, 2014, in a joint NPS/Everglades Foundation press release. The release stated the NPS is moving forward to address the damage to the ecosystem caused by the eroding plugs and man-made canals.

The public scoping period for the EVER Cape Sable Plugs Restoration Phase II EA was scheduled from February 4 through March 8, 2015 (32 days). The public scoping period was initiated by the NPS by publishing a news release on the NPS EVER website and distributing it to media outlets.

A public scoping newsletter was posted on the NPS PEPC website on February 4, 2015 and was distributed electronically via email to over 3,000 individuals, organizations, and agencies on the park's mailing list. The public scoping newsletter provided background information on the

project, information on how to comment on the project, and the preliminary draft purpose, need, objectives, and alternatives. The newsletter was also re-posted on blogs maintained by several stakeholder organizations.

The April 2012 report, *Engineering Analysis and Feasibility of Repairing or Replacing Failed Dams and Limiting Salt Water Intrusion in Cape Sable, Everglades National Park*, was also posted on the PEPC website to provide in-depth information on the project background and preliminary alternatives (URS 2012). The 2012 Feasibility Study may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

The following questions were posted to PEPC for response by the public regarding the EVER Cape Sable Plugs Restoration Phase II EA:

1. *Do you have any comments or concerns regarding the purpose, need and objectives for this project?*
2. *Do you have any comments or concerns regarding the preliminary project alternatives?*
3. *Do you have any suggestions regarding other alternatives for meeting the project purpose and need?*
4. *Are there any environmental issues or concerns you feel the NPS should address in the EA?*

4.1.2.1 Public Comment Opportunities.

The public was invited to participate and submit comments at any time in the scoping portion of this project. Comments could be provided via the following methods:

- The NPS PEPC website
- E-mail to NPS EVER superintendent or staff
- Hard copy letter to the EVER superintendent

No public meetings were scheduled for this public scoping process. Per Section 5.5C of the NPS *DO #12 Handbook*, "Workshops, meetings, hearings, or other opportunities to give oral input on an NPS EA are not required …" Due to the low public attendance at the public meetings for the Cape Sable Plugs Restoration Phase I project, a decision was made by the NPS EVER superintendent to not hold a public meeting for the public scoping portion of this project. Comments on the published draft EA will be accepted for a minimum of thirty (30) days. Comments received during that time will be incorporated into the final draft EA. If a large number of the public request such a meeting or a particularly large number of comments are received on the project, the potential for a public meeting will be considered for later phases of the project development process.

4.1.2.2 Agency Scoping Process.

In order to solicit agency input on the project, a scoping letter with a copy of the public newsletter was sent to each of the following agencies as well as local, state, and federal elected officials:

- Florida State Clearinghouse (for distribution to state agencies)
- NOAA Fisheries (NMFS)
- USFWS

Agencies were invited to comment directly on the project through PEPC, email to the NPS EVER superintendent, or hard copy letter, or through the Florida State Clearinghouse.

4.1.2.3 Scoping Process with Native American Tribes.

In order to solicit Tribal input on the project, a scoping letter with a copy of the public newsletter was sent to the Miccosukee Tribe of Indians of Florida, the Seminole Tribe of Florida, and the Seminole Nation of Oklahoma. The letters invited the tribes to participate in government-to-government consultation and to provide information or concerns regarding cultural and/or natural resources in the area of the proposed project.

4.1.2.4 Scoping Correspondence and Comments.

During the comment period 42 pieces of correspondence were received with 162 comments. Correspondence was received by one of the following methods: web form (PEPC), hard copy letter, and email (or email attachment). Letters received by hard copy or email were entered into the PEPC system for analysis. Each of these letters or submissions is referred to as correspondence.

4.1.3 Scoping Correspondence.

4.1.3.1 Summary of Scoping Correspondence.

Of the 42 pieces of correspondence received, 29 were received via the PEPC web form, eight via letter, and five via email.

Correspondences were received from the following organization/agency types, as shown in **Table 4.1**.

TABLE 4. 1 - CORRESPONDENCE BY ORGANIZATION TYPE

Organization Type	# Correspondences
Unaffiliated Individual	21
Conservation/Preservation	5
Recreational Groups	5
State Government	5
Federal Government	4
Business	1
Tribal Government	1
Total	**42**

The federal government agencies responding included letters from the USFWS and NOAA Fisheries; two NPS employees also provided responses in PEPC. The state government agencies providing responses included the Florida State Clearinghouse, FDEP, FWC, SFWMD, and SHPO. The Tribal Historic Preservation Office of the Seminole Tribe also provided a response letter.

