ANNEX A
FISH AND WILDLIFE COORDINATION ACT AND ENDANGERED SPECIES ACT COMPLIANCE

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A FISH AND WILDLIFE COORDINATION ACT AND ENDANGERED SPECIES ACT COMPLIANCE

This annex outlines the coordination and compliance under the Fish and Wildlife Coordination Act and Endangered Species Act (ESA).

A.1 Coordination Act Reports

The Final Fish and Wildlife Coordination Act Report (FWCAR) was received from the U.S. Fish and Wildlife Service (USFWS) on 5 December 2019.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960
December 5, 2019

Andrew Kelly, Colonel
District Commander
U.S. Army Corps of Engineers
701 San Marco Boulevard, Room 372
Jacksonville, Florida 32207-8175

Service Consultation Code: 41420-2006-FA-0236
Project: Lake Okeechobee Watershed Restoration Project

Dear Colonel Kelly:

The enclosed report is a final Fish and Wildlife Coordination Act (FWCA) report on the Lake Okeechobee Watershed Restoration Project (LOWRP) for your review. This final FWCA report was based on the Optimized Tentatively Selected Plan as described and analyzed in the U.S. Army Corps of Engineers' (Corps') 2019 Project Implementation Report (PIR). This report is provided by the U.S. Fish and Wildlife Service (Service) in accordance with the FWCA of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*) and, in part, the Endangered Species Act of 1973, as amended (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This final FWCA report provides the Service's continuing guidance and recommendations for the benefit of fish and wildlife resources related to Lake Okeechobee and the downstream ecosystems affected by water releases from the lake.

This report does not constitute a biological opinion as described under section 7 of the ESA. We anticipate sending our final Biological Opinion to the Corps on federally listed species for this project soon. That Opinion addresses the LOWRPs likely beneficial or adverse effects on the Everglade snail kite (*Rostrhamus sociabilis plumbeus*), northern crested caracara (*Caracara cheriway*), wood stork (*Mycteria americana*), Florida grasshopper sparrow (*Ammodramus savannarum floridanus*), eastern indigo snake (*Drymarchon corais couperi*), Florida panther (*Felis* [=*Puma*] *concolor coryi*), Florida bonneted bat (*Eumops floridanus*), West Indian (Florida) manatee (*Trichechus manatus*), and Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*). After ESA consultation is concluded, if significant modifications are made to the selected plan or if additional information involving potential impacts to listed species becomes available, reinitiation of consultation may be necessary.

On June 18, 2018, we provided the Corps with the draft FWCA report and solicited comments from the Florida Fish and Wildlife Conservation Commission, National Marine Fisheries Service, and the Seminole Tribe of Florida. We did not receive any comments from those agencies; therefore, this report constitutes the Secretary of the Interior's recommendations for the LOWRP, in accordance with section 2(b) of the FWCA. The Service expects the Corps' will

incorporate the final FWCA report and recommendations into the final PIR for full consideration, public review, and comment in accordance with the provisions of the National Environmental Policy Act.

Sincerely yours,

Donald R. Progulske

Donald (Bob) Progulske
Everglades Program Supervisor
South Florida Ecological Services Office

Enclosure

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Final Fish and Wildlife Coordination Act Report

LAKE OKEECHOBEE WATERSHED RESTORATION PROJECT

Submitted to:
Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

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Fish and Wildlife Service
South Florida Ecological Services Office
Vero Beach, Florida

December 2019

EXECUTIVE SUMMARY

The Fish and Wildlife Coordination Act represents one of the earliest and most significant indications of the intent of Congress that fish and wildlife considerations were to be a major component of the analysis of projects affecting bodies of water and were to receive equal consideration with other traditional project purposes such as navigation and flood damage reduction. The purpose of this report is to ensure that fish and wildlife issues and recommendations are heard and considered through the decision making chain up to the Administration and Congress. This report assesses the potential benefits and adverse impacts on fish and wildlife resources from the Lake Okeechobee Watershed Restoration Project (LOWRP).

The U.S. Fish and Wildlife Service (Service) recognizes the limitations of the current infrastructure surrounding Lake Okeechobee in dealing with extremes in climate and the inherent tradeoffs among competing project purposes. We have participated throughout formulation of alternatives, and their evaluation and modification in order to find a reasonable balance between achieving project goals and objectives while fulfilling our agency's goal to conserve, protect, and enhance fish and wildlife and their habitats.

The primary purpose of the LOWRP is to capture and store freshwater flows from the watershed at times when excess flows are available and may be otherwise ecologically damaging. Another purpose of the project is to restore wetlands for fish and wildlife habitat. These actions would serve to improve the ecological health of Lake Okeechobee and the downstream estuaries while at the same time maintain or increase the amount of water available for agricultural and residential uses.

The Service recognizes the expertise and diligence of the U.S. Army Corps of Engineers (Corps) and South Florida Water Management District (District) staff in this accelerated planning process. We recognize the complexity in siting a large above-ground water storage feature upstream of Lake Okeechobee and applaud the team's efforts to attempt to build consensus with stakeholders including the Seminole Tribe of Florida. We recognize this project as another important step towards balancing water resource use around Lake Okeechobee and the St. Lucie and Caloosahatchee Estuaries. We appreciate the potential for the restoration of approximately 4,800 acres of wetland habitat along the Kissimmee River, and the sensitivity to site the Wetland Attenuation Feature (WAF) in an area that, in general, has lesser ecological-quality habitat. However, we caution that there are still potential adverse effects that will need additional evaluation. These include the effects of the LOWRP on federally listed species and a high likelihood for remediation of existing chemical contamination in the WAF footprint and possibly other project components. We are optimistic that the agencies can avoid or minimize adverse effects of Aquifer Storage and Recovery on the local fisheries, and commit to our continued involvement in that process. We have provided recommendations at the end this report regarding our most substantial fish and wildlife resource concerns.

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LIST OF ACRONYMS AND ABBREVIATIONS USED IN THE TEXT

AAHU(s)	Average Annual Habitat Units
ac-ft	acre-feet
ASR	Aquifer Storage and Recovery
C&SF	Central and Southern Florida
CERP	Comprehensive Everglades Restoration Plan
CE/ICA	Cost Effectiveness/Incremental Cost Analysis
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
District	South Florida Water Management District
E	Endangered
EAA	Everglades Agricultural Area
ECB	Existing Condition Baseline
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. 1531 *et seq.*)
FDEP	Florida Department of Environmental Protection
FWC	Florida Fish and Wildlife Conservation Commission
FWCA	Fish and Wildlife Coordination Act
FWO	Future Without Project
HHD	Herbert Hoover Dike
HU(s)	Habitat Units
km	kilometers
KRASR	Kissimmee River Aquifer Storage and Recovery
LORS	Lake Okeechobee Regulation Schedule
LOWRP	Lake Okeechobee Watershed Restoration Project
m	meters
MBTA	Migratory Bird Treaty Act
mg/L	milligram per liter
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum 29
NOAA	National Oceanographic and Atmospheric Administration
NWR	National Wildlife Refuge
PDT	Project Delivery Team
PIR	Project Implementation Report
POR	Period of Record
ppb	parts per billion
ppt	parts per thousand (salinity)
RECOVER	Restoration Coordination and Verification
SAV	Submerged Aquatic Vegetation
Service	U.S. Fish and Wildlife Service
SFER	South Florida Environmental Report
SLE	Saint Lucie Estuary
SSC	Species of Special Concern
T	Threatened
TP	Total Phosphorus

TSP	Tentatively Selected Plan
ug/L	microgram per liter
WAF	Wetland Attenuation Feature
WCA(s)	Water Conservation Area(s)
WRDA	Water Resources Development Act
WY	Water Year

I. PURPOSE, SCOPE, AND AUTHORITY

A. Introduction

The Comprehensive Everglades Restoration Plan (CERP) was approved as a framework for the restoration of the natural system under Section 601 of the Water Resources Development Act of 2000 (WRDA 2000). The CERP consists of 68 components to restore, preserve, and protect the South Florida Ecosystem while providing for other water-related needs of the region. Together, these components should benefit the ecology of more than 2.4 million acres of the south Florida ecosystem by improving and restoring the proper quantity, quality, timing and distribution of water made available for the natural system while also addressing urban and agricultural water supply concerns and maintaining the existing levels of flood protection.

Previous ecosystem restoration and water supply planning efforts, including the Central and Southern Florida (C&SF) Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (Restudy) (U.S. Army Corps of Engineers [Corps] and South Florida Water Management District [District] 1999), have established the need for and the beneficial effects of additional storage and water quality treatment in the watershed upstream of Lake Okeechobee as part of the comprehensive plan to achieve restoration objectives. The Lake Okeechobee Watershed Restoration Project (LOWRP) is one of two CERP projects upstream of Lake Okeechobee; the other is the Lake Istokpoga Regulation Schedule. There was an initial planning effort for the LOWRP that began in 2001, but was suspended due to financial constraints around 2006.

B. Purpose and Scope of Project

During the last century, much of the land within the project study area was converted from dry prairie, pine flatwoods, wet prairie, and freshwater marsh to primarily agriculture, and a lesser extent, residential use. This fragmentation or loss of native habitats combined with anthropogenic nutrient pollution has resulted in a reduction in the quality and quantity of native plants and animals in the watershed. The draining of wetland habitat, including the channelization of the Kissimmee River, Fisheating Creek, and other streams has created a flashier hydroperiod that promotes drainage (improved flood control) but also results in rapid stage ascensions in Lake Okeechobee and greater storm-water flows into the northern estuaries. As a result, the integrity of native ecosystems in these areas also suffer. During the dry season, less water is available on the landscape and consequences of drought are more severe. These hydrologic and nutrient changes result in greater colonization of pollution tolerant and exotic invasive species in the watershed, lake, and estuaries.

Lake Okeechobee is constrained by the Herbert Hoover Dike. Lake water levels are regulated by the Corps and District under the Lake Okeechobee Regulation Schedule for water supply, flood protection, navigation, and the natural environment. If lake water levels rise (or are predicted to rise) too high, discharges are made to the northern estuaries where they can be problematic depending on the conditions there. If the lake water levels drop too low, water supply may be reduced. Consensus amongst LOWRP team members and stakeholders is that additional water

storage is needed to keep the lake from staying either too high or too low for too long. Improved stage management would not only result in increased habitat benefits within Lake Okeechobee, but also reduce the frequency of damaging freshwater releases to downstream estuaries.

The Corps and District (2019) have prepared a draft Project Implementation Report (PIR) that described and supported the plan designed to attenuate peak storm-water flows within the watershed, restore wetlands within the watershed, and improve Lake Okeechobee water levels and quality. The increase in water storage and treatment will provide for better management of Lake Okeechobee water levels, a reduction of damaging water releases to the St. Lucie and Caloosahatchee Estuaries, and an increase in restored aquatic habitat. The following management measures will be constructed and operated to achieve these goals:

a) a 13,600-acre Wetland Attenuation Facility (WAF; 5.5 feet maximum depth, and 46,000 acre-feet [ac-ft] storage capacity);
b) 4,800 acres of restored wetlands at the Paradise Run and Kissimmee River-Center sites;
c) 80 Aquifer Storage and Recovery (ASR) wells (55 wells in the watershed and 25 co-located with the WAF); and
d) associated pumps and other infrastructure.

Within the CERP framework, and during the initial LOWRP planning effort in 2001, 10 project goals were identified and organized by their contributions to the 3 overall CERP goals.

CERP Goal # 1: Enhance Ecologic Values
LOWRP Goals:
1. Improve ecological health in Lake Okeechobee and the watershed
2. Improve water quality in Lake Okeechobee and the watershed
3. Reduce damaging freshwater discharges to the northern estuaries

CERP Goal # 2: Enhance Economic Values and Social Well Being
LOWRP Goals:
4. Maintain and enhance municipal, industrial, and agricultural water supply
5. Maintain agricultural and urban flood protection
6. Protect and manage significant cultural, historical, and archeological resources
7. Minimize adverse socioeconomic impacts on the local and regional economies

CERP Goal # 3: Optimize Project Performance and Efficiency
LOWRP Goals:
8. Maximize immediate, interim, and long-term project performance
9. Ensure that the recommended plan is cost efficient
10. Minimize risk and uncertainty of project performance

Subsequent to the initial LOWRP effort, water quality treatment (*i.e.,* phosphorus removal) became less of a project goal requiring alternative formulation and more of an ancillary project benefit. The remainder of the project goals guided the evaluation of alternatives and the

identification of the current LOWRP Tentatively Selected Plan (TSP). Originally, the Restudy (Corps and District 1999) objectives for the LOWRP were to provide: 1) above-ground storage of 200,000 ac-ft of water; 2) below-ground storage via 200 ASR wells; and 3) 3,600 acres of wetland restoration. The geographic scope of the analysis of the alternatives includes the watershed north of Lake Okeechobee, Lake Okeechobee, and the St. Lucie and Caloosahatchee Estuaries (Figure 1).

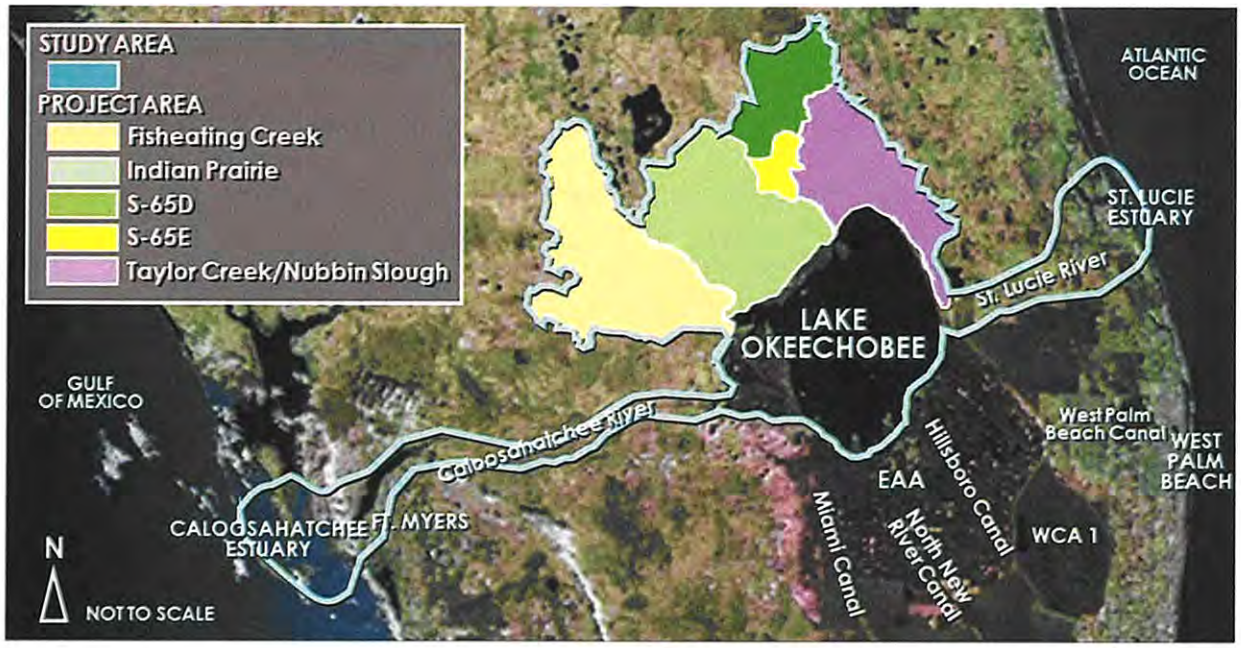

Figure 1. LOWRP study area (figure from Corps and District 2019).

C. Authorities

Authority for this action is the C&SF Project in section 203 of the Flood Control Act of 1948 (62 Stat. 1176). The C&SF Project is a multipurpose project that provides flood control, water supply for municipal, industrial, and agricultural uses; prevention of salt water intrusion; water supply for Everglades National Park; and protection of fish and wildlife resources.

The LOWRP was initiated under the C&SF Restudy, which was authorized by Section 309(l) of the WRDA of 1992 (P.L. 102-580). The WRDA 2000 (section 601) provides authority for the CERP, and provides specific authority for the completion of a PIR.

This final Fish and Wildlife Coordination Act (FWCA) report constitutes the report of the Secretary of the Interior as required by section 2(b) of the FWCA of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*), which establishes fish and wildlife conservation as a co-equal purpose or objective of federally funded or permitted water resource development projects. The FWCA allows for reports and recommendations from the U.S. Fish and Wildlife Service (Service) and the State agency exercising administration over wildlife resources [in this case, the

Florida Fish and Wildlife Conservation Commission (FWC)] to be integrated into Corps' reports seeking authorization for the Federal action. The FWCA also grants authority to the Corps to include fish and wildlife conservation measures within these projects. Other authorities relevant to Service participation in the planning process for this project include the Endangered Species Act of 1973, as amended (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*), the National Environmental Policy Act of 1969, as amended (NEPA) (42 U.S.C. 4321 *et seq.*), and the Migratory Bird Treaty Act (MBTA) (16 U.S.C. § 703 *et seq.*).

II. PREVIOUS SERVICE INVOLVEMENT WITH THE LAKE OKEECHOBEE WATERSHED PROJECT

The Service has participated (and continues to) in a number of CERP and non-CERP initiatives in the Lake Okeechobee and Kissimmee River watersheds. These initiatives serve some of the same functions as the LOWRP (*i.e.,* wetlands restoration, habitat conservation, and water storage). Our responsibilities include providing project planning and operations recommendations regarding fish, wildlife, and plant resources, and ESA consultations. The Service was an important member of the first iteration of the LOWRP Project Delivery Team (PDT; 2001-2006) which included another CERP project, the Lake Istokpoga Regulation Schedule. As part of that initial effort, we identified targets and an evaluation process for the assessment of potential wetlands in need of restoration. The Service has also been an important member of the Regional ASR project team – a technology that is part of the LOWRP. The Service has also participated on project teams and provided input on the Kissimmee River Restoration project, Herbert Hoover Dike Rehabilitation project, and various Lake Okeechobee regulation schedules.

III. AREA SETTING

A. Project Location

The planning area for this project included Lake Okeechobee, and the following drainage basins: Fisheating Creek; Indian Prairie; Kissimmee River (Pools D and E); Taylor Creek; and Nubbin Slough. This included portions of Glades, Highlands, Okeechobee, and Martin Counties. The surrounding downstream areas that were also evaluated for project impacts and benefits included the St. Lucie and Caloosahatchee (Hendry and Lee Counties) Estuaries.

B. Description of Study Area

1. Hydrological Description

a. Lake Okeechobee

The name of the lake derives from the Seminole Indian language, in which "oki" is water and "chubi" is big. Lake Okeechobee is located 30 miles west of the Atlantic Ocean and 60 miles east of the Gulf of Mexico, in the central part of the Florida peninsula. Lake Okeechobee (maximum surface area of 1,732 km^2 or ~428,000 acres) is a shallow (mean depth of 2.7 meters

or 8.8 feet) subtropical lake that is now surrounded (except at the mouth of Fisheating Creek) by the Herbert Hoover Dike. Lake Okeechobee inflows and outflows are controlled by an extensive system of levees, canals, water control structures, and large pump stations. Water flows into the lake primarily from the Kissimmee River (C-38), Fisheating Creek, Nubbin Slough, Taylor Creek, and various canals. Water may flow out of the west side of the lake via S-77 through the Caloosahatchee River (C-43) to the Caloosahatchee Estuary; out of the east side via S-308 through the St. Lucie Canal (C-44) to the St. Lucie Estuary; and out of other structures to West Palm Beach Canals. The Hillsboro, North New River, and Miami Canals drain the Lake to the south into the Everglades Agricultural Area (EAA), Stormwater Treatment Areas, A-1 Flow Equalization Basin, Water Conservation Areas (WCAs), Lower East Coast, remnant Everglades, and Florida Bay.