Responses were received from four states, with 88.1% of the correspondences from Florida; other states included Indiana, Massachusetts, and Maryland.

4.1.3.2 Summary of Scoping Comments.

Correspondence from respondents regarding the Cape Sable Plugs Restoration Phase II EA ranged from strong support for the project to strong opposition to the project. Some of the correspondence also supported some elements of the proposed action, while opposing other elements. The remaining correspondence did not express an opinion clearly supporting or opposing the project, but only provided comments, questions, recommendations, or concerns. The following questions, concerns, and comments were posed in the correspondence received during the public scoping period. The Internal and Public Scoping reports may be reviewed on the project website at http://parkplanning.nps.gov/documentsList.cfm?projectID=56562.

Regarding Question #1 (*Do you have any comments or concerns regarding the purpose, need and objectives for this project?*), 50% of respondents either did not respond or stated that they had no comments for this question. An additional 31% of commenters only stated general support for the project, but did not provide any comment with suggested revisions to the purpose, need, or objectives for the project. Eight responses (19%) provided comments or concerns regarding the project purpose, need, and/or objectives. The two main concerns expressed about the purpose and need for the project were (1) that the project either should not be conducted or may not be necessary in light of climate change and anticipated associated sea level rise in the coming years, and (2) that the plugging of East Side Creek should not be included as part of the project purpose and need since it is a naturally occurring waterway. Other comments on the purpose and need for the project included editorial suggestions, a recommendation to better address wilderness in the purpose and need, and a request to convey the purpose and need in more plain language.

Regarding Question #2 (*Do you have any comments or concerns regarding the preliminary project alternatives?),* 64% of respondents either did not respond or stated that they had no comments for this question. Fifteen commenters (36%) provided comments, concerns, or suggestions about the preliminary project alternatives. Suggestions for alternative design elements included both support for and opposition to a weir or flow-through structure as part of the plug design, both support for and opposition to canoe/kayak ramps, and a request to leave a portion of the canals open for fishing opportunities. Four commenters expressed concerns only about plugging East Side Creek as a natural waterway, while supporting plug alternatives for the other three waterways. Comments were also made in regards to construction methodology and timing. One respondent also requested that a monitoring plan for the plugs be included as part of the alternatives.

Regarding Question #3 (*Do you have any suggestions regarding other alternatives for meeting the project purpose and need?*), 76% of respondents either did not respond or stated that they had no comments for this question. Ten responses (24%) provided suggestions for new alternatives or alternative elements. Comments regarding design elements such as weir or flow-through structure and a canoe/kayak ramp were received, similar to those for Question 2. One respondent asked about what modeling had been conducted regarding the plug alternatives and questioned whether more areas in the Cape Sable area should be plugged at the same time as the proposed waterways. Other commenters either opposed all of the action alternatives or recommended complete backfilling of the canals.

Regarding Question #4 (*Are there any environmental issues or concerns you feel the NPS should address in the EA?*), 62% of respondents either did not respond or stated that they had no comments for this question. Sixteen commenters (38%) provided comments or suggestions regarding environmental issues that should be addressed in the EA document as part of the NEPA analysis. Environmental issues requested to be addressed in the EA document included: threatened/endangered species and wildlife (including game fisheries), climate change and sea level rise, water quality and quantity, and general ecosystem impacts. A few respondents also requested that a monitoring and/or mitigation plan be included as part of the EA.

In the general comments provided by the public, organizations, and agencies, the most common comments received were in reference to general project support or opposition, climate change and sea level rise, wildlife and threatened/endangered species, wilderness, backcountry recreation (non-motorized boating and fishing), new alternatives or elements of design, construction methodology, and monitoring and mitigation. Twenty respondents (48%) expressed general support for the project, and three respondents (7%) expressed general opposition to the project.

4.1.3.3 Comment Analysis Methodology.

Once all correspondence was entered into PEPC, each was read, and specific comments within each correspondence were identified. Once comments were identified, they were assigned a topic (code).

To facilitate this, a coding structure was developed that considered all of the correspondence received. This coding structure was comprised of codes that are established in the NPS PEPC system, referred to as national codes, as well as codes that were developed specifically for this project. The codes selected from the national list and those added that were specific to this project were used to identify the general content of a comment.