Water levels in Lake Okeechobee are managed according to a regulation schedule that tries to achieve multiple-use purposes as well as provide seasonal lake level fluctuations. The schedule was designed to maintain a lower lake stage to provide both storage capacity and flood protection for surrounding areas during the wet season. The schedule is also a guide for the management of high lake stages that might threaten the integrity of the Herbert Hoover Dike and thereby risk flooding of downstream lands. During the winter, lake water levels may be increased to store water for the upcoming dry season. This is facilitated by holding water that flows into the lake from the Kissimmee River Basin and occasionally by back-pumping excess storm water from the City of Clewiston, the EAA, or through other structures on the "southern half" of the lake.

Water quality data indicate that Lake Okeechobee is in a eutrophic condition, primarily due to excessive nutrient loads from the agricultural sources both north and south of the Lake. This condition has been exacerbated by the recent hurricanes. In the late 1960s and early 1970s, total phosphorus (TP) concentrations as low as 50 μg/L were routinely measured. Today, the total phosphorus in-lake goal is 40 μg/L, but actual TP concentrations are much higher. According to the South Florida Environmental Report (SFER) (District and FDEP 2018), "in Water Year (WY) 2017, the in-lake TP concentration was 150 μg/L, which is about 27 percent higher as compared to the WY2016 value of 118 μg/L. The current five-year moving (WY2013–WY2017) average TP concentration is 129 μg/L, which is near the upper value of the pre-hurricane (pre-2004) range of 57 to 127 μg/L." It is likely that historic in-lake turbidity was much lower than current conditions as well.

b. Northern Basins of Lake Okeechobee

The Lake Okeechobee watershed is a shallow trough that drains south from the City of Orlando to the Florida Everglades, and is bounded by sand hills of the Lake Wales Ridge on the west and upland marshes of the Osceola Plain to the east. The LOWRP did not encompass all northern basins that flow into Lake Okeechobee. The study team was constrained to the area shown in Figure 1. This area includes the basins of Fisheating Creek, Indian Prairie, the Kissimmee River (Pools D and E only), Taylor Creek, Mosquito Creek, Nubbin Slough, Henry Creek, and Lettuce Creek. Surface water flows in most of the northern watershed are regulated by water control structures.

The roughly 2 million-acre Kissimmee River drainage basin lies north of the lake and provides most of the surface water inflow to the lake (1.33 million ac-ft; Table 1). Fisheating Creek basin encompasses 318,042 acres and flows from the Lake Wales Ridge into the west side of the lake. Indian Prairie is the area drained by the Harney Pond and Indian Prairie canals. Average annual surface flow contributions to the lake are about the same for Fisheating Creek and Indian Prairie basin (both just under 300,000 ac-ft; Table 1). Taylor Creek flows into the north end of the lake but east of the Kissimmee River; however, flows may bypass the City of Okeechobee via the L-63 canal system. The historic confluence of Taylor Creek with the lake today conveys smaller flows mainly comprised of runoff from the city. Mosquito Creek, Nubbin Slough, Henry Creek, and Lettuce Creek all flow into the east side of the lake and drain smaller areas. There are times when these smaller watersheds have little or no flow.

Table 1. The average surface water inflows, total phosphorus (TP) loads, average phosphorus concentrations, and unit area loads, from the Lake Okeechobee sub-watersheds during Water Year 2017 (table from District and FDEP 2018)[a].

Source	Area		Discharge		TP Load		Unit Area Load	Average TP Conc.	Runoff
	(acres)	(%)	(ac-ft)	(%)	(t)	(%)	(lb/ac)	(µg/L)	(inches)
Fisheating Creek Subwatershed	318,042	9.2	296,704	11.9	51	11.3	0.35	139	11.2
Indian Prairie Subwatershed	276,577	8.0	297,831	12.0	68	15.1	0.54	184	12.9
Lake Istokpoga Subwatershed (S-68)	394,203	11.4	349,350	14.1	41	9.1	0.23	95	10.6
Lower Kissimmee Subwatershed [(S-65E) - (S-65)]	429,188	12.4	479,508	19.3	101	22.6	0.52	172	13.4
Taylor Creek/Nubbin Slough Subwatershed	197,795	5.7	170,587	6.9	105	23.4	1.17	498	10.3
Upper Kissimmee Subwatershed (S-65)	1,028,421	29.8	856,133	34.4	73	16.2	0.16	69	10.0
Subtotals for East, West and South Lake Okeechobee Subwatersheds	806,248	23.4	35,104	1.4	10	2.3	0.03	234	0.5
Totals from Lake Okeechobee Watershed	3,450,475	100.0	2,485,217	100.0	449	100.0			
Average Values							0.29	146	8.6
Atmospheric Deposition (t)					35				
Total Loads to Lake Okeechobee (t)					484				

a. Values shown in this table only account for contributions from the basins to Lake Okeechobee. The East, West, and South Lake Okeechobee subwatersheds drain primarily to the east, west, and south, respectively. This table only represents the portion of runoff from these areas that are discharged to the lake. It does not capture contributions from these basins to other basins or other surface waters.

c. Northern Estuaries

The St. Lucie Estuary (SLE) is located east of Lake Okeechobee, and connects to the lake via the St. Lucie Canal (C-44), which discharges into the South Fork of the SLE (if the S-80 structure is open). The SLE flows into the Indian River Lagoon and then Atlantic Ocean via the St. Lucie Inlet. The Caloosahatchee Estuary is located southwest of Lake Okeechobee on the Gulf of Mexico coast. The Caloosahatchee River (C-43) extends from Lake Okeechobee to the Franklin Lock and Dam (S-79) where it empties into the estuary.

Surface water releases from the lake into the SLE are generally lower than into the Caloosahatchee Estuary. For example, water managers operating under the Lake Okeechobee Regulation Schedule (LORS), may send more than twice as much flow to the C-43, as to the C-44 Canal. These freshwater flows may be problematic if they drive salinities too low for the estuarine plants and animal in those areas. Conversely, some low freshwater flows are beneficial in the C-43 to maintain an oligohaline zone from the S-79 downstream to Fort Myers. Occasionally, surface water may gravity back-flow through open locks into Lake Okeechobee from C-44 and C-43 Canals, but lake levels need to be lower than 14.5 and 11.5 feet National Geodetic Vertical Datum 29 (NGVD), respectively (District and FDEP 2018).

2. Ecological Description

The Service has provided summaries of the hydrologic and biological resource values of Lake Okeechobee in several previous FWCA reports to the Corps. Extensive scientific literature and other publications intended for the layman are available. Aumen and Wetzel (1995) edited a thorough compendium of scientific papers that were assembled as a special issue of *Archiv für Hydrobiologie* (45) dedicated exclusively to Lake Okeechobee. In that compendium, Aumen (1995) provides an excellent general description of Lake Okeechobee and the resource issues in the lake. The Corps (1999) issued a final report entitled "Wildlife Utilization and Habitat Utilization Study of Western Littoral Zone, Lake Okeechobee, Florida." The following sections provide brief summaries of the hydrologic and biological characteristics of Lake Okeechobee.

a. Lake Okeechobee

In the late 1860s, Lake Okeechobee was much larger than after 1880 (due to the first local dredging efforts), with an extensive wetland littoral zone along the shoreline. Water levels fluctuated between 17 feet and 23 feet NGVD, and periodically flooded the exposed areas of the low-gradient marsh. Under both high and low conditions, there was abundant submerged and exposed habitat for fish and other wildlife. Today the lake is constrained within the Herbert Hoover Dike, and the littoral zone is much smaller (400 km^2, ~99,000 ac). As a result, when water levels are above 15 feet NGVD, the entire littoral zone is flooded; leaving little habitat for wildlife that requires exposed ground. When lake stages are below 11 feet NGVD, there is little if any surface water on the marsh and therefore, not readily available as habitat for fish and other aquatic life.

At least 40 different fish species exist in Lake Okeechobee. Bull et al. (1995) evaluated fish distribution in Lake Okeechobee using a semi-balloon trawl net between July 1987 and January 1991. They reported that 98 percent of the total catch, in terms of numbers and biomass, was composed of seven species: threadfin shad (*Dorosoma petense*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), gizzard shad (*Dorosoma cepedianum*), white catfish (*Ameiurus catus*), redear sunfish (*Lepomis microlophus*), and bluegill (*Lepomis macrochirus*). In the 1980's, the commercial fisheries generated $6.3 million annually, and consisted of a trotline fishery for catfish (*Ameiurus* spp. and *Ictalurus* spp.), and a haul seine fishery for catfish and bream (*Lepomis* spp.) (Bell 1987). During the same period, the

recreational fishery generated $22.1 million annually and had an estimated asset value of $100 million (Bell 1987).

Prior to the 2004 and 2005 hurricane seasons, the lake provided nationally known, high-quality largemouth bass (*Micropterus salmoides*) and black crappie fisheries. The lake also supports a commercial fishery dominated by catfish species. Over 500 fishing tournaments were permitted by the Florida Fish and Wildlife Conservation Commission (FWC) in 2003. As a result of high lake stages and storm-water inputs associated with the 2004-2006 hurricanes, the fisheries deteriorated, but since then are gradually improving.

As summarized in the 2018 SFER (District and FDEP), 38 different fish species were collected from the lake via nearshore electrofishing. The most abundant species (comprising 81percent of the catch), were threadfin shad, eastern mosquitofish (*Gambusia holbrooki*), gizzard shad, and bluegill. By weight, eight fish species collectively comprised 85 percent of the catch: largemouth bass, Florida gar, striped mullet (*Mugil cephalus*), bluegill, lake chubsucker (*Erimyzon sucetta*), gizzard shad, blue tilapia (*Oreochromis aureus*), and bowfin (*Amia calva*). Trawl sampling in the pelagic zone collected mostly threadfin shad, black crappie, white catfish, channel catfish (*Ictalurus punctatus*), and bluegill. By weight, white catfish, Florida gar, black crappie, channel catfish, and threadfin shad comprised 91 percent of the sample. Long-term fishery trends indicate an increase in forage fish and a relative decline in bass and sunfish; however, there also was strong evidence of production and recruitment of juvenile bass in 2016. The relative abundance of black crappie increased in 2011 and since 2012 has accounted for 19 to 29 percent of the total catch (District and FDEP 2018).

Lake Okeechobee is also a critical concentration point for overwintering waterfowl and other migratory birds along the Atlantic flyway, and supports feeding and nesting of wading birds. According to the 2018 SFER (District and FDEP), as water levels receded in 2017, foraging wading birds became abundant on the lake and included two of the highest single survey numbers in late April and mid-May. "The March to May surveys averaged 10,656 each, totaling the highest number of foraging wading birds recorded since the monitoring program started" (District and FDEP 2018). Despite the high number of wading birds on the lake, the 2017 nesting effort was only average (since the implementation of the LORS in 2008). Lower lake levels, resulting in limited nesting substrate and reduced foraging areas, was implicated in the lower than expected nesting effort (District and FDEP 2018).

Another wading bird, the federally threatened wood stork (*Mycteria americana*) also forages in Lake Okeechobee. There is one active wood stork rookery (named Brighton) about two miles north of the confluence of the Harney Pond Canal and Lake Okeechobee. There is another wood stork rookery in St. Lucie County at Cypress Creek. Wood storks from both these sites could forage in the lake during the nesting season.

Another important avian resource of Lake Okeechobee is the Everglade snail kite (*Rostrhamus sociabilis plumbeus*). Prior to 2010, snail kites would only nest in the lake during spring; however, after 2010 with the coincident increase of exotic apple snails (*Pomacea maculata*), snail kites frequently breed in summer as well (depending on lake stages). Lake Okeechobee has

recently ranked among the most productive in terms of number of snail kites fledged (Fletcher et al. 2014, 2016a, and 2016b). The 2016 nesting effort was the largest observed recently with 221 known-fate snail kite nests (*i.e.,* confirmed to have been successful or failed). In 2017, snail kite nesting success was reduced due to the effects of drought followed by Hurricane Irma, but Lake Okeechobee still accounted for the highest fledgling production (Fletcher et al. 2018). No snail kite nesting occurred in 2019 due to substantially lower than normal lake stages.

Lake Okeechobee is also of particular importance since it serves as a critical stopover point as snail kites traverse the network of wetlands within their range. A loss of suitable habitat and refugia, especially during droughts and low-water in the lake, may have significant demographic consequences (Takekawa and Beissinger 1989; Kitchens et al. 2002; Martin et al. 2006). The south and western littoral zones of the lake comprise part of the designated critical habitat for the Everglade snail kite.

Another federally listed species, the threatened West Indian (Florida) manatee (*Trichechus manatus*), may also be found in Lake Okeechobee. The manatee is further protected as a depleted subpopulation under the Marine Mammal Protection Act (16 U.S.C. 1361-1407). The species was reclassified from "endangered" to "threatened" on March 30, 2017 due to an increased population estimate and improvements in their habitat. Manatees may occupy any inland and coastal waters of south Florida including estuaries, bays, rivers, creeks, and canals (Service 2001) where water control structures allow. According to the Service's geographic information system database, they have been recently observed within Lake Okeechobee and its rim canal (*i.e.,* L-47 Canal), the Kissimmee River (*i.e.,* C-38 Canal), and the C-44 and C-43 Canals. The two most significant threats to the Florida manatee population statewide are collisions with watercraft and the loss of warm water habitat (Runge et al. 2007). Other threats include crushing or entrapment in gates and locks; entanglement in ropes, lines, and nets; ingestion of fishing gear or debris; vandalism; poaching; and exposure to red tide brevetoxin (Bossart et al. 1998).

Manatees may occur year-round in Lake Okeechobee depending on water temperature. From 2000 through 2012 there were 64 manatee mortalities reported from the Lake Okeechobee area. There are no synoptic surveys for manatees in the lake; therefore, the Service relies on mortality reports as a way to indicate manatee occurrence in the lake. The extent and health of submerged aquatic vegetation (SAV; an important forage for the manatee) can dictate the distribution of this species within the lake, canals and estuaries.

One federally listed plant, the endangered Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*) is present along the shoreline of Lake Okeechobee. The Okeechobee gourd is an annual or perennial vine endemic to Florida, known to occur in natural and man-made islands around the northwestern and southern portions of Lake Okeechobee. In Lake Okeechobee, the most stable colonies occur in the southeastern quadrant on Torry, Kreamer, and Ritta Islands. Lake water levels can affect this plant's success by drowning out individual plants (if too deep) or may facilitate seed dispersal.

b. Northern Basins of Lake Okeechobee

When Hamilton Disston signed the drainage contract with the State of Florida in 1881, he not only received title to 4 million acres of Florida real estate, he was also committed to reclaiming much of that acreage. One of the first tasks was to dredge a navigable waterway from the cow camp that would become the town of Kissimmee down the twisting and turning Kissimmee River to Lake Okeechobee. As of 2017, the Corps and District have spent about $732 million of the total estimated $759 million needed to reverse Disston's improvements and recover a good portion of the hydrologic and ecologic integrity of the Kissimmee River. The 2018 SFER (District and FDEP) identifies the restoration successes to date and boasts improvements to wading bird abundance and nesting, waterfowl abundance, and dissolved oxygen concentration in the river channel (for improved fisheries).

Wetland restoration (via Natural Resources Conservation Service programs) has been ongoing in the upper Fisheating Creek basin recently. The middle portion of the basin has some of the best forested habitats in the study area; unfortunately, the downstream-most 5 or 6 miles (as the crow flies) is surrounded by improved pasture and likely contributes considerable sediment and nutrients to the lake during storm events. The habitat in the Indian Prairie Basin outside of the Brighton Reservation of the Seminole Tribe of Florida is primarily pasture and rangeland with some wetlands characterized by various amounts of drainage. Habitat for plants and animals is better within the Brighton Reservation as noted by the stronger wetland signature on the landscape. Habitat in the Taylor Creek and Nubbin Slough basins is 60 percent pasture (improved, unimproved, and woodland types) with equal amounts of wetlands and residential land uses (both about 9 percent).

The increase in acres of pasture habitats around Lake Okeechobee has likely improved the baseline condition for one federally listed species, the threatened Northern crested caracara (*Caracara cheriway*). The caracara is a resident, non-migratory falcon that occupies grassland, dry prairie, and pasture habitats in central Florida, southwestern United States, and Central America. The caracara is most abundant in a five-county area that includes Glades, DeSoto, Highlands, Okeechobee, and Osceola Counties, and therefore, almost the entire LOWRP study area.

c. Northern Estuaries

The St. Lucie and Caloosahatchee Estuaries have some of the most important ecological, recreational, and commercial lands in the study area. Estuaries, just by their nature of being in a transitional zone between salt water and fresh water, harbor many different plant and animal species and are nursery areas for important marine fish and shellfish species. The Indian River Lagoon (where the SLE discharges) has been touted as the most biologically diverse estuary in North America. Both the St. Lucie and Caloosahatchee Estuaries support ecologically valuable oyster and seagrass beds. These areas provide the base for much of the estuarine diversity; however, they are at increasing risk due to poor water quality that includes high nutrient concentrations and salinity imbalances.

3. Fish and Wildlife Resources

a. Federally Listed and Candidate Species

The Service identified one plant and eight federally listed vertebrate species that may occur within or around the LOWRP component footprints or otherwise be affected by the project. Consultation under the Endangered Species Act for the LOWRP is ongoing; we expect to complete the final Biological Opinion soon for the eastern indigo snake, crested caracara, and Florida bonneted bat. The federally listed species in the LOWRP area include:

- endangered Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*)
- endangered Florida panther [*Felis (=Puma) concolor coryi*]
- threatened West Indian (Florida) manatee (*Trichechus manatus*)
- endangered Florida bonneted bat (*Eumops floridanus*)
- endangered Everglade snail kite (*Rostrhamus sociabilis plumbeus*)
- threatened wood stork (*Mycteria americana*)
- endangered Florida grasshopper sparrow (*Ammodramus savannarum floridanus*)
- threatened northern crested caracara (*Caracara cheriway*)
- threatened eastern indigo snake (*Drymarchon corais couperi*)

Another species, the whooping crane (*Grus americana*) is present in Florida as an experimental population only, and therefore, is not protected in Florida under the ESA, but is still protected under the MBTA. As of spring 2017, the Florida whooping crane population includes 14 birds (4 males, 8 females, 2 unknowns), including 4 pairs (data available at https://ebird.org/home).

Additionally, critical habitat for the snail kite (see 50 CFR 17.95) is present within the study area along the western edge of Lake Okeechobee from the S-310 structure near the town of Clewiston to the point of confluence of the Kissimmee River (C-38) with Lake Okeechobee. Critical habitat for the manatee is also present in the St. Lucie and Caloosahatchee Estuaries.