During coding comments were also classified as substantive or non-substantive. A substantive comment is defined as one that does one or more of the following (NPS DO #12, Section 4.6A):

- Question, with a reasonable basis, the accuracy of information in the EA;
- Question, with a reasonable basis, the adequacy of the environmental analysis;
- Present reasonable alternatives other than those presented in the EA; and/or
- Cause changes or revisions in the proposal.

Although the above refers to an EA document and not public scoping, the same general concept was applied to the Cape Sable Plugs Restoration Phase II EA public scoping comments. If a comment met one or more of the above criteria, it was categorized as substantive. As further stated in DO # 12, substantive comments "raise, debate, or question a point of fact or policy." Comments in favor of or against the proposed action or alternatives, or comments that only agree or disagree with NPS policy, are not considered substantive.

Under each code, all comments were grouped by similar themes, and those groups were assigned a concern statement. A concern statement is a statement that captures the content of several comments.

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4.3 LIST OF RECIPIENTS OF THE EA

The following federal, state, local, and tribal government agencies, and organizations have been sent a copy of this EA. In addition, elected officials, individuals, businesses, organizations, media outlets, and other groups that have expressed interest in EVER in the past have been sent letters stating that this EA is available for review and comment.

Federal Agencies:

- Advisory Council on Historic Preservation
- National Oceanic & Atmospheric Administration, National Marine Fisheries Service
- National Park Service
- US Army Corps of Engineers
- US Fish and Wildlife Service
- US Geological Survey

State Agencies:

- Florida Department of Environmental Protection
- Florida Division of Historical Resources, Bureau of Historic Preservation
- Florida Fish and Wildlife Conservation Commission
- Florida State Clearinghouse (for distribution to State agencies)
- South Florida Water Management District

Local Agencies:

- Monroe County

Tribes:

- Miccosukee Tribe of Indians of Florida
- Seminole Nation of Oklahoma
- Seminole Tribe of Florida
- William McKinley Osceola Camp

Organizations:

- Audubon Society
- Everglades Coalition
- Everglades Foundation
- Florida Sportsman
- National Parks Conservation Association
- Sierra Club
- The Coalition to Protect America's National Parks

Chapter 5

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CHAPTER 5: REFERENCES

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Chapter 6

Acronyms

CHAPTER 6: ACRONYMS

AIRFA	American Indian Religious Freedom Act
APE	Area Potential Effects
ARPA	Archaeological Resources Protection Act
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practices
CCATF	Miami-Dade County Climate Change Advisory Task Force
CEPP	Central Everglades Planning Project
CEQ	Council on Environmental Quality
CERP	Comprehensive Everglades Restoration Plan
CFA	Core Foraging Area
CFR	Code of Federal Regulations
CWA	Clean Water Act
CY	Cubic Yards
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Programs
dB	Decibels
DDT	Dichloro-Diphenyl-Trichloroethane
DO	Director's Orders
EA	Environmental Assessment
EEWS	East Everglades Wilderness Study
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
ESF	Environmental Screening Form
EVER	Everglades National Park
FAC	Florida Administrative Code
FCMP	Florida Coastal Management Program
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FMC	Fishery Management Council
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact

FS	Florida Statute
FWC	Florida Fish and Wildlife Conservation Commission
GMFMC	Gulf of Mexico Fishery Management Council
GMP	General Management Plan
HAPC	Habitat of Particular Concern
IPPC	Intergovernmental Panel on Climate Change
LED	Light-Emitting Diodes
MBTA	Migratory Bird Treaty Act
MLLW	Mean Lower Low Water
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MWD	Modified Water Deliveries
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPS	National Park Service
NRHP	National Register of Historic Places
NTU	Nephelometric Turbidity Units
NWI	National Wetlands Inventory
OFW	Outstanding Florida Waters
PEPC	Planning Environment and Public Comment
ROD	Record of Decision
SAV	Submerged Aquatic Vegetation
SFWMD	South Florida Water Management District
SHPO	State Historic Preservation Officer
SLOPES	Standard Local Operating Procedures for Endangered Species
SOF	Statement of Findings
SOP	Standard Operating Procedures
T&E	Threatened and Endangered
UMAM	Uniform Wetland Mitigation Assessment Method
UN	United Nations
USACE	US Army Corps of Engineers

U.S.C.	United States Code
USFWS	US Fish and Wildlife Service