In addition to those species regulated by the Service, we encourage the Corps to consult with National Oceanographic and Atmospheric Administration (NOAA) Fisheries regarding possible effects of the project on listed species under their jurisdiction. These could include Gulf sturgeon (*Acipenser oxyrinchus desotoi*), shortnose sturgeon (*Acipenser brevirostrum*), smalltooth sawfish (*Pristis pectinata*), Johnson's seagrass (*Halophila johnsonii*), and sea turtles.

b. State-listed Species

The State of Florida lists the following species as Endangered (E), Threatened (T), or Species of Special Concern (SSC) and are expected to occur in the general study area:

- American alligator (*Alligator mississippiensis*), T – for similarity of appearance to the federally threatened American crocodile (*Crocodylus acutus*)
- Florida brown snake (*Storeria dekayi victa*), T

- Florida pine snake (*Pituophis melanoleucus mugitus*), T
- gopher tortoise (*Gopherus polyphemus*), T
- short-tailed snake (*Stilosoma extenuatum*), T
- American oystercatcher (*Haematopus palliates*), T
- black skimmer (*Rynchops niger*), T
- burrowing owl (*Athene cunicularia*), T
- Florida sandhill crane (*Grus canadensis pratensis*), T
- Kirtland's warbler (*Dendroica kirtlandii*), E
- least tern (*Sternula antillarum*) T
- little blue heron (*Egretta caerulea*), T
- piping plover (*Charadrius melodus*), T
- reddish egret (*Egretta rufescens*), T
- roseate spoonbill (*Ajaia ajaja*), T
- snowy plover (*Charadrius alexandrinus*), T
- southeastern American kestrel (*Falco sparverius paulus*), T
- tricolored heron (*Egretta tricolor*), T
- Sherman's fox squirrel (*Sciurus niger shermani*), SSC
- Homosassa shrew (*Sorex longirostris*) SSC

c. Other Fish and Wildlife Resources

Lake Okeechobee provides habitat for fish and wildlife resources of direct monetary value (commercial and recreational fisheries, waterfowl hunting, alligator hunting) and of inestimable indirect value in terms of tourism, quality of life, and the survival of many threatened, endangered, and rare species. Furse and Fox (1994) estimated the value of five different vegetative communities in the lake in supporting the commercial and recreational fisheries, which they then estimated to have a "total economic value" in excess of $480 million. The economic effect of a healthy lake ecosystem on non-consumptive recreational activities in the lake may be more difficult to measure, but it is becoming more significant. Examples of non-consumptive uses of the lake include airboat tours, birding expeditions, and educational field trips. According to FWC data, the number of annual permitted fishing tournaments on Lake Okeechobee has averaged 464 over the last five years (*i.e.,* 2013 to 2017) with a recent maximum of 493 tournaments in 2015.

Hydrologic changes along with additional nutrient inputs have fostered the rapid expansion of nuisance exotic plants in the watershed and lake littoral zone. Exotic plants species in the lake include water hyacinth (*Eichhornia crassipes*), tropical American watergrass (*Luziola subintegra*), melaleuca (*Melaleuca quinquenervia*), torpedograss (*Panicum repens*), and water primroses (*Ludwigia* spp.). Cattails (*Typha* sp.) have expanded in areas of the littoral marsh directly in contact with phosphorus-enriched water. As a result, more frequent fire and herbicide treatments are needed to control exotic or nuisance plant growth.

In addition to exotic plants, the lake now also contains a large and growing number of exotic animals, including an Asiatic clam (*Corbicula fluminea*), purple swamphen (*Porphyrio*

porphyrio), and several species of fish (e.g., sucker mouth catfish [*Hypostomus plecostomus*], blue tilapia [*Oreochromis aureus*], and Mayan cichlid [*Cichlasoma urophthalmus*]), whose negative impacts have not yet been documented.

IV. FISH AND WILDLIFE RESOURCE CONCERNS

A. Introduction

The Service expects this project to be beneficial to the management of water resources within Lake Okeechobee, and to a lesser extent the St. Lucie and Caloosahatchee Estuaries. We appreciate the importance of this project to improve water quality and timing of surface flows from the basins into Lake Okeechobee, and to restore aquatic habitats in wetlands such as Paradise Run and along the Kissimmee River. The principal focus of this report is the protection, conservation, and enhancement of fish and wildlife habitats in the region, consistent with the project purposes. The restoration goal for Lake Okeechobee is the attainment of a resilient, productive, lacustrine ecosystem supporting a diverse assemblage of fish and wildlife while providing for the water supply needs of the region.

Historically, Florida lakes had a natural, rainfall-driven rising and lowering of lake stage. These intra-annual fluctuations have become more extreme due to drainage of the landscape for flood protection of residential and agricultural lands. The wetland "sponge" that once soaked up the rainy season's precipitation, and then slowly supplied downstream areas with water throughout the dry season are greatly reduced in spatial extent. Approximately 65 percent of historical wetlands in the LOWRP study area north of Lake Okeechobee are completely gone.

Lake Okeechobee's depth and water quality have implications for fish and wildlife values throughout south Florida. Adverse effects of drought or wet seasons with extremely high rainfall can affect the lake for either short periods or for durations of two or more years. Regulatory releases from the lake can have dramatically adverse consequences in the St. Lucie and Caloosahatchee Estuaries. The influence of water management in the lake's watershed can also affect hydropatterns and water quality in the Greater Everglades. The Lake Okeechobee conceptual model (Havens and Gawlik 2005) demonstrates the complex interactions among various environmental stressors affecting the lake.

B. Resource Concerns

1. Effects of Lake Stages on Lake Okeechobee

Prior to the hurricane season of 2004, the littoral zone of Lake Okeechobee was highly productive and sustained a good diversity of fish and wildlife. It is the area most affected by changes to lake stages (as dictated by the regulation schedule). Variations in water depth and the duration of inundation control the vegetative communities of the littoral zone, the total area of the lake available as habitat for aquatic animals, and the availability of aquatic prey for higher consumers, particularly wading birds. Havens et al. (1996b) found that the littoral zone had a greater trophic complexity than open water habitats. Many of the additional species in the

littoral zone that are not found in the pelagic zone are large predators (14 species of adult fish and 14 species of birds), but the majority of the additional taxa (54) are macroinvertebrates. The effects of water regulation in the lake on phytoplankton, periphyton, and benthic invertebrates are passed through the food web to readily observable losses in biodiversity at higher trophic levels.

Extremely low lake levels desiccate the littoral zone. When lake levels drop to 11 feet, approximately 94 percent of the littoral marsh is dry and no longer functions as habitat for fish and other aquatic-dependent wildlife (District 2000). Additionally, a dry littoral zone may facilitate the spread of exotic invasive species such as torpedo grass and Melaleuca. One of the ecologically valuable, aquatic communities that becomes dry when the lake drops below 11 feet is dominated by spike rush (*Eleocharis cellulosa*). This community is of particular concern because it supports the population of native apple snails (*Pomacea paludosa*) - food for the endangered snail kite. Spike rush is particularly valuable habitat for foraging snail kites because its moderate stem density accommodates the bird's visual hunting behavior. Maintaining clear water and a sandy-bottom littoral habitat with emergent vegetation is necessary to support a healthy native apple snail population (Darby et al. 2004). The western littoral zone of Lake Okeechobee is important habitat for the Everglade snail kite and is designated critical habitat.

During periods of extreme high lake levels (>17 feet), wind and erosion cause emergent and submerged plants to be torn loose from their substrates, resulting in a loss of important fish and wildlife habitat. When lake levels exceeded 17 feet in 1995 and 2004, large sections of bulrush (*Scirpus californicus* and *S. validus*) were lost. These plants occur at the interface between the pelagic and littoral zones where they are exposed to wave action and constitute prime habitat for largemouth bass and black crappie, two of the most important recreational fishes in the lake (Furse and Fox 1994). According to Steinman et al. (2002) at least three other adverse ecological effects can result from extended periods of high water levels within Lake Okeechobee:

- less light reaches the bottom of the lake, resulting in loss of submerged vegetation;
- phosphorus concentrations increase to unacceptable levels in the nearshore regions, as sediments are transported from the central mud zone toward the littoral zone; and
- more favorable conditions result for the spread of exotic, invasive species in the lake's marsh zone.

Milleson (1987) correctly predicted that prolonged inundation of the littoral zone by stages over 15 feet would reduce the diversity of the marsh vegetation and would adversely affect waterfowl, wading birds, reptiles, fish, and other species that depend on the lake's littoral and nearshore zones. Bull et al. (1995) found significant negative correlations between water depth at sample sites in the lake's pelagic zone and the abundance of threadfin shad and bluegill, while increased depth was positively correlated with abundance of white catfish and black crappie. Additional study is needed on the effect of lake stage on the standing stock and reproductive success of fish in the littoral zone.

2. Effects of Poor Water Quality on Lake Okeechobee

Havens (1997) provided a review of ecological changes in Lake Okeechobee caused by cultural eutrophication and discussed the relationships between higher lake stages and increased total phosphorus concentrations in the pelagic zone of the lake. Janus et al. (1990) and Maceina (1993) hypothesized that higher lake stages increase the incidence of algal blooms. An algal bloom in August 1986, covering 300 km^2 (74,000 acres) caused the death of thousands of apple snails in the western littoral zone of the lake, part of the designated critical habitat for the endangered snail kite, which feeds almost exclusively on apple snails. On July 2, 2016, NASA recorded a cyanobacteria bloom in Lake Okeechobee (https://earthobservatory.nasa.gov/IOTD/view.php?id=88311), and subsequent discharge of that water to the SLE was implicated in thick masses of floating algae that blocked waterways and necessitated human health advisories.

The concentration of total phosphorus in the lake nearly doubled from 49 parts per billion (ppb) in 1973 to 98 ppb in 1984 (Janus et al. 1990). Despite some progress in reducing phosphorus loading rates to the lake through implementation of Best Management Practices upstream of the lake, the 40 ppb (or μg/L) target (total phosphorus concentration) is still not being met. Recently, the Blue-Green Algae Task Force recommended increased compliance, improved data collection and record keeping to promote transparency and accountability for agricultural Best Management Practices (FDEP 2019). Even with reduction of phosphorus loading from external sources, internal phosphorus loading from re-suspension of phosphorus-rich sediments that have built up in the lake may affect water quality in the lake for several decades (Havens et al. 1996a; Steinman et al. 1998).

Warren et al. (1995) found that the benthic invertebrate communities of Lake Okeechobee's sublittoral zone were of relatively poor quality and that shifts toward dominance of more undesirable species (indicative of highly eutrophic conditions) have occurred at a rapid rate. Higher lake stages are likely to increase the transport of nutrient-rich water from the pelagic zone to the littoral zone, which would ultimately reduce the diversity of the invertebrate community in the littoral zone, which has a higher diversity of benthic invertebrates than the sublittoral zone (Havens et al. 1996b).

Havens and James (1999) suggested that observed declines in water transparency could be explained by the migration of mud sediments from mid-lake towards the littoral zone along the southwestern shore. This migration of sediment would be more likely to occur under extended periods of high water and could have severe impact on the primary productivity of the littoral zone. The reduction in water clarity, which is more likely to occur with a combination of high average water stages and storms, can have an adverse effect not only on SAV, but also the extremely important periphyton community. Similar to the Everglades, a healthy littoral zone in Lake Okeechobee sustains periphyton, which is a nutritious food base for grazing invertebrates and fishes, such as grass shrimp (*Palaemonetes paludosus*), apple snails, flagfish (*Jordanella floridae*), and sailfin mollies (*Poecilia latipinna*). These fish and invertebrates rely on the primary production of periphyton and form a key linkage in the food chain to commercially and recreationally important fish and wildlife. The remaining bulrush stems on the outer edge of the littoral zone have been largely lacking periphyton (Fox 2007), likely due to a combination of

physical scouring of the stems and the lack of light penetration, both of which can be correlated with high water levels. The increased turbidity following the 2004 and 2005 hurricane seasons has also seemed to retard regrowth of periphyton on the stems of emergent vegetation that survived physical damage from the storms.

3. Loss or Fragmentation of Habitat in the Watershed

Historically, the natural vegetation of the Lake Okeechobee watershed was a mix of wet and dry prairies, freshwater marshes, hardwood swamps, cypress swamps, mesic temperate hammock, and pine flatwoods. These habitats for native plants and animals have been substantially altered by human activities. These activities include the removal of native vegetation and soil disturbance for various agricultural or residential purposes, and construction of ditches, canals, and water control structures that may rapidly drain water into Lake Okeechobee.

Today, the largest land use in the watershed is agriculture (about 60 percent). Approximately 85 percent of this is improved pasture, and indicates cow-calf operations. Urban, residential and commercial land uses comprise about 5 percent of the project area and are primarily in and around the City of Okeechobee, or distributed along the northern shore of Lake Okeechobee. Roughly, one-third of the watershed remains as natural lands or open water.

Some wetlands have been irretrievably lost due to drainage and land use conversion. There has been an approximate 65 percent loss in wetland spatial extent across the study area. Many more wetlands, even though they still exist, have lost some functionality. Most notably was the channelization of the Kissimmee River. The loss of forested riverine wetland systems has degraded corridors, which hampers the ability of wildlife to move across the landscape. The loss of isolated wetlands has adversely affected amphibian populations. All these changes provide opportunities for the colonization of the watershed by problematic exotic plants and animals.

4. Chemical Contamination in the Watershed

In residential and agricultural areas of the Lake Okeechobee watershed, the historical use of pesticides and other synthetic organic compounds may result in chemical residues in soils, ground water, surface water, and sediments. Sediments can be particularly important because many of these organic compounds selectively adsorb to sediment particles. As a result, these materials have the potential to adversely affect aquatic benthic communities and the food web, or can be suspended and directly affect the quality of surface waters.

For example, during a 2006 evaluation of a property in the Paradise Run area of the LOWRP footprint, District contractors found contamination by selenium, 4,4′ DDD, 4,4′ DDE, and chlordane in a former tomato farming area. In addition, extremely low levels of the pesticides 2,4-DB, endosulfan I, endosulfan sulfate, endrin aldehyde, endrin keytone, heptachlor, heptachlor epoxide, and paraquat were detected. Selenium was also detected in canal sediment. Total recoverable petroleum hydrocarbons and several polycyclic aromatic hydrocarbons were found in soils near pump stations. In cattle pen areas, arsenic, organochlorine and organophosphate pesticides, toxaphene, lindane, coumaphos, endosulfan sulfate, and endrin

keytone were found. Ground water sampling detected dieldrin, arsenic, and MCPA ([2-methyl-4-chlorophenoxy] acetic acid). Many of these areas may be remediated by soil removal. Other areas may require different remediation techniques before they are suitable for water storage or restoration features. Fortunately, there are cross-agency chemical sampling and assessment procedures.

5. Effects to Northern Estuaries

Water management of Lake Okeechobee can directly effect estuarine health due to the relationship between regulatory lake releases and the salinity within the estuaries. Maintaining desired estuarine salinities to support the wide range of plant and animal communities requires a balance of water management and seasonal rainfall fluctuations. During the dry season, freshwater flow to the estuaries should be reduced, or even eliminated, which results in a rise in salinity within the estuarine systems. For the SLE, local basin runoff is enough to maintain minimal freshwater input into the estuary, except in the driest years; however, the Caloosahatchee estuary depends on fresh water releases from Lake Okeechobee or the local basin to maintain a healthy ecosystem during the dry season, particularly during drought conditions. Conversely, during the wet season, excessive flows of fresh water from the lake to both estuaries lower the salinity to damaging, and sometimes destructive, levels. Current performance measures use freshwater flow inputs as a surrogate measure for desirable salinity conditions within the estuaries.

a. Caloosahatchee Estuary

The natural and historic gradient of salinity zones within the Caloosahatchee Estuary and San Carlos Bay serve as important nursery, feeding, and refugia areas for juvenile stages of desirable sport and commercial fishes. At least 70 percent of Florida's recreationally-sought fishes depend on estuaries for at least part of their life histories (Harris et al. 1983; Estevez 1998; Lindall 1973). Excessive variation in fresh water flows and salinity force estuarine biota into a constant flux between those favoring higher salinity and those favoring lower salinity (Bulger et al. 1990). Consequently, optimal salinity conditions may not last long enough for organisms to complete their life cycle and the estuary can become devoid of some populations, even keystone species that support major ecosystem components along an estuary's salinity gradient such as fresh and salt water SAV and/or oysters.

Tape grass (*Vallisneria americana*; also called eel grass) is the dominant oligohaline SAV in the upper Caloosahatchee estuary, including 40 acres of the Caloosahatchee National Wildlife Refuge (NWR). It occurs in well-defined beds in shallow water and is important habitat for a variety of freshwater and estuarine invertebrate and vertebrate species, including some commercially and recreationally important fishes (Bortone and Turpin 1999) and migratory waterfowl. During times of extended low inflow conditions, when salinity is too high, tape grass becomes very sparse or can disappear (Chamberlain et al. 1995; Doering et al. 2002; District 2000).

A substantial loss in the extent of seagrass coverage has occurred in the lower estuary (Harris et al. 1983). Each species of SAV has a specific temperature and salinity tolerance range and their tolerance towards variations in salinity are similar to their tolerances for temperature. Furthermore, estuarine plants and animals are well adapted to and depend upon natural seasonal changes in salinity. When salinity falls outside of these normal and seasonal ranges, it may result in a reduction in densities and shifts in distribution of SAV species and organisms dependent upon these productive habitats (Chamberlain and Doering 1998).

Salinity is also important in determining the distribution of coastal and estuarine bivalves, such as oysters. Short pulses of freshwater inflow can greatly benefit oyster populations by killing predators, while excessive freshwater inflows may kill entire populations of oysters (Gunter 1953; Schlesselman 1955; MacKenzie 1977). Although a substantial oyster population still exists within the lower Caloosahatchee Estuary, historical accounts of the river indicate that oysters were once a more prominent feature in the area upstream (Sackett 1888). As individual oysters die, they leave empty compartments for various estuarine residents. Volety et al. (2003) found that a greater abundance of decapods and fishes were associated with clusters of live oysters compared to dead-articulated clusters, while the structure provided by both living and dead oyster shells supported a greater abundance of these estuarine organisms than no shells at all.

b. St. Lucie Estuary

The ecological problems within the SLE are very similar to those experienced by the Caloosahatchee in terms of damage to estuarine plant and animal communities. Ecological harm from high flows to the SLE causes serious public concern. The North Fork of the St. Lucie River, which normally averages 18 parts per thousand (ppt) salinity decreases to 0 ppt during peak flows. Portions of the SLE that normally average 24 ppt decrease to 5 ppt, and the Indian River Lagoon, which normally averages 30 ppt, decreases to approximately 20 ppt. The high volume freshwater discharges may coincide with a high incidence of fish with lesions and public health warnings due to harmful algae blooms.

In addition to the deleterious effect that freshwater releases from Lake Okeechobee have on salinity, direct impacts on the water quality of the estuary are felt, including conveyance of silts, sediments and other pollutants to the estuary. Because of local runoff from agricultural and urban development within the watershed, even in the absence of Lake Okeechobee discharges, the desirable salinity envelope of the estuary is often violated by too much fresh water entering the estuary.

6. Habitat Conversion in the Wetland Attenuation Feature

The current land cover in the future 13,600-acre WAF footprint is mostly improved pasture (11,213 acres) with about 330 acres of rangeland or unimproved pasture. About 1,058 acres are wetlands (91 percent is freshwater marsh), and about 600 acres were classified as either upland cabbage palm or oak-cabbage palm forest (Corps and District 2019). The WAF is a flow-through, constructed wetland used for surface water storage to attenuate peak flows and stages in

Lake Okeechobee. The WAF will receive surface water when available from either the C-41A Canal or ASR discharges. Current design has three cells with a maximum depth in the center cell of 5.5 feet. A 1,600 cfs pump on the C-41A Canal, will fill the upstream (north) cell. Water levels in the north cell may fluctuate frequently up to 4 feet (Figure 2), likely providing little habitat for fish and wildlife. Water levels in the center and south cells should fluctuate less, but it is still unclear what types of wildlife they might support. ASR wells associated with the WAF could discharge to the south cell. The Corps is not claiming any wildlife benefits within the WAF footprint. The conversion to wetland-type habitat is likely to force upland species to move off the site (*e.g.,* sandhill cranes, crested caracaras, eastern indigo snakes); however, it may benefit other species capable of utilizing these depth ranges after construction (*e.g.,* water fowl, smaller fish, otters, turtles, alligators, invertebrates, apple snails, snail kites, etc).

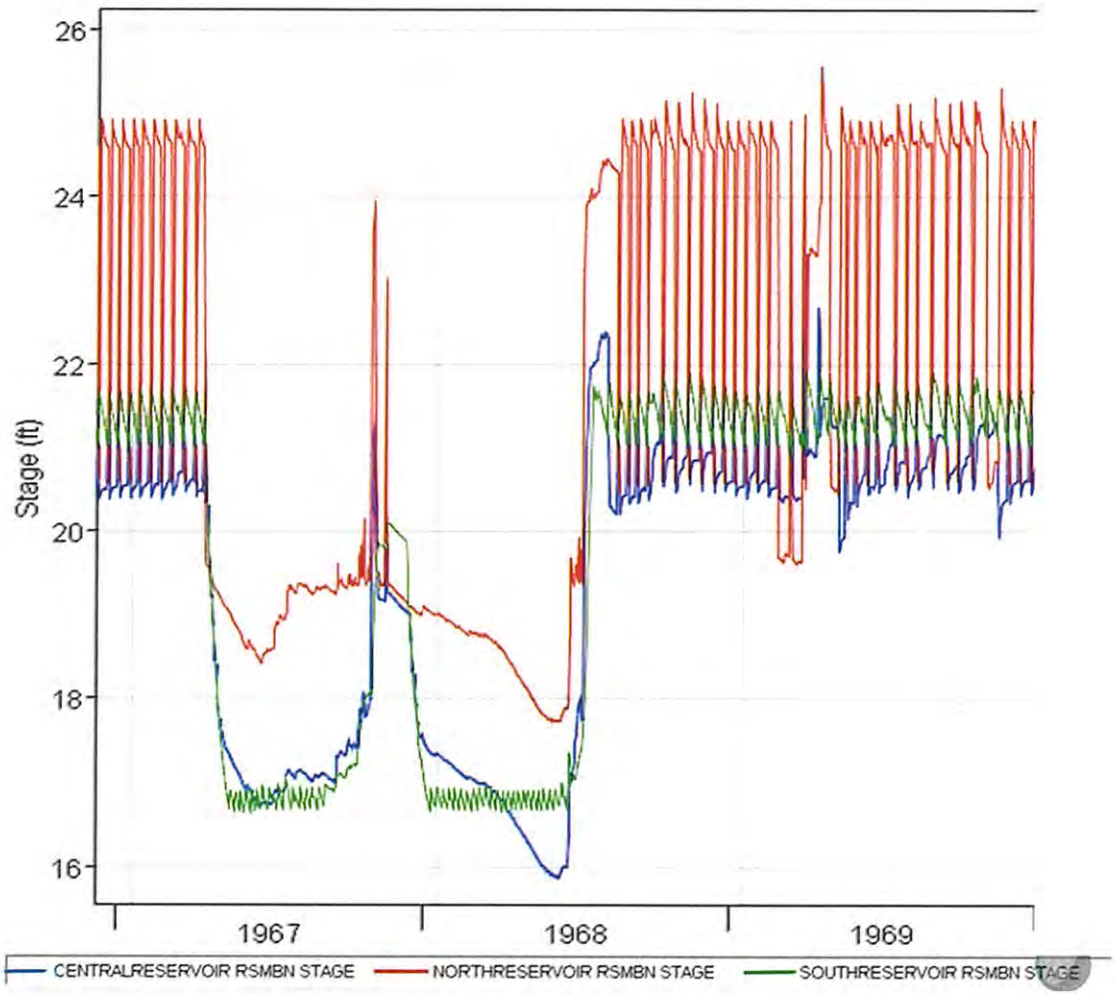

Figure 2. Simulated (Regional Simulation Model – Basins) stages in the three WAF cells (red = north, blue = center, and green = south) during lower water conditions (latter 1967 into 1968) and more normal rainfall periods (latter 1968 through 1969) (figure from LOWRP meeting on December 19, 2018).

7. Fishery Impingement and Entrainment Concerns

The pumping of surface water, either into the WAF or during ASR recharge, represents a potential threat to fish and other aquatic resources through entrainment and impingement at the intake structures. Entrainment occurs when an organism is drawn into a water intake and cannot escape. Impingement occurs when an entrapped organism is held in contact with the intake screen and is unable to free itself. The severity of the impact on the fisheries resource depends on the abundance, distribution, size, swimming ability, and behavior of the organisms near the intake, as well as water velocity, flow and depth, intake design, screen mesh size, installation and construction procedures, and other physical factors (Canadian Department of Fisheries and Oceans, 1995).

Based on limited sampling at the Kissimmee River pilot ASR (KRASR) site (six composite samples were collected on January 25 and 26, 2012), fish larvae were entrained through the intake structure. The KRASR intake was designed to limit impingement and entrainment by installation of a wedgewire screen with a pore size of 1 mm and an anticipated intake velocity at the screen face of ≤ 0.25 feet/second. Any fish species that spawns in areas where pumps are pulling surface water have an increased risk of larval entrainment. The larval and post-larval stages of black crappie are especially at risk because after the channelization of the Kissimmee River, Pool E became a favorite spawning location for this species. The typical spawning period for black crappies at this location is protracted, from January to May. Adults prefer to nest in colonies in shallow water near aquatic vegetation. A few days after hatching, post-larvae disperse from the nest area and eventually move to deeper water near the middle of the channel. Fry move vertically throughout the water column primarily to forage on zooplankton and secondarily to avoid predation. They follow the currents downstream into Lake Okeechobee. Their spawning requirements increase the likelihood that in the lower Kissimmee River, nest sites may be near intakes. The larval and post-larval stages are poor swimmers and would probably be unable to escape intake velocities (0.25 feet/second) once drawn into the intake flow-field. This is important to note not only for those fish hatching or near the shoreline, but also for those that may be drifting down from upstream spawning locations (including open-water spawners like threadfin or gizzard shad). However, larvae would probably need to be very close to the intakes (within a few meters) to be at risk.

The KRASR intake was also sampled for stream invertebrates. Large amounts (no counts were made) of invertebrates were collected, including zooplankton, Chironomidae (midge larvae), *Chaoborus* sp. (glassworm or phantom midge larvae), and amphipods (probably *Hyalella* sp.). From this limited 2012 sampling event, it does seem likely that ASR or other surface water pumps could reduce the numbers of these types of small invertebrates in the C-38 or C-41A (downstream of the S-84) in direct proportion to the number of days of operation and the number of intake locations. Therefore, the likelihood of any invertebrate entrainment was characterized as high (Corps and District 2014).

8. Temperature and Dissolved Oxygen Concerns from ASR Discharges

The effects of temperature and dissolved oxygen changes in the receiving stream, caused by ASR discharges, could affect the fisheries. Water temperature in the Kissimmee River varies with air temperature and may range from a minimum of 13 °C (55.4 °F) during January and February to a maximum of 30.5 °C (86.9 °F) during July to September. According to the District (2005), channelization of the river has resulted in chronic low dissolved oxygen conditions and concentrations that vary from zero to 4 mg/l for much of the year, but may range as high as 9 mg/l (in February, when water temperatures are low). However, after restoration of the river, the District expects dissolved oxygen concentrations will increase from <1–2 mg/l to 3–6 mg/l during the wet season and from 2–4 mg/l to 5–7 mg/l during the dry season. The dissolved oxygen levels reported for Pools A and C (District 2005) are slightly lower than the more recent sampling in Pool E that was conducted for the KRASR facility. The KRASR sampling indicated higher monthly average dissolved oxygen concentrations in the river (always above 2 mg/l); however, in 12 out of the 14 years (2000-2013), the annual instantaneous minimum dissolved oxygen reading was less than 2.0 mg/l at the S-65 E. The water temperature of the KRASR discharge was a relatively constant 25 °C (77 °F; from weekly temperatures recorded during Cycle Test 3 discharge from January to June 2011) and the dissolved oxygen concentration ranged from 7.0 to 7.8 mg/l (increased by a cascade aerator prior to discharge). From a fisheries perspective, the addition of oxygenated water would be a benefit during warmer months when ambient Kissimmee River dissolved oxygen may be less than 4 mg/l; however, if the ASR discharge stops, then those refugia could disappear and fishkills might result. (Note: FDEPs minimum dissolved oxygen standard for the Kissimmee River is temperature dependent and is 38 percent of saturation – ranges from 2.9 to 4.5 mg/l [62-302.533 of the Florida Administrative Code]). Additional information is available in the Regional ASR Ecological Risk Assessment (Corps and District 2014).

Manatees may also be at risk of thermal effects from ASR discharges into the lower Kissimmee River and Lake Okeechobee. In 2012, three different manatees were observed (one each on April 24, May 24, and July 9) near the S-65E and S-84 structures. On July 17, 2012, four manatees were observed near the S-84. Two days later, one manatee was observed downstream of the S-65D and another near the mouth of the Kissimmee River. It is not clear if these individuals were the same as those observed on July 17 or different individuals, but they were all present in the area targeted for LOWRP ASR implementation. In previous years (1980, 2003, 2009, 2010 and 2011), there were at least six additional manatee sightings reported to the FWC in Lake Okeechobee within 3 miles of the mouth of the Kissimmee River. These observations were reported from January to April, and November.

Manatees should migrate to coastal areas as water temperatures drop in the lake coincident with the onset of winter. Waters colder than 20 °C (68 °F) increase the manatees' susceptibility to cold-stress and cold-induced mortality. Because of this temperature restriction, manatees seek out warm water refugia to help reduce energetic maintenance costs. The temperature of the KRASR discharge was consistently at or above 25°C (25.2 to 27.5 °C). Based on the ambient temperature data, manatees are expected to leave the Kissimmee River in November-December as the water temperature approaches 20°C, and would not return until February or March.

However, data exists for at least two manatee observations in January and February near the KRASR system. It is not clear if manatees can find existing thermal refugia in the river or Lake Okeechobee during the winter, primarily because the river and lake are not part of the systematic winter survey area. To eliminate the potential risk to manatees from cold-shock, any ASR that was discharging warmer water in November (or when ambient water temperatures drop below 20 °C), would need to continue until spring when ambient surface water temperatures were above 20 °C. When the Ecological Risk Assessment was conducted in 2014 for Regional ASR Project, the simulated hydrology from the Lake Okeechobee Operations Screening (LOOPS) model indicated there were no occurrences where discharges were shut off during the January to April period for any of the alternatives. In cases where ASR was discharging in November or December, it continued until after April the following year when ambient temperatures would be warm enough to preclude thermal shock. Therefore, the risk of manatee mortality from thermal stress from ASR appears to be minimal. If future ASR systems plan to discharge water warmer than 20°C into areas inhabited by manatees when the surrounding water is less than 20 °C, it should be coordinated with the FWC, Service, and NOAA prior to the start of the recovery phase (due to the species protected status under the ESA and Marine Mammal Protection Act).

9. Methylmercury and Sulfur Concerns from ASR Discharges

Florida has numerous health advisories (including in Lake Okeechobee) against eating too many fish contaminated with unsafe levels of mercury. Sulfate and sulfide concentrations in the Upper Florida Aquifer groundwater are more than 10 times greater than that of Kissimmee River surface water. These compounds in conjunction with organic carbon and sulfate-reducing bacteria in anaerobic environments may stimulate methylmercury (a neurotoxin) production. In turn, methylmercury can biomagnify in the food web and result in fish or alligators that are less safe for human consumption. The ultimate risk of ASR-related sulfate loads on exacerbating mercury methylation in the Kissimmee River and Lake Okeechobee has a higher level of uncertainty; therefore, it is a component of the LOWRP Adaptive Management Plan.

C. Summary/Planning Objectives

Resource concerns were divided into existing problems that the project was designed to address (*e.g.,* lake stages, inappropriate hydrology, and habitat loss) and concerns that result from the construction and operation of those project features (*e.g.,* contaminants, habitat loss, and fishery concerns). With a wide variety of resource concerns dependent upon the effectiveness of regional water management, the planning objective for this project was to balance these resource needs against one another, and select a plan that best meets the storage and habitat goals and benefits of the project.

V. EVALUATION METHODOLOGY

The original above-ground water storage target was 200,000 acre-feet (Corps and District, 1999; North of Lake Okeechobee Storage Reservoir [CERP Component A]). Ultimately, deep reservoirs were eliminated during LOWRP planning due to: 1) few large sites with potential intakes from either the lake or Pool E of the Kissimmee River; 2) Tribal nations and local

communities voiced concerns regarding the potential impacts of siting reservoirs on or near their property; and 3) high seepage rates in the project area. Therefore, the PDT evaluated shallow water storage options. Four previously examined deep-water storage sites were converted to shallow storage and re-evaluated based on: 1) percentage of public land ownership; 2) opportunities to co-locate proposed ASR wells or wetland restoration sites; and 3) per unit cost of water storage. The Service evaluated potential wetland sites based on percentage of drained hydric soils, support for known wading bird rookeries, connectivity to natural and public lands, and percentage of lands needing restoration.

The Reservoir Sizing and Operations Screening (RESOPS) model was used to predict the number of ASR wells combined with above ground water storage features to predict water deliveries, timing of flow, Lake Okeechobee stages, potential ecological improvements, and reduction in freshwater discharges to the northern estuaries. The TSP was selected, in part, based on hydrologic output generated by the Regional Simulation Model for Basins (RSM-BN) for the northern estuaries. The period of record (POR) was 41 years (1965-2005). Model outputs were run through performance measures resulting in comparative data for evaluation by the PDT and RECOVER.

Alternatives were formulated in two simultaneous phases. Phase 1 identified water storage management measures to benefit Lake Okeechobee stage conditions, reduce undesirable discharges to the northern estuaries, and increase the availability of water supply. Phase 1 management measures included: 1) deep or shallow above-ground storage to capture and store normal and peak flows; 2) WAF (between 6 inches and 4 feet deep) that might provide better plant and animal habitat; and 3) ASR wells for underground water storage. One other management measure – deep injection wells – was abandoned during the planning process due to stakeholder concerns and may receive its own planning process in the future. Another management measure – Lake Okeechobee dredging – was evaluated but abandoned due to cost inefficiency. Phase 2 identified individual wetland restoration management measures (in this case, different wetland sites) to increase the spatial extent and functionality of plant and animal habitat within the surrounding watershed. Then the top performing management measures from each phase were combined to form the final array of alternatives.

During the evaluation process, some alternatives were modified to improve their performance. Evaluations of the alternatives were made by comparing the modeling results for each alternative (as expressed in performance measure output) with the No Action alternative and with each other. The following performance measures were used:

Lake Okeechobee Stage Performance Measures (elevation datum = NGVD 29):

- Percentage of time lake stage >17 feet (target is zero)
- Percentage of time lake stage >15.5 feet
- Percentage of time lake stage >12.5 and <15.5 feet (general ecological target)
- Percentage of time lake stage <12.5 feet
- Percentage of time lake stage <10 feet (target is zero)

Lake Okeechobee Ecological Indicator Score Performance Measure:

This new performance measure uses lake stage model output data and converts it into six nearshore ecological scoring metrics. These include 1) low cyanobacteria abundance; 2) high epipelon abundance; 3) high epiphyton; 4) high panfish; 5) high vascular submerged aquatic vegetation; and 6) high *Chara* sp. coverage. The target condition is a combination of optimal lake stages (*i.e.,* between 12.5 feet - 15.5 feet NGVD 29) and annual fluctuations in stage from a maximum elevation at the end of the wet season (generally October) to minimum elevation at the end of the dry season (generally May). Additional information on the scoring of this measure is available in the LOWRP PIR (Corps and District 2019; Section 4).

Caloosahatchee Estuary (flows from S-79):

- Number of Mean Monthly Flows <450 cfs
- Number of Mean Monthly Flows >450 cfs and <2,800 cfs (general ecological target)
- Number of Mean Monthly Flows >2,800 cfs (damaging if >60 days)
- Number of Mean Monthly Flows >4,500 cfs (extreme high discharge)

St. Lucie Estuary (flows from S-80)

- Number of Mean Monthly Flows <350 cfs
- Number of 14-day Moving Average Flows >350 cfs and <2,000 cfs (general ecological target)
- Number of 14-day Moving Average Flows >2,000 cfs (from basin; damaging if >42 days)
- Additional Number of 14-day Moving Average Flows >2,000 cfs (from lake releases)
- Number of Mean Monthly Flows >3,000 cfs (extreme high discharge)

Watershed Wetlands

- Wading Bird Support: Site is within 15 km of a known wading bird colony and would possess the proper hydrologic characteristics after restoration to support that colony.
- Connectivity: Site is connected to other lands that are in public ownership or have other environmental protections such as conservation easements.
- Surface Water Connectivity: Site has a surface water connection to another waterbody (lake, creek, river, canal, or wetlands) and would improve hydrologic connectivity and, in addition, maintain or improve surface water quality through nutrient removal and physical buffering from adverse land management.
- Restoration Potential: Site has a high percentage of lands needing restoration as opposed to lands currently in native habitat.
- Colocation: Co-locating wetlands with other LOWRP features has the potential to improve wetland performance and reduce overall costs. ASR or surface storage features could also be used to rehydrate wetlands during dry times.
- Public Lands: More public land ownership is preferable due to ease of access for geotechnical, cultural, and environmental surveys. Additionally, the use of public lands reduces the project's overall real estate acquisition costs and timelines.

Additional performance measures or evaluation tools beyond the Service's purview were used by other PDT member agencies in their respective evaluations, and were discussed and considered during regular PDT meetings. These included, in part, water supply, flood control, navigation, and cultural resources.

VI. FISH AND WILDLIFE RESOURCES WITHOUT THE PROJECT

Without the project, the current rural landscape, agricultural land use, and somewhat reduced plant and animal habitats would continue in the near term. Over the longer term, development patterns may stay the same or be exacerbated by more people moving into the area whether it be retirees, seasonal residents, or others from coastal areas due to effects of climate change. Without the project, the water storage and treatment benefits of the proposed project would not be realized. Watershed wetlands would not be restored or would need to be restored by other entities. Conditions in Lake Okeechobee would continue to deteriorate and fresh water discharges from the lake to the northern estuaries would continue despite other water storage being built elsewhere in the system (*i.e.,* C-43 and C-44 reservoirs). The No Action alternative may be more favorable for those plants and animals currently occupying upland areas proposed to be flooded within the water storage and wetland restoration components. This includes the federally threatened crested caracara and eastern indigo snake.

VII. DESCRIPTION OF ALTERNATIVES

A. Alternative Descriptions - Storage

The LOWRP PIR (Corps and District 2019) discusses the history of alternative development, the associated assumptions, and the optimization process. For water storage, the three final alternatives were as follows (storage capacity per alternative shown in Table 2):

Alternative 1Bshlw includes the shallow K-05 reservoir (5 feet average pool) and 80 ASR wells (Figure 3). This component would be operated to maximize regional (nand Lake Okeechobee) water storage benefits.

Alternative 1BW includes the K-05 WAF (4 feet average pool) and 80 ASR wells (Figure 4). This component would primarily be used for surface water storage to attenuate peak flows but might have a secondary benefit of encouraging wetland vegetation growth within the WAF footprint.

Alternative 2Cr includes the deep K-42 reservoir (15 feet average pool) and 65 ASR wells (Figure 5). This component would be operated to maximize regional (northern estuaries and Lake Okeechobee) water storage benefits.

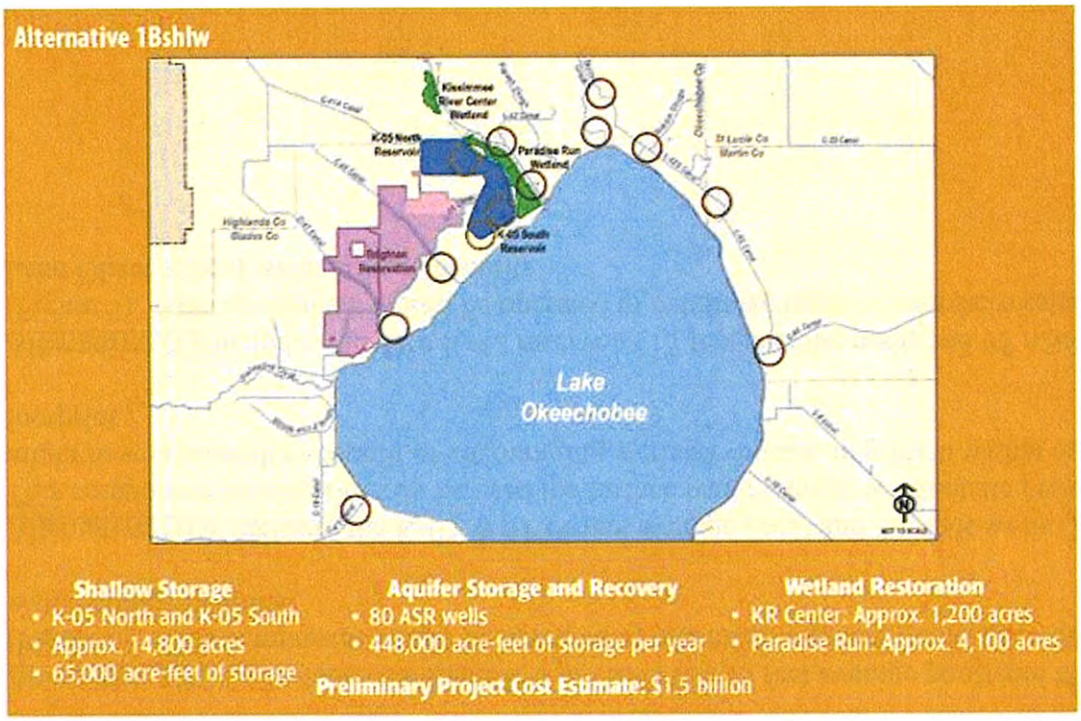

Figure 3. Components for Alternative 1Bshlw (figure from Corps and District 2019).

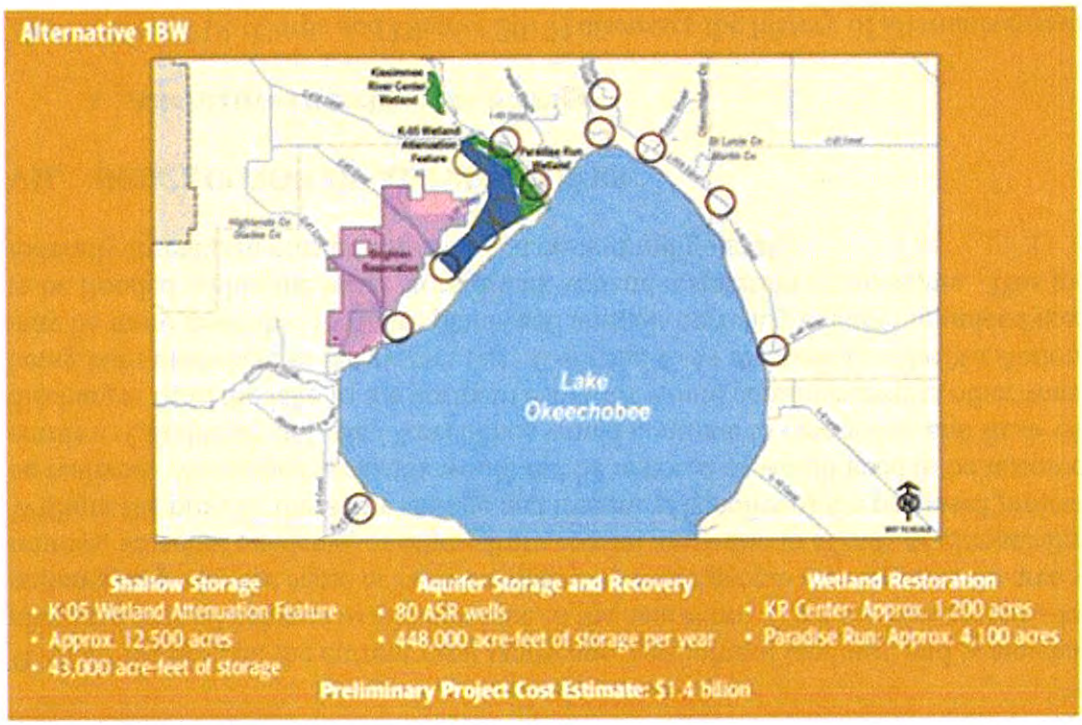

Figure 4. Components for Alternative 1BW (figure from Corps and District 2019).

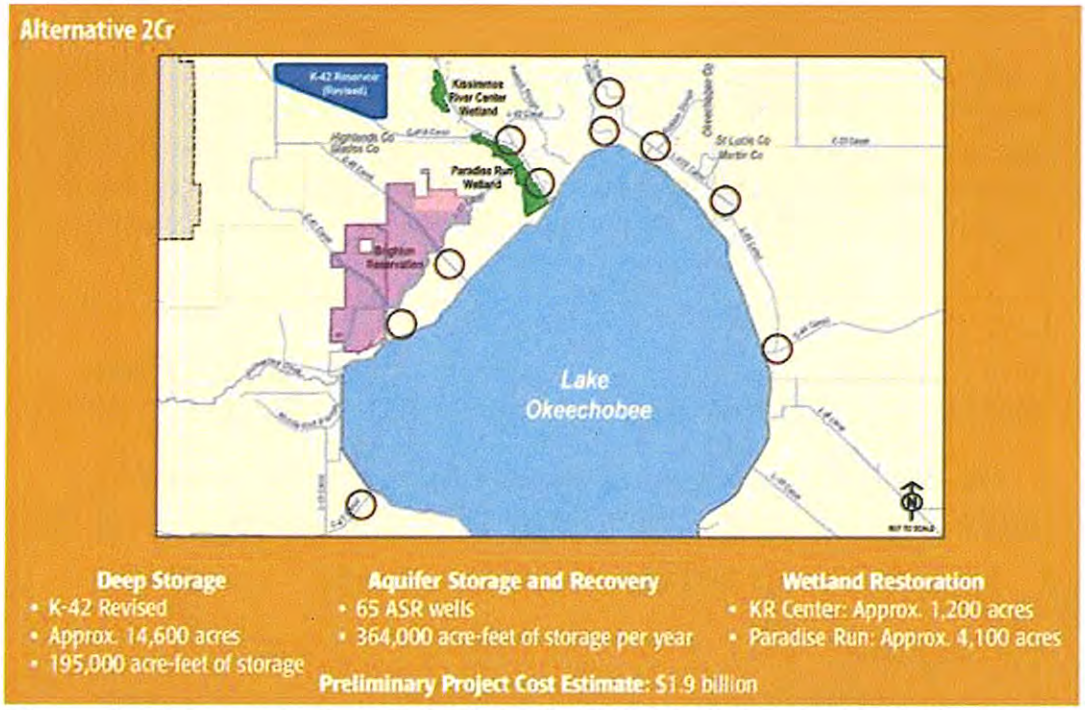

Figure 5. Components for Alternative 2Cr (figure from Corps and District 2019).

Table 2. Various capacities of each water storage alternative.

Water Storage Management Components	Reservoir/WAF		ASR	
	Reservoir/WAF	Storage Capacity (ac-ft.)	# of ASR wells	Storage Capacity (ac-ft. per year)
1Bshlw	K-05 Shallow (5')	65,000	80	448,000
1BW	K-05 WAF (4')	43,000	80	448,000
2Cr	K-42 Deep (15')	195,000	65	364,000

B. Alternative Descriptions - Wetlands

For wetland restoration, there were eight final alternatives, and were designated: 1) Lake Okeechobee - West; 2) Lake Okeechobee - East; 3) Paradise Run; 4) Kissimmee River (North, Center and South); 5) Indian Prairie; 6) IP-10; 7) Bootheel Creek; and 8) Fish Slough (Figure 6). These sites were selected from a previous LOWRP planning effort in 2004 where the PDT identified and ranked 32 potential restoration sites of different sizes that had at least 85 percent hydric soils, but little or no wetland function. Each site had its own characteristics and the team did not prioritize restoration of historic long-hydroperiod over short-hydroperiod wetlands, or historic herbaceous over forested wetlands.

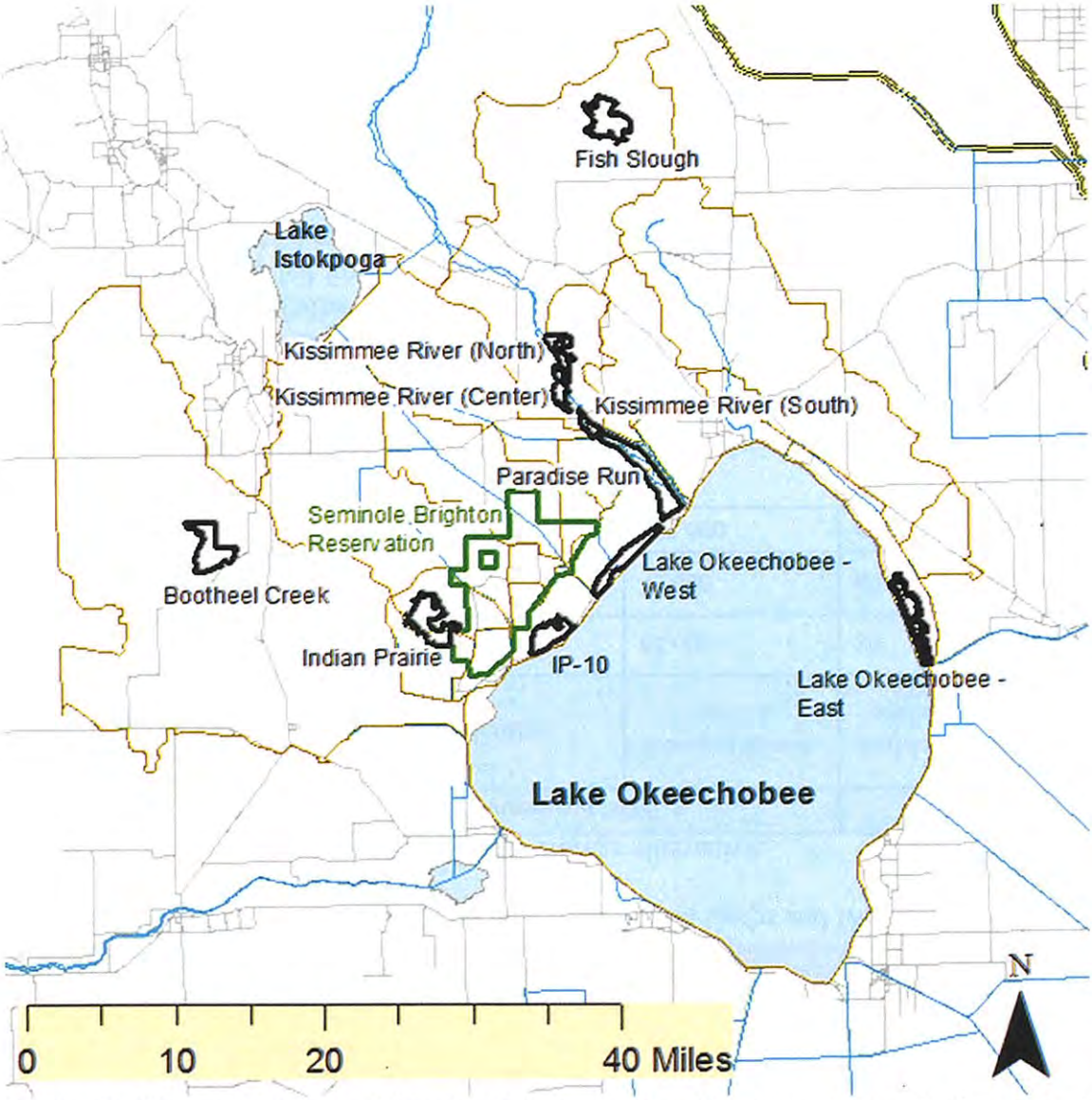

Figure 6. Top ranking potential wetland sites considered for restoration. The Seminole Tribe of Florida's Brighton Indian Reservation also shown for spatial context.

VIII. EVALUATION OF THE ALTERNATIVES AND THE TENTATIVELY SELECTED PLAN

A. Lake Okeechobee

Project alternatives were evaluated against the others, and against the No Action alternative (*i.e.,* Future Without Project [FWO]) in order to identify which ones best approached the multiple goals of the project. Alternatives were evaluated by comparing their respective performance measure model outputs. For Lake Okeechobee, one desired restoration condition is for the stage to remain within the ecologically preferred range of 12.5 to 15.5 feet and avoid

frequent or prolonged departures outside of this range. The occurrence of extreme high and low lake stage events should also be rare. The targets for extreme lake stages either above 17 feet or below 10 feet are zero weeks. Table 3 shows the "percentage of time" from the modeling output for each alternative. Alt 2Cr performed best for all performance measures except percentage of time above 17 feet, where the FWO performed best. According to Corps and District (2019), the FWO performed better "due to lake operational optimizations that were modeled for CEPP and LOWRP." However, the differences between any with-action alternatives were no more than 2 percentage points. For clarity, one percent is equivalent to 150 days across the 41-year POR.

Table 3. Performance of LOWRP alternatives for Lake Okeechobee stage performance measures (table from Corps and District 2019). A higher value denotes better performance for Percentage of Time inside the Stage Envelope only. For the other performance measures, a lower value is better.

Lake Okeechobee Stage Levels (NVGD29)	FWO	Alt 1Bshlw	Alt 1BW	Alt 2Cr
% Time Inside Ecologically Preferred Stage Envelope (12.5–15.5 ft.)	27.7%	32.3%	31.9%	33.9%
% Time Above Stage Envelope (>15.5 ft.)	29.9%	27.8%	28.4%	27.2%
% Time Below Stage Envelope (<12.5 ft.)	42.4%	39.9%	39.7%	38.8%
% Time Below Navigational Min. Stage (< 12.56 ft.)	29.8%	26.7%	26.9%	25.0%
% Time Above Extreme High Stage (> 17 ft.)	0.4%	1.6%	1.4%	1.0%
% Time Below Extreme Low Stage (< 10 ft.)	3.3%	2.0%	2.0%	1.7%

Table 4 shows the scores for each storage alternative using the Lake Okeechobee Ecological Indicator Score Performance Measure. The performance measure output is in the form of a numeric score for each individual metric or as a combined score for all metrics. The maximum possible cumulative score (for a 41-year POR) is 447 points. Alt 2Cr performed best overall and for the panfish and epiphytes metric. Other metrics had similar scores across alternatives. In the case of cyanobacteria, vascular SAV, and *Chara* sp., the FWO performed as well or better than with-project alternatives.

Table 4 Performance of LOWRP alternatives for Lake Okeechobee ecological indicator performance measure (table from Corps and District 2019).

	FWO	Alt 1Bshlw	Alt 1BW	Alt 2Cr
Cyanobacteria	49	49	48	45
Vascular SAV	66	66	67	67
Panfish	49	51	52	56
Epipelon	34.5	36	36.5	36
Epiphyton	50	53.5	52.5	56
Chara	55	51	52	52
Combined Ecological Scores	**303.5**	**306.5**	**308**	**312**

B. St. Lucie and Caloosahatchee Estuaries

Freshwater discharges from Lake Okeechobee can cause adverse ecological impacts to the St. Lucie and Caloosahatchee Estuaries. If excessive, these discharges decrease salinity and adversely affect valuable estuarine resources such as oysters, juvenile marine fishes, seagrass, and other submerged aquatic vegetation. LOWRP water storage should alleviate some of this potential for harm and allow estuarine resources to recover. Table 5 shows the scores for each storage alternative for the estuary performance measures. For the St. Lucie, Alt1BW and Alt1Bshlw performed the best overall (lower scores were better). For the Caloosahatchee Estuary, Alt 1Bshlw performed the best.

C. Watershed Wetlands

The target was to restore 3,600 acres of watershed wetlands (*i.e.*, outside of the lake). Ranking and selection was based on the performance measures noted previously (Section V of this report). Table 6 shows the wetland scores for the eight potential sites. Subsequently, the Kissimmee River site was separated into three parts (north, center, and south) for further analysis. Then, the top six sites were retained for the next step in the analysis. Figure 7 shows the top six final wetland alternatives.

Table 5. Performance of LOWRP alternatives for the St. Lucie and Caloosahatchee Estuaries (lower numbers indicate better performance).

Scenario	Average annual Lake Okeechobee Releases (1,000 ac-ft.)	Number of years Lake Okeechobee contributes to a detrimental event	Number of months Lake Okeechobee contributes to a detrimental event	Number of times extreme high-flow criteria exceeded[1]	Number of times high release criteria exceeded[2]	Number of months minimum flows not met to maintain salinity envelope[3]
St. Lucie Estuary						
FWO	126	11	20	25	32	83
Alt 1Bshlw	94	9	12	21	23	83
Alt 1BW	95	8	12	22	22	83
Alt 2Cr	113	8	17	23	27	83
Caloosahatchee Estuary						
FWO	257	14	23	30	70	23
Alt 1Bshlw	167	8	13	26	60	25
Alt 1BW	176	11	16	25	63	24
Alt 2Cr	170	11	16	27	64	23

[1] Criterion is >3,000 cfs for St. Lucie Estuary and >4,500 cfs for Caloosahatchee Estuary
[2] Criterion is 2,000-3,000 cfs for St. Lucie Estuary and >2,800 cfs for Caloosahatchee Estuary
[3] Criterion is <350 cfs for St. Lucie Estuary and <450 cfs for Caloosahatchee Estuary

Table 6. Performance measure scores for the eight LOWRP wetland alternatives.

Site	Wading Bird Colonies	Connectivity	Surface Water Connectivity	Restoration Potential	Colocation	Public Lands	Total	Retained
Lake Okeechobee West	0.65	1	0.74	0.76	0.5	0	3.65	Yes
Paradise Run	0.47	0	1	0.49	1	0.5	3.46	Yes
Kissimmee River	0.47	0.16	0.75	0.33	0.5	1	3.21	Yes
IP-10	1	0.26	0.3	0.71	0.5	0	2.77	Yes
Bootheel Creek	0	0.79	0.52	0.39	0	0	1.7	No
Indian Prairie	0.47	0.39	0.1	0.53	0	0	1.49	No
Fish Slough	0	0.49	0.18	0.66	0	0	1.33	No
Lake Okeechobee East	0.12	0	0	1	0	0	1.12	No

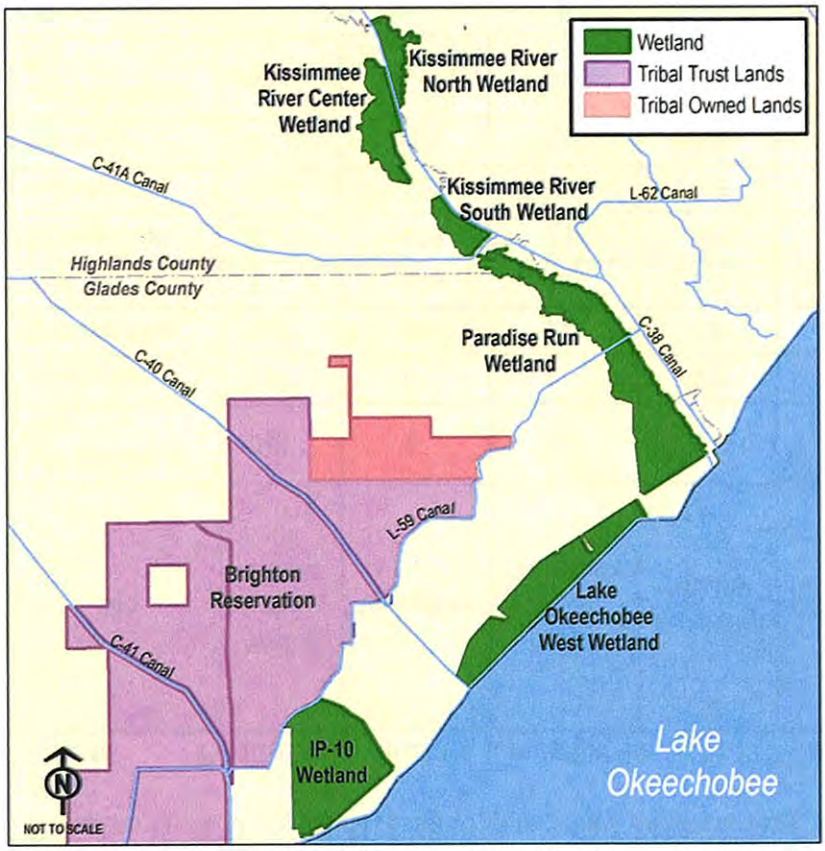

Figure 7. Location of top six potential LOWRP wetland restoration sites (figure from Corps and District 2019).

D. Habitat Units Analyses

The ecological benefits of each alternative were calculated as habitat units (HUs). Simply, a HU is the product of the "quality" of the environmental metric (on a scale of zero to 1.0) multiplied by the "quantity" (*i.e.,* acres) of that metric. The time scale is the same, so HUs can be calculated for Existing Conditions, and predicted for both Future With and Future Without Project conditions. In addition, calculating HUs for different ecosystems (*e.g.,* watershed, lake, and estuary) creates a "common currency" to allow the PDT to make equivalent comparisons and sum the entire alternative's benefits in one number. Table 7 shows the overall HUs for Lake Okeechobee and Table 8 shows the overall HUs for the northern estuaries affected by the project.

Table 7 Combined Lake Okeechobee HUs for the water storage alternatives and Future Without Project (table from Corps and District 2019).

	FWO	Alt 1Bshlw	Alt 1BW	Alt 2Cr
Ecological Indicator HUs	106,938	107,995	108,523	109,933
Stage Envelope HUs	26,906	29,887	29,720	30,850
Extreme Stage HUs	42,971	41,743	41,969	42,695
Overall Lake Okeechobee HUs	**176,814**	**179,625**	**180,213**	**183,478**
Potential Lift (HUs)	**0**	**2,811**	**3,399**	**6,664**

Table 8 Combined northern estuaries HUs for the water storage alternatives and Future Without Project (table from Corps and District 2019).

	FWO	Alt 1Bshlw	Alt 1BW	Alt 2Cr
Caloosahatchee HUs	39,038	41,878	41,168	41,168
St. Lucie HUs	6,447	8,022	8,097	7,647
Overall Northern Estuaries HUs	**45,485**	**49,899**	**49,265**	**48,815**
Potential Lift	**0**	**4,414**	**3,779**	**3,330**

From these static HU analyses, average annual HUs (AAHUs) were calculated. To calculate AAHU, a restoration trajectory (*i.e.,* annual quality improvement) over the 50-year lifespan of the project was predicted for each the FWO and the three LOWRP alternatives. The individual annual HUs were then calculated as the difference between the quality of each LOWRP alternative and FWO for each year through 2070. For example, a gradually decreasing straight-line trajectory represented the FWO habitat conditions in Lake Okeechobee over the next 50 years. However, for the Alternative 2Cr trajectory, the conditions in Lake Okeechobee were predicted to improve rapidly over the first 25 years, but then plateau for the last 25 years of the project life cycle. The LOWRP PIR (Corps and District 2019) provides additional details and trajectories regarding the AAHU calculations for the lake and the estuaries. Once the AAHUs were calculated, planning-level costs were estimated for each alternative. The Corps used software (*i.e.,* Institute of Water Resources Planning Suite [IWR-Plan; certified version 2.0] Plan Generator and Cost Effectiveness/Incremental Cost Analysis modules) to combine the AAHUs and cost to identify a cost effective solution (output in Table 9).

Table 9 Cost effectiveness and benefits output for the three LOWRP water storage alternatives (table from Corps and District 2019).

	FWO	Alt 1Bshlw (STORAGE)	Alt 1BW (STORAGE)	Alt 2Cr (STORAGE)
Total Implementation Costs*	$0	$1,595,000,000	$1,514,000,000	$2,045,000,000
Annual O&M	$0	$14,407,000	$14,407,000	$12,424,000
Average Annual Cost*	$0	$65,561,000	$62,968,000	$78,172,000
Lake Okeechobee AAHU	0	1,884	2,374	5,091
Estuary AAHU	0	4,194	3,591	3,163
Total Storage AAHU	0	6,078	5,965	8,255
Cost-effective	NA	YES	YES	YES
AAC* per AAHU	NA	$12,089	$11,818	$10,682
Best Buy	NA	NO	NO	YES

Similarly, the static HUs for the top six wetland sites were calculated, and then the AAHUs and planning-level costs for each site were calculated (see Corps and District 2019, Appendix E for additional information). Again, the Corps used their IWR-Plan software to identify the best combinations of wetland sites. Table 10 shows the top five wetland combinations. As a result, the Kissimmee River–Center site was the first best-buy plan and the least-cost plan; however, its total of 1,200 acres was determined to be insufficient to meet the intended wetland restoration goal for the project. Therefore, the second-lowest cost best-buy plan was selected; the combination of the Kissimmee River–Center and Paradise Run sites was 5,300 acres (5,279 static HUs, compared to 1,547 HUs for FWO).

At this point in the evaluation process, these wetland sites were added to all three with-project storage alternatives. Alternative 1BW was subsequently selected as the alternative that meets project goals and objectives with the lowest Total Implementation Costs, while still being cost-effective. Specifically, the Corps and District (2019) recommended Alternative 1BW as the TSP because:

a) The FWO condition is not effective, acceptable, complete, or efficient.
b) The RECOVER System-wide Evaluation concluded that there is little evidence of ecologically significant differences between alternatives for the northern estuaries and Lake Okeechobee benefits; therefore, overall project cost was a significant consideration.
c) Alternative 1BW reasonably maximizes ecosystem restoration benefits compared to costs. The only best-buy plan identified by the CE/ICA was Alternative 2Cr, which had the highest output but at the highest planning-level cost: $394 million dollars more than Alternative 1Bshlw and $464 million dollars more than Alternative 1BW. Alternatives 1BW and 1Bshlw were also considered as potential NER plans as smaller-scale, cost-effective plans. The overall benefits and increment of cost-per-benefit for these plans are very similar; therefore, overall costs were considered. The planning-level cost of Alternative 1BW is $70 million dollars less that Alternative 1Bshlw.

d) This plan proposes a shallow WAF rather than a deep or shallow reservoir. Due to its reduced water depth, a WAF reduces overall dam safety concerns and seepage losses.
e) Although a WAF provides aboveground storage like a reservoir, water levels might be suitable for growth of wetland vegetation due to the water depth typically realized during operation of the facility. The average depths of Alternatives 2Cr and 1Bshlw are likely too deep to support the growth of wetland habitat, and may have reduced aesthetic values.
f) This plan co-locates ASR with the WAF, providing synergistic facility attributes, improving operational flexibility, maximizing ecological performance for the northern estuaries, and minimizing the need for additional infrastructure, thereby saving capital construction costs and long-term operations and maintenance requirements. Co-locating ASR with the WAF increases overall WAF storage capabilities without increasing land acquisition requirements.
g) The WAF and wetland sites in this plan are adjacent to Lake Okeechobee and increase the amount of time that lake stage levels are within the ecologically preferred stage envelope, providing connectivity to Lake Okeechobee and a measurable improvement to lake ecology.
h) This plan co-locates the WAF with the wetland restoration features, further gaining efficiencies and providing wetland habitat connectivity.
i) This plan maximizes use of public lands within the project area, reducing RED impacts and OSE to local communities.
j) This plan is not likely to adversely affect endangered Florida grasshopper sparrow habitat.

Table 10 Wetland best-buy combinations (AAC = Average Annual Cost, AAHU = Average Annual Habitat Units; table from Corps and District 2019, Appendix E).

Wetland Component	Sites	Total Acres	Total First Costs (millions)	AAHU	AAC (millions)	AAC per AAHU	Incremental AAHU	Incremental AAC (millions)	Incremental AAC per AAHU
A	Kissimmee River–Center	1,200	$24	706	$0.889	$1,260	n/a	n/a	n/a
B	Kissimmee River–Center Paradise Run	5,300	$109	2,750	$4.0375	$1,470	2,044	$3.1485	$1,540
C	Kissimmee River–Center Paradise Run Lake Okeechobee West	8,100	$197	4,543	$7.2971	$1,610	1,793	$3.2596	$1,820
D	Kissimmee River–Center Paradise Run Lake Okeechobee West IP10	11,600	$329	6,760	$12.1865	$1,800	2,217	$4.8894	$2,210
E	Kissimmee River–Center Paradise Run Lake Okeechobee West IP10 Kissimmee River–South	12,200	$353	7,000	$13.0754	$1,870	240	$0.8889	$3,700

E. The Optimized Tentatively Selected Plan

Following the first draft PIR, the TSP was subsequently revised and renamed Alternative 1BWR. The footprint was revised based on feedback from some stakeholders, along with more detailed

design optimizations to increase the cost-effectiveness of the LOWRP. Specifically, the Corps moved the eastern boundary of the WAF to eliminate the gap between the WAF and Paradise Run. This added 1,100 acres to the WAF, but decreased the Paradise Run wetland by 500 acres. A 1,000-foot buffer from the WAF to State Road 78 was added, and the intake for the Kissimmee River-Center wetland was changed from a submerged weir to a pump station. The new WAF is 13,600 acres (storage volume of 46,000 ac-feet) and Paradise Run is 3,600 acres. The size of the Kissimmee River-Center wetland and ASR components were not changed (Figure 8). Recreational facilities were added at multiple sites in the WAF and wetland restoration sites.

Figure 8. Optimized TSP components for the LOWRP (figure from Corps and District 2019).

IX. POTENTIAL ADVERSE AND BENEFICIAL EFFECTS OF THE TENTATIVELY SELECTED PLAN

A. Habitat Conversion in the Wetland Attenuation Feature

Habitat in the WAF is primarily improved pasture. In that regard, the PDT selected an area that had comparatively low existing ecological function. It also has less existing wetlands than the other two alternative storage sites. As shown in Table 11, the WAF will flood 976 acres of existing wetlands. As a result, we expect the current vegetation, including 38 acres of mixed wetland hardwood trees, will change to deep, long-hydroperiod vegetation (possibly SAV or cattails). There is uncertainty regarding the type of vegetation that will ultimately colonize the

WAF; therefore, the Corps is not claiming any footprint wetland benefits. However, the WAF is likely to exhibit more wetland function than the existing landscape.

Table 11 The total acres of each land use in the WAF footprint (table from Corps and District 2019).

FLUCCS Level 4 Code	Land Use Category	WAF (acres)
2110	Improved pastures	12,432
2120	Unimproved pastures	120
2210	Citrus Groves	1
3200	Shrub and brushland	67
5120	Channelized waterways, canals	1
5300	Reservoirs	7
6172	Mixed wetland hardwoods - mixed shrubs	38
6410	Freshwater marshes	813
6430	Wet prairies	124
6440	Emergent aquatic vegetation	1
7430	Spoil areas	28
	TOTAL AREA (acres)	**13,632**

B. Fishery Entrainment and Impingement

Entrainment and impingement of fishes and aquatic invertebrates is a large concern especially given the quality of the surface waters where LOWRP pumps (for the WAF and ASR) would be installed. The fishery of Lake Okeechobee is a demonstrated economic driver in the area and it needs to be maintained or improved for the local economy to remain vital. We have provided recommendations to the Corps about how to minimize the threat of impingement and entrainment on aquatic resources (*e.g.,* screens, low intake velocities, etc.), but the overall best ecological solution would be to install intakes in areas with little or no aquatic resources to adversely impact. The Corps and District (2014) assessed the risk of entrainment and concluded that ASR water intakes present a high risk for fish and invertebrates under most scenarios evaluated. The only exception were catfish because based on their reproductive strategy of parental care, their young are less vulnerable. The potential risk that this entrainment will result

in a measurable effect on native fisheries and invertebrates was considered moderate under most scenarios evaluated. In locations where the ASR wells will pull directly from canals, the Corps intends to design the intake to limit impingement and entrainment by using intake screens that are set at appropriate depths and include slot-size openings to reduce intake velocities, and/or a multi-stage, filter fabric-type system (Corps and District 2019). Furthermore, they committed to additional evaluations after project authorization, during the preconstruction engineering and design phase (Corps and District 2019). The Service will continue to work with the Corps to protect and conserve aquatic resources in the project area.

C. ASR Discharge Effects

There is some uncertainty regarding the long-term performance of ASR in this region. The KRASR facility proved that short-term operations (*i.e.,* 4 years) of one ASR well can be successful. However, it still remains to be seen if scaling up to 80 wells (or 20 wells in the C-38) will be as successful and not result in any adverse water quality effects. The positive aspect of this is that careful monitoring of the ASR discharges can detect any increased risk of water quality impairment and steps can be taken before any serious or long-lasting ecological damage occurs.

Dissolved oxygen – The risk of fishkills from the loss of ASR DO refugia for different fish species in the lower Kissimmee River was assessed (Corps and District 2014). They evaluated the availability of temporary high DO in the receiving water caused by the discharge, followed by periods of no ASR discharge and subsequent drop in DO concentrations. Gamefish and minnows were identified as being at high risk based on their life cycle.

Temperature – The risk to fisheries from KRASR temperature plumes was also assessed (Corps and District 2014). The risk of modifying the timing of fish spawning was considered high for cold-water spawners; however, the risk of that resulting in measurable effects was considered moderate. Effects on fish species that only live for one year (*e.g.,* brook silversides; *Labidesthes sicculus*) were considered a moderate risk. For moderate-temperature and warm-water spawners, the risk from ASR temperature changes on reproductive effects was characterized as low. The Corps and District (2014) also concluded the risk of manatee mortality from thermal stress from ASR appeared to be minimal. However, when the locations of 80 LOWRP ASR wells are determined, this issue should be re-evaluated.

Sulfate – It is unclear whether sulfate pumped from aquifers will have a measurable ecological effect on surface waters. Certainly, some increase in concentrations is possible; however, careful monitoring of ASR water quality may mitigate this risk. Additional sampling and modeling is needed to better characterize this risk for the 80 wells of the LOWRP TSP.

D. Creation of Wetland Habitat

We expect approximately 4,800 acres of watershed wetland habitats will be created or restored by the TSP. This is likely to benefit many resident wetland-dependent species including state-listed species like Florida sandhill crane (*Grus canadensis pratensis*), little blue heron (*Egretta*

caerulea), roseate spoonbill (*Ajaia ajaja*), and tricolored heron (*Egretta tricolor*). The federally listed wood stork and snail kite might also benefit. It may also benefit migratory birds such as black skimmer (*Rynchops niger*), and other overwintering waterfowl and shorebird species. In areas with longer hydroperiods, we expect increases in forage fish, amphibians, alligators, aquatic turtles, and snakes. On the negative side, the Service expects the flooding of upland habitats (in the WAF and wetlands) might adversely impact some species such as sandhill cranes, crested caracaras, and eastern indigo snakes. The LOWRP monitoring plan should assess the overall health and diversity of biological communities in the WAF, Paradise Run, and Kissimmee River-Center wetlands both prior to, and after, construction.

E. Lake Okeechobee Stage and Marsh Improvements

Any alternative that does not substantially "flatten" the annual hydrograph can be only marginally successful at restoring the lake's littoral zone close to more favorable historic vegetation patterns. However, this cannot be achieved with the current infrastructure surrounding the lake. Much more dynamic storage will need to be connected to the lake. The LOWRP TSP takes a step in that direction and helps the lake stages stay in the optimal zone 4.2 percent of the time (about 630 days over the 41 year POR) more than the FWO. The TSP also decreases the amount of time that the lake is below 10.0 feet (1.3 percent of the time, Table 3). This may benefit the overall fisheries and aquatic invertebrates along with avian species that utilize the lake throughout the year. According to the performance measure, panfish, epipelon, and epiphytes are also likely to benefit from the TSP over the FWO (Table 4).

F. Water Quality Improvements

Nutrient reduction was not a purposeful objective of the LOWRP, but the PDT recognized that some nutrient removal is likely to occur in the restored wetlands, WAF, and ASR storage. It is difficult to estimate the loading of nutrients that might be removed from these features, but the regional ASR environmental risk assessment (Corps and District 2014) measured total phosphorus (TP) concentrations in surface water, ground water, and ASR discharge water at the KRASR facility. These data provide some insight on the magnitude of phosphorus removal that could be expected. The TP concentration in the Upper Floridan aquifer was < 10 µg/L. The C-38 surface water had a mean of 67 µg/L and a maximum concentration of 250 µg/L. Therefore, just due to dilution, TP should be reduced by ASR operations. However, geochemical reactions are likely to sequester additional TP underground. For example, the TP in the KRASR discharge had a mean of 14 µg/L and a maximum concentration of 78 µg/L. Therefore, the mean TP concentration dropped from 67 µg/L in the C-38 upstream of the KRASR facility to 14 µg/L in the discharge. Knowing that the in-lake TP target for Lake Okeechobee is 40 µg/L, it is easy to see the potential value of ASR for TP reduction. Subsequent modelling results showed the optimized TSP reduced to phosphorus loading by between 8 to 11 percent over the FWO, depending on baseline concentrations (Corps and District 2019).

G. St. Lucie and Caloosahatchee Estuaries Benefits

The effects of the TSP show a measurable reduction in both discharge volumes and discharge events from Lake Okeechobee to both the St. Lucie and Caloosahatchee Estuaries. While the TSP was not always the best performer numerically, there were minimal differences in the performance of the TSP over the best alternative for the SLE. For the Caloosahatchee Estuary, the Alt 1Bshlw seemed to be slightly better than the TSP at decreasing damaging high flows. However, in every case there was a measurable benefit to the estuaries over the FWO. The LOWRP goal for these estuaries was to contribute to their restoration by reducing damaging freshwater lake releases. Other CERP projects (*i.e.,* Indian River Lagoon-South project for the SLE and the C-43 Reservoir project for the Caloosahatchee Estuary) are under construction now and those planning efforts targeted restoring a larger share of both their respective estuaries. The Service expects that the combination of all these CERP projects, in addition to on-going State, Federal, and Local efforts in the basins, will be needed to restore high-functioning estuarine systems.

H. Invasive Species Control

The LOWRP has developed an invasive species control plan in addition to the efforts already in place by the various agencies on the lake and in the watershed. To the extent that exotic invasive species are not being controlled in the future WAF, Paradise Run, and Kissimmee River-Center footprints, the implementation of exotic control in these areas is a benefit of the project.

I. Contaminant remediation

There is evidence of chemical contamination in the watershed. To the extent that additional sampling and construction of the WAF, Paradise Run and Kissimmee River-Cener features would assess and remediate that contamination is a benefit of the project.

J. Recreation improvements

The creation of restored wetland habitats at Paradise Run, Kissimmee River-Center, and the WAF is likely to improve recreational opportunities for hunting, fishing, wildlife watching, hiking, biking, and environmental studies. The LOWRP's hydrologic improvements to Lake Okeechobee, and the St. Lucie and Caloosahatchee Estuaries are also likely to improve similar recreation in those areas. The WAF would offer small boating opportunities The WAF may be incorporated into the statewide FWC alligator and waterfowl quota hunting programs. The Paradise Run and Kissimmee River-Center wetland restoration components might also provide new boating access within the watershed.

K. Summary of Consultation under the Endangered Species Act

The Service received a letter from the Corps requesting initiation of formal consultation under the provisions of section 7 of the ESA on July 8, 2016. We received the Corps' Biological Assessment on June 21, 2018. We issued a draft Biological Opinion on November 18, 2018.

We expect to complete a Final Biological Opinion for effects of the LOWRP on federally listed species in December 2019.

X. RECOMMENDATIONS/CONSERVATION MEASURES

Management of water into and out of Lake Okeechobee is critical to maintaining a proper water balance throughout south Florida. The Service is providing recommendations on this project in order to make the project more environmentally compatible and to further enhance the diversity and abundance of fish and wildlife resources in the project area.

1. For future projects, the period of record for model simulations should be extended to include the water years beyond 2005. This is important because it would include the severe drought of 2007-2008 (with the lowest recorded water stage in Lake Okeechobee) and the very wet winter and spring of 2016. Including these weather patterns in the model allows the agencies to expand their understanding of ecological consequences for future planning efforts.

2. Construction and flooding of the WAF might displace nesting pairs of crested caracaras. We therefore reiterate our recommendation from the Biological Opinion, that any LOWRP-displaced, breeding caracaras be monitored to determine their survival and reproductive fate post-operation of the WAF.

3. Additional sampling of larval fishes is needed in the C-38 (Pool E of the Kissimmee River) or other similar areas where either ASR or WAF surface water pumps are to be operated. These data will guide the placement of pumps into the areas representing the least risk to the local fisheries or will allow engineers to design the pumps to minimize the risk.

4. Now that the District has received money from the Florida Legislature to begin ASR planning, we recommend additional operation and monitoring of the existing KRASR facility, prior to Congressional authorization of the LOWRP, to provide insights on longer-term performance for both storage efficiency and water quality changes (as identified in the Environmental Risk Assessment [Corps and District 2014]).

5. The Service recommends that the Corps and District continue to seek our involvement as the engineering design phase proceeds (in accordance with CERP Memorandum Guidance #66, entitled: RECOVER Assistance to Projects During Implementation).

XI. SUMMARY OF POSITION

The Service has participated in the development and review of alternatives for this project. The Service believes that the TSP will benefit wetlands species in the watershed through the creation or restoration of approximately 4,800 acres of habitat in Paradise Run and Kissimmee River-Center wetlands. On balance, the TSP will also improve ecological conditions within Lake Okeechobee's littoral zone by holding the lake in the optimal range more often, and reducing the

extent and duration of extreme low water elevations during droughts. The St. Lucie and Caloosahatchee estuaries will benefit somewhat by a reduction in both high discharge volumes and discharge events from Lake Okeechobee.

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A.2 Listing of Threatened and Endangered Species

The list of federally threatened and endangered species within the Lake Okeechobee Watershed Restoration Project (LOWRP) study area was received from the USFWS on 23 August 2016. The list of federally threatened and endangered species is shown below.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

August 23, 2016

Gina P. Ralph, Ph. D.
Chief, Environmental Branch
U.S. Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, Florida 32207-8175

Service Consultation Code: 04EF2000-2016-TA-0429
Date Received: July 8, 2016
Project: Lake Okeechobee Watershed Project
County: Multiple

Dear Dr. Ralph:

The U.S. Fish and Wildlife Service (Service) has reviewed the U.S. Army Corps of Engineers (Corps) letter dated July 1, 2016, and its request for information under section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) for the Lake Okeechobee Watershed Project.

The following federally listed species and critical habitats are under the jurisdiction of the Service and should be evaluated in your Biological Assessment for effects of the project.

Common Name	Scientific Name	Status	Agency
Birds			
Florida grasshopper	*Ammodramus savannarum*	E	Federal
Florida scrub-jay	*Aphelocoma coerulescens*	T	Federal
Everglade snail kite	*Rostrhamus sociabilis*	E	Federal
Audubon's crested	*Polyborus plancus*	T	Federal
Red-cockaded	*Picoides borealis*	E	Federal
Whooping crane	*Grus americana*	Experimental Population non-essential	Federal, State
Wood stork	*Mycteria americana*	E	Federal
Plants and Lichens			
Florida perforate cladonia	*Cladonia perforata*	E	Federal
Four-petal pawpaw	*Asimina tetramera*	E	Federal
Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeensis*	E	Federal
Lakela's mint	*Dicerandra immaculata*	E	Federal
Johnson's seagrass	*Halophila johnsonii*	T	Federal

Common Name	Scientific Name	Status	Agency
Beach jacquemontia	*Jacquemontia reclinata*	E	Federal
Scrub blazingstar	*Liatris ohlingerae*	E	Federal
Papery whitlow-wort	*Paronychia chartacea*	T	Federal
Lewton's polygala	*Polygala lewtonii*	E	Federal
Tiny polygala	*Polygala smallii*	E	Federal
Carter's mustard	*Warea carteri*	E	Federal
Mammals			
Florida panther	*Puma concolor coryi*	E	Federal
Florida manatee	*Trichechus manatus*	E	Federal
Florida bonneted bat	*Eumops floridanus*	E	Federal
Reptiles			
Bluetail mole skink	*Eumeces egregius lividus*	T	Federal
Eastern indigo snake	*Drymarchon corais couperi*	T	Federal
Sand skink	*Neoseps reynoldsi*	T	Federal
Critical Habitat			
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Final designated critical habitat	
West Indian Manatee	*Trichechus manatus*	Final designated critical habitat	

There may be other species or critical habitat under the jurisdiction of other agencies (i.e., Florida Fish and Wildlife Conservation Commission, NOAA National Marine Fisheries Service, etc.) that the Corps should consider as well. Thank you for your cooperation in the effort to protect fish and wildlife resources. If you have any questions regarding this project, please contact Art Roybal at 772-469-4317.

Sincerely yours,

for

Donald (Bob) Progulske
Everglades Program Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Jacksonville, Florida (Gretchen Ehlinger)
SFWMD, West Palm Beach, Florida (Peter Antonacci)

A.3 Endangered Species Act Biological Assessment

The U.S. Army Corps of Engineers (USACE) provided the National Marine Fisheries Service (NMFS) with the Endangered Species Act Programmatic Biological Assessment (BA) for the Comprehensive Everglades Restoration Plan (CERP) in July 2013. The NMFS provided a Programmatic Biological Opinion for the CERP to the USACE on 17 December 2013 which includes the Lake Okeechobee Watershed Restoration Project.

The USACE provided the USFWS with the Lake Okeechobee Watershed Restoration Project Endangered Species Act Biological Assessment on 22 June 2018. With continued coordination with USFWS, it was determined that a supplemental BA was not needed based on coordination of the Recommended Plan with the USFWS. Effects determinations on federally listed species in the BA submitted concurrent with the Draft Integrated Project Implementation Report and Environmental Impact Statement (PIR/EIS) remained the same. Direct and/or indirect impacts within the action area resulting from the Recommended Plan remained the same.

A.3.1 Comprehensive Everglades Restoration Plan Programmatic Biological Assessment Submitted to the National Marine Fisheries Service

ENDANGERED SPECIES ACT
PROGRAMMATIC BIOLOGICAL ASSESSMENT

Comprehensive Everglades Restoration Plan (CERP)

Prepared for
NOAA National Marine Fisheries Service

Prepared by
Department of the Army
Jacksonville District Corps of Engineers

July 2013

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1.0 EXECUTIVE SUMMARY

Through extensive coordination in October and November 2011 between the U.S. Army Corps of Engineers (Corps) and the National Marine Fisheries Service (NMFS), a need for a programmatic Endangered Species Act Section 7 consultation was recognized in order to adequately evaluate the potential effects of the Comprehensive Everglades Restoration Plan (CERP) program on listed species and designated critical habitat under NMFS' purview. The CERP projects described in this document include Biscayne Bay Coastal Wetlands; C-111 Spreader Canal Western Project; Site 1 Impoundment; Indian River Lagoon South Feasibility Study; Caloosahatchee River (C-43) West Basin Storage Reservoir; Picayune Strand Restoration Project; Everglades National Park (ENP) Seepage Management Project; and the Central Everglades Planning Project.

As a result, this consultation effort entails the submittal of a Programmatic Biological Assessment (BA) addressing all CERP projects. The intent of this document, therefore, is to reference the Central and Southern Florida Project Comprehensive Review Study (C&SF - also referred to as the Restudy or Yellow Book); update the status of each CERP project; and evaluate the potential effects to any threatened or endangered species under NMFS purview that was not addressed in previous consultations. This Programmatic BA also includes the most recent CERP project referred to as the Central Everglades Planning project (CEPP) and provides specific evaluations of potential effects to threatened and endangered species within the purview of NMFS.

The primary restoration purpose of CERP is to restore the biological integrity of the remaining natural areas within the project boundaries through modifications to the existing C&SF Project while also providing for the water supply and flood control needs in this area. The project area includes Lake Okeechobee, the Everglades Agricultural Area, the Water Conservation Areas, the majority of Everglades National Park, Coastal Estuaries, Florida Bay, the majority of Big Cypress National Preserve and urban and agricultural areas along Florida's east coast south of the St. Lucie Canal.

Species and critical habitat identified during informal consultation as potentially affected by the proposed CERP projects include fifteen federally listed threatened or endangered species; along with designated critical habitat for Johnson's seagrass, elkhorn coral, staghorn coral, and the smalltooth sawfish.

Based on the information contained in this BA, the Jacksonville District of the Corps has determined that implementation of the Comprehensive Plan "may affect, but is not likely to adversely affect" Johnson's seagrass, smalltooth sawfish, green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, and loggerhead sea turtle. Potential effects are minimized through the overall project restoration opportunities; the expectation of improved water quality and deliveries to coastal and nearshore habitats; and the inclusion of project commitments and conservation measures described herein.

Other federally threatened or endangered species that are known to exist or potentially exist within close proximity of the project area, but which will not likely be of concern in this study due to the lack of suitable habitat include blue whale, finback whale, humpback whale, sei whale, sperm whale, elkhorn coral, and staghorn coral.

Recognizing the possibility of re-initiating consultation, the Corps will continue discussions with NMFS in the event of project design or operational modifications.

Pursuant to Section 7 of the Endangered Species Act of 1973, as amended, the Corps is requesting written concurrence from the NMFS with the determination of this Biological Assessment.

2.0 INTRODUCTION

The purpose of a Biological Assessment (BA) is to evaluate the potential effects of a federal action (project) on listed and proposed species, including designated and proposed critical habitat, and determine whether the continued existence of any such species or habitat are likely to be adversely affected by the federal action. The BA is also used in determining whether formal consultation or a conference is necessary [Federal Register 51 (106): Section 402.1 (f), pg. 19960, 3 June 1986]. This is achieved through the following:

- The results of an on-site inspection of the area affected by the federal action to determine if listed or proposed species are present or occur seasonally.
- The views of recognized experts on the species at issue.
- A review of the literature and other information.
- An analysis of the effects of the federal action on species and habitat including consideration of cumulative effects, and the results of any related studies.
- An analysis of alternative actions considered by the federal agency for the proposed action.

The federal action evaluated in this Programmatic BA is CERP, which contains over sixty project features. Principal features of the plan are the creation of approximately 217,000 acres of new reservoirs and wetlands based water treatment areas. These features vastly increase storage and water supply for the natural system, as well as for urban and agricultural needs, while maintaining current Central and Southern Florida Project (C&SF) purposes. The recommended CERP achieves the restoration of more natural flows of water, including sheetflow, improved water quality, and more natural hydroperiods in the south Florida ecosystem. Improvements to native flora and fauna, including threatened and endangered species, will occur as a result of the restoration of hydrologic conditions.

On 3 November 2011, the U.S. Army Corps of Engineers (Corps) and the National Marine Fisheries Service (NMFS) agreed to a consultation effort entailing the submittal of a Programmatic BA evaluating each of the CERP projects potentially affecting threatened and endangered species within the purview of NMFS. Those projects include Biscayne Bay Coastal Wetlands; C-111 Spreader Canal Western Project; Site 1 Impoundment; Indian River Lagoon South Feasibility Study; Caloosahatchee River (C-43) West Basin Storage Reservoir; Picayune Strand Restoration Project; Everglades National Park (ENP) Seepage Management Project; and the Central Everglades Planning Project (CEPP).

The intent of this Programmatic BA is to reference the Central and Southern Florida Project Comprehensive Review Study (AKA the Restudy or Yellow Book); update the status of each CERP project; and evaluate potential effects to any threatened or endangered species under NMFS purview that was not addressed in previous consultations. As stated, this Programmatic BA also includes the most recent CERP project referred to as the Central Everglades Planning Project (CEPP) and provides specific evaluations of potential impacts to threatened and endangered species, along with designated critical habitat, within the purview of NMFS.

3.0 CONSULTATION SUMMARY

Annex B of the Restudy includes a preliminary programmatic biological opinion assessing potential impacts to threatened and endangered species with the understanding that a more intense evaluation would occur through separate biological assessments contained in each project's National Environmental Protection Act (NEPA) documentation.

Federally listed species potentially occurring in the Comprehensive Plan project area that are under the purview of NMFS include the smalltooth sawfish (*Pristis pectinata*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), blue whale (*Balaenoptera musculus*), finback whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), loggerhead sea turtle (*Caretta caretta*), Johnson's seagrass (*Halophila johnsonii*), elkhorn coral (*Acropora palmata*), and staghorn coral (*Acropora cervicornis*). In addition, the project study area contains designated critical habitat for Johnson's seagrass, elkhorn coral, staghorn coral, smalltooth sawfish, and Gulf sturgeon.

On 3 October 2011, NMFS sought additional information on the CERP program and individual projects to better evaluate potential effects on listed species and critical habitat under NMFS purview. As a result, 14 CERP projects are in various stages of planning and/or construction. Of these, NMFS determined that eight of the projects may affect listed species and/or designated critical habitat under their purview; while the other six projects have either been constructed or would have no effect on listed species or designated critical habitat.

The status of these projects and chronology of previous Endangered Species Act (ESA) consultation with NMFS is summarized below:

1. Biscayne Bay Coastal Wetlands (BBCW): By letter dated August 30, 2007, NMFS concurred with the Corps' determination that implementation of the BBCW Acceler8 (initial phase of the project) may affect, but is not likely to adversely affect, smalltooth sawfish. By letter dated 3 November 2011, the NMFS concurred with the Corps' determination that the BBCW project is not likely to adversely affect any listed species under NMFS's purview and subsequently concurred with the Corps' determination that proceeding with the project will not violate sections 7(a)(2) and 7(d) pending completion of a recommended programmatic consultation for any remaining individual CERP projects.

2. C-111 Spreader Canal Western Project: On 7 May 2009, the Corps requested concurrence with NMFS on its determination of may affect, but is not likely to adversely affect smalltooth sawfish and sea turtles. In addition, the Corps determined that the project would not modify critical habitat for elkhorn or staghorn coral. Critical habitat for the smalltooth sawfish had not been designated until after publication of the final

PIR/EIS. After further discussion with NMFS, the Corps changed their determinations to no effect for each species and their designated critical habitat, and NMFS concurred by email on 6 August 2009. Construction is complete for this project; therefore, re-initiation is not required.

3. Site 1 Impoundment: On 16 February 2005, the Corps requested concurrence with NMFS on its determination of no effect on the smalltooth sawfish and opossum pipefish downstream of the project area. By letter dated 18 February 2005, NMFS concurred with the Corps' no effect determination. Construction has been initiated for this project; therefore, re-initiation is not required.

Of the remaining CERP projects pending construction, five are required to re-initiate ESA consultation with NMFS to evaluate potential effects on the smalltooth sawfish and/or its designated critical habitat. Those projects and their consultation histories are summarized below:

1. Indian River Lagoon South Feasibility Study: On 18 March 2002, NMFS concurred with the Corps' determination that the project may affect, but is not likely to adversely affect sea turtles, Johnson's seagrass, and Johnson's seagrass designated critical habitat. On 1 April 2003, the smalltooth sawfish (*Pristis pectinata*) was listed as endangered under the Endangered Species Act (ESA). Construction is not complete and re-initiation of ESA Section 7 consultation with NMFS is required to evaluate any potential effects on the smalltooth sawfish. Consultation will focus exclusively on the species since the project is not located within designated critical habitat for smalltooth sawfish. An assessment of potential effects is included in this document.

2. Caloosahatchee River (C-43) West Basin Storage Reservoir: By letter dated 18 March 2002, NMFS stated that only the Gulf sturgeon could potentially be affected by the proposed action, but concluded that the project would not adversely affect the species. On 10 January 2007, the Corps submitted a revised BA to NMFS. By letter dated 20 July 2007, NMFS concurred with the Corps' determination that the project may affect, but is not likely to adversely affect sea turtles and smalltooth sawfish. On 2 September 2009, NMFS designated critical habitat for smalltooth sawfish. Although the project site is not located within designated critical habitat, it is located upstream from smalltooth sawfish critical habitat. Since construction has not been completed for this project, the Corps requests reinitiation of Section 7 consultation to evaluate potential effects to designated critical habitat for smalltooth sawfish. An assessment of potential effects is included in this document.

3. Picayune Strand Restoration Project: On 20 October 2004, the Corps requested concurrence from NMFS on its no effect determination on smalltooth sawfish, green sea turtle, Kemp's ridley sea turtle and loggerhead sea turtle. As stated in the BA published in the Final Project Implementation Report/Environmental Impact Statement (PIR/EIS), NMFS concurred with the Corps' effect determination for those species. This project is

intended to re-establish sheetflow to the Ten Thousand Islands National Wildlife Refuge, which on 27 August 2009, was designated as critical habitat for the smalltooth sawfish; therefore, re-initiation of consultation with NMFS to evaluate potential effects is required, and an evaluation of potential effects are discussed in this document.

4. Everglades National Park (ENP) Seepage Management Project: As envisioned, this project is comprised of three components: L-31N Improvements for Seepage Management, S-356 Structures, and the Bird Drive Recharge Area. These three components would work to improve freshwater deliveries to Northeast Shark River Slough and restore wetland hydroperiods and hydropatterns in ENP via seepage management. Planning efforts proceeded up to the formulation of an initial array of alternatives; however, the project is presently on hold until related projects can develop the best possible solutions for seepage management out of ENP. This CERP project has been incorporated into CEPP. Potential effects to threatened and endangered species under NMFS purview are examined in section 7.2.8

5. Central Everglades Planning Project (CEPP): The purpose of CEPP is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades (Water Conservation Area [WCA] 3 and ENP). The CEPP will be composed of increments of project components that were identified in CERP, reducing the risks and uncertainties associated with project planning and implementation. The goal of CEPP is to improve the quantity, quality, timing and distribution of water in the Northern Estuaries, WCA 3, and ENP in order to restore the hydrology, habitat and functions of the natural system.

Consultation for four of these CERP projects was previously conducted; however, re-initiation is required for the evaluation of potential effects on smalltooth sawfish and/or its designated critical habitat that wasn't included in previous consultations. Therefore, the Corps is seeking concurrence on the determination of potential effects on smalltooth sawfish and/or designated critical habitat for each of these projects to satisfy the remaining ESA Section 7 requirements.

Presently, the Corps and its non-federal partner, the South Florida Water Management District (SFWMD) are preparing National Environmental Policy Act (NEPA) documentation for the next tier of CERP restoration via CEPP. Although the proposed project has separate components and timelines still under development, a detailed evaluation of potential effects of this project on federally listed species within NMFS purview is included in this Programmatic BA.

4.0 PROJECT DESCRIPTION

4.1 Project Authority

The C&SF Project Comprehensive Review Study, also known as the Restudy or Yellow Book, was authorized by Section 309(l) of the Water Resources Development Act of 1992 (P.L.102-580). This study was also authorized by two resolutions of the Committee on Transportation and Infrastructure, United States House of Representatives, dated September 24, 1992. Section 528 of

the Water Resources Development Act of 1996 provides specific direction and guidance for the Restudy.

4.2 Description of Proposed Action

In general, the CERP Comprehensive Plan seeks to restore the biological integrity of the remaining natural areas within the project boundaries through modifications to the existing C&SF Project while also providing for the water supply and flood control needs in this area. A description of some of the major features of the proposed action is provided below:

Water Storage Areas: New water storage reservoirs are proposed in the following general areas: 20,000 acres in the Kissimmee River Basin near Lake Okeechobee; 10,000 acres in the St. Lucie River Basin near Lake Okeechobee; 20,000 acres in the Caloosahatchee River Basin near Lake Okeechobee and 60,000 acres in the Everglades Agricultural Area. These reservoirs will store excess water when it is not needed in the natural system or for water supply, so that it may be used later. Currently, much of this excess water is discharged to the Atlantic Ocean and Gulf of Mexico where it often causes adverse impacts to estuarine environments. Other new water storage areas, called Stormwater Treatment Areas and Water Preserve Areas, would help to improve water quality and improve water supply and flood control.

Additional Water Control Structures: Several new water control structures are proposed in the Initial Draft Plan. These structures provide additional flexibility in the control of timing, direction and volume of water flow necessary to improve and maintain natural habitats and water supply and flood control. For example, new structures proposed for the southern border of WCA 2B and eastern border of ENP will allow the movement of excess water from WCA 2B to the Taylor Slough area in ENP where it is needed to restore natural conditions.

Removal of Existing Structures: The proposed action would remove several existing water control structures, including large portions of the L-28 and Tamiami Trail canals and levees. This would provide more natural free flow of water between large areas that are currently separated and would allow many fish and wildlife species to move more freely between habitats.

Operational Changes: Numerous changes are proposed for the way new and existing water control structures are operated. Examples include different rules for opening and closing gates and different rules for turning pumps on and off. Each of the proposed changes would help to make the timing, distribution and volume of water flow more like natural conditions and/or would help provide for water supply and flood control.

The focus of CERP has been on recovering the defining ecological features of the original Everglades and other south Florida ecosystems. The construction of the many levees and dikes designed to compartmentalize the Everglades and separate Lake Okeechobee from its natural overflow, and the canals that drained water to the coast, disrupted natural hydrological

patterns, and destroyed the ability of many animals to find the dependable habitat needed for survival.

The CERP, by removing over 240 miles of internal levees in the Everglades, and approaching recovery of the natural volume of water in the remaining wetlands, will restore these essential defining features of the pre-drainage wetlands over large portions of the remaining system. The plan also includes water storage and water quality treatment areas that will improve water quality conditions in the south Florida ecosystem.

The CERP provides major benefits to the Caloosahatchee and St. Lucie estuaries, and Lake Worth Lagoon. The plan eliminates almost all the damaging fresh water releases to the Caloosahatchee and most detrimental releases to the St. Lucie. The plan makes substantial improvements to Lake Worth Lagoon. As a result, seagrass beds and other submerged aquatic vegetation will benefit and thus provide abundant favorable habitat for the many aquatic species that depend on these areas for food, shelter, and breeding grounds, thereby enhancing the productivity and economic viability of estuarine fisheries. The CERP also includes several water storage and treatment areas to improve water quality conditions in the Indian River Lagoon and the St. Lucie and Caloosahatchee estuarine systems.

The CERP makes improvements in fresh water deliveries to Florida and Biscayne bays. These bays will benefit from more natural water deliveries. Appropriate freshwater regimes will result in substantial improvements in aquatic and semi-aquatic habitats; fish and wildlife will respond favorably to these beneficial changes. Mangroves, coastal marshes, and seagrass beds interacting together to produce food, shelter, and breeding and nursery grounds will support more balanced, productive fish, shellfish, and wildlife communities.

The CERP expands the storage capability of the C&SF Project, enabling the system to better meet ecosystem and urban water supply needs in the future. Frequency of water restrictions expected with CERP is greatly reduced compared to the Without Plan Condition. This will be accomplished by more effectively providing adequate flows from the regional system to recharge the surficial aquifer. This will help offset withdrawals from public water supply wellfields and other users in the urbanized Lower East Coast Region. Such recharge also protects the surficial aquifer from saltwater intrusion, allowing it to remain a productive source of fresh water in the future.

The CERP will significantly increase the capability to supply water from the regional system to agricultural users. This will provide better protection from economically harmful water supply cutbacks and allow agriculture to remain productive. Storage facilities associated with Lake Okeechobee such as those north of the lake, and Lake Okeechobee aquifer storage and recovery will enable the lake to remain an important source of water supply while keeping lake stages at more ecologically desirable levels. Additional storage facilities built throughout the system will diversify sources of water for many users and enable recycling of water within a basin to meet dry season demands, significantly improving the reliability of agricultural water supply in the future.

The CERP also assures that the quality of south Florida's water bodies will be restored to achieve overall ecosystem restoration. The recommended Comprehensive Plan includes many features to assure that water quality standards will be met and water quality conditions are improved or not degraded. The Comprehensive Plan includes the development of a comprehensive integrated water quality plan, which will lead to recommendations for water quality remediation programs and the integration of water quality restoration targets into future design, construction, and operation activities as features of the recommended Comprehensive Plan are implemented.

4.3 Project Objectives

The purpose of the Restudy was to reexamine the C&SF Project to determine the feasibility of modifying the project to restore the south Florida ecosystem and to provide for other water-related needs of the region. Specifically, as required by the authorizing legislation, the Restudy investigated making structural or operational modifications to the C&SF Project for improving the quality of the environment; protecting water quality in the south Florida ecosystem; improving protection of the aquifer; improving the integrity, capability, and conservation of urban and agricultural water supplies; and improving other water-related purposes.

The following principles guided the development of CERP:

- The overarching objective of CERP is the restoration, preservation and protection of the south Florida ecosystem while providing for other water related needs of the region;
- The CERP will be based on the best available science, and independent scientific review will be an integral part of its development and implementation;
- The CERP will be developed through an inclusive and open process that engages all stakeholders;
- All applicable Federal, tribal, state, and local agencies will be full partners and their views will be considered fully; and
- The CERP must be a flexible plan that is based on the concept of adaptive assessment – recognizing that modifications will be made in the future based on new information.

4.4 Project Location

The project area includes Lake Okeechobee, the Everglades Agricultural Area, the Water Conservation Areas, the majority of Everglades National Park, Coastal Estuaries, Florida Bay, the majority of Big Cypress National Preserve and urban and agricultural areas along Florida's east coast south of the St. Lucie Canal.

The CERP area encompasses approximately 18,000 square miles from Orlando to the Florida Reef Tract with at least 11 major physiographic provinces: Everglades, Big Cypress, Lake Okeechobee, Florida Bay, Biscayne Bay, Florida Reef Tract, nearshore coastal waters, Atlantic Coastal Ridge, Florida Keys, Immokalee Rise, and the Kissimmee River Valley. The Kissimmee

River, Lake Okeechobee and the Everglades are the dominant watersheds that connect a mosaic of wetlands, uplands, coastal areas, and marine areas. The study area includes all or part of the following 16 counties: Monroe, Miami-Dade, Broward, Collier, Palm Beach, Hendry, Martin, St. Lucie, Glades, Lee, Charlotte, Highlands, Okeechobee, Osceola, Orange, and Polk.

The C&SF Project, which was first authorized by Congress in 1948, is a multi-purpose project that provides flood control; water supply for municipal, industrial, and agricultural uses; prevention of saltwater intrusion; water supply for Everglades National Park; and protection of fish and wildlife resources throughout the study area. The primary system includes about 1,000 miles each of levees and canals, 150 water control structures, and 16 major pump stations. The Central and Southern Florida Project is shown on **Figure 4-1**.

The following section summarizes each of the regions that comprise this large study area. The study regions are the Kissimmee River Basin, Lake Okeechobee, Upper East Coast, Everglades Agricultural Area, Water Conservation Areas, Lower East Coast, Biscayne Bay, Everglades National Park, Florida Bay, Whitewater Bay and the Ten Thousand Islands, Florida Keys, Big Cypress Basin, and Lower West Coast. A map of the study regions is shown on **Figure 4-2.**

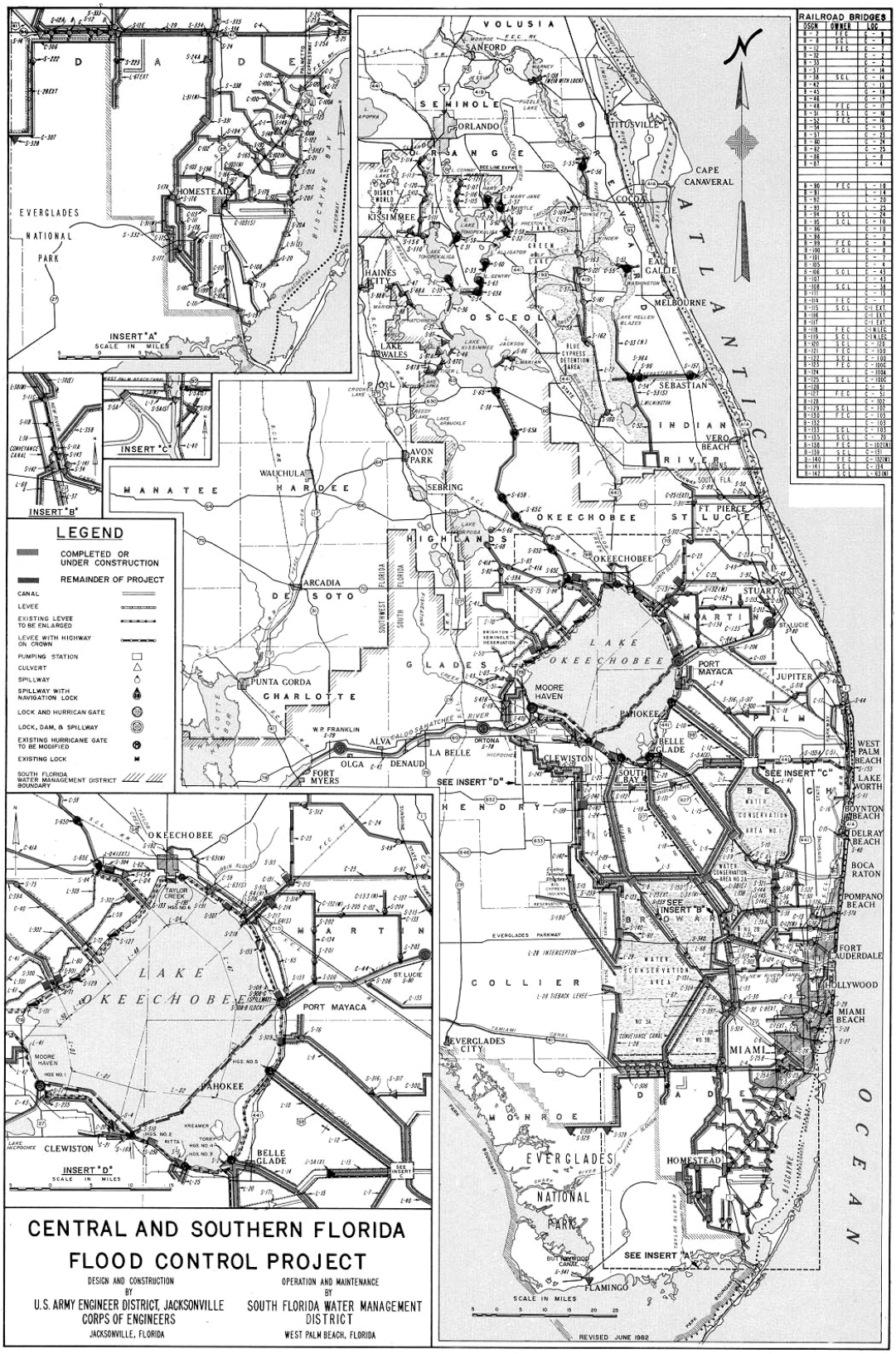

Figure 4-1. C&SF Study Map

Figure 4-2. Study Regions

4.4.1 Kissimmee River Basin

The Kissimmee River Basin is comprised of 3,013 square miles, and extends from Orlando southward to Lake Okeechobee. The watershed, which is the largest source of surface water to the lake, is about 105 miles long and has a maximum width of 35 miles. Project works in the basin for flood control and navigation were constructed by the Corps as part of the C&SF Project. Upper Basin works consist of channels and structures that control water flows through 18 natural lakes into Lake Kissimmee. The Lower Basin includes the channelized Kissimmee River (C-38) as a 56-mile earthen canal extending from Lake Kissimmee to Lake Okeechobee. The northern portion of the basin is comprised of many lakes, some of which have been interconnected by canals. This large sub-basin, often termed the "Upper Basin" or "Chain of Lakes", is bounded on the southern end by State Road 60, where the largest of the lakes, Lake Kissimmee, empties into the Kissimmee River. The Upper Basin is 1,633 square miles and includes Lake Kissimmee and the east and west Chain of Lakes area in Orange and Osceola Counties. A 758-square-mile Lower Basin includes the tributary watersheds of the Kissimmee River between the outlet in Lake Kissimmee and Lake Okeechobee. The 622-square-mile Lake Istokpoga area provides tributary inflow to the Lower Basin.

4.4.2 Lake Okeechobee

Lake Okeechobee lies 30 miles west from the Atlantic coast and 60 miles east from the Gulf of Mexico in the central part of the peninsula. Lake Okeechobee is a broad shallow lake occurring as a bedrock depression. The large, roughly circular lake, with a surface area of approximately 730 square miles, is the principal natural reservoir in southern Florida. The lake's largest outlets include the St. Lucie Canal eastward to the Atlantic Ocean and the Caloosahatchee Canal and River to the Gulf of Mexico. The four major agricultural canals – the West Palm Beach, Hillsboro, North New River, and Miami Canals - have a smaller capacity, but are used whenever possible to release excess water to the Water Conservation Areas, south of the lake, when storage and discharge capacity are available. When regulatory releases from the lake are required, excess water can be passed to the three Water Conservation Areas up to the capacity of the pumping stations and agricultural canals, with the remainder going to the Atlantic Ocean and Gulf of Mexico. The waters of the lake are impounded by a system of encircling levees, which form a multi-purpose reservoir for navigation, water supply, flood control, and recreation. Pumping stations and control structures in the levee along Lake Okeechobee are designed to move water either into or out of the lake as needed. Other surface water bodies include the Kissimmee River, Fisheating Creek, and Taylor Creek that flow into the lake from the north; the Caloosahatchee River that flows out of the lake to the west; the St. Lucie and West Palm Beach Canals that flow out of the lake to the east; and the Hillsboro, North New River, and Miami Canals that flow out of the lake to the south. The hydroperiod of the lake is partially controlled, permitting water levels to fluctuate with flood and drought conditions and the demand for water supply.

4.4.3 Upper East Coast

The Upper East Coast area encompasses approximately 1,139 square miles and includes most of Martin and St. Lucie Counties as well as a portion of eastern Okeechobee County. Martin and St. Lucie Counties are bounded to the east by the Atlantic Ocean, and a substantial portion of Martin County's western landmass borders Lake Okeechobee. Urban development is primarily located along the coastal areas while the central and western portions are used primarily for agriculture where the main products are citrus, truck crops, sugarcane, and beef and dairy products. The land is generally flat, ranging in elevation from 15 to 60 feet NGVD in the western portion with an average elevation of 28 feet. The coastal area ranges from sea level to 25 feet. The coastal sand hills adjacent to the Atlantic Intracoastal Waterway are higher than most parts of the county and reach a maximum elevation of 60 feet. This feature is known as the Atlantic Coastal Ridge. The natural drainage has been significantly altered by the construction of canals, drainage ditches and numerous water control structures which predominately direct stormwater discharge to the east coast. The area contains the C&SF Project Canals C-23, C-24, and C-25 drainage basins and the drainage area served by C-44 (St. Lucie Canal). The St. Lucie Canal is Lake Okeechobee's eastern outlet, extending 25.5 miles from Port Mayaca to the city of Stuart, where it terminates at the south fork of the St. Lucie River. The St. Lucie River Basin is part of a much larger southeastern Florida basin that drains over 8,000 square miles. The St. Lucie River, composed of the North and South forks, lies in Martin and St. Lucie Counties in the northeastern portion of the basin. The South Fork is a relatively short stretch of river. The North Fork, designated as an aquatic preserve by the State of Florida, begins south of Fort Pierce and flows past the city of Port St. Lucie to the St. Lucie River Estuary. The St. Lucie Estuary is part of a larger estuarine system known as the Indian River Lagoon. The Indian River Lagoon has been designated an estuary of national significance and is a component of the U. S. Environmental Protection Agency sponsored National Estuary program. The Indian River Lagoon is also designated as a state priority water body for protection and restoration under the state's Surface Water Improvement and Management (SWIM) Act. The Surface Water Improvement and Management Act Plan identifies excessive freshwater runoff from the St. Lucie Estuary watershed as a problem within the St. Lucie Estuary. Much of the St. Lucie River has been channelized and many drainage canals empty into the river, particularly the St. Lucie Canal, C-23 and C-24. The St. Lucie Canal, the largest overflow canal for Lake Okeechobee, is a navigation channel 8 feet deep and 100 feet wide connecting the Atlantic Intracoastal Waterway in Stuart with Lake Okeechobee at Port Mayaca.

4.4.4 Everglades Agricultural Area

The lands located immediately south and southeast of the lake are known as the Everglades Agricultural Area. This area of about 700,000 acres is rich, fertile agricultural land. A large portion of the Everglades Agricultural Area is devoted to the production of sugarcane. The average ground elevation is about 12 feet. The occurrence of surface water in the area is now a direct result of the construction of the numerous conveyance and drainage canals. The primary canals consist of the Miami, the North New River, the Hillsboro, and the West Palm Beach Canals, which traverse the area north south, and

the Bolles and Cross Canal, which extends east-west. Water levels and flows are stringently manipulated in the canals to achieve optimum crop growth. Major surface impoundments in the area are non-existent.

4.4.5 Water Conservation Areas

The WCAs are an integral component of the Everglades and freshwater supplies for south Florida. The WCAs, located south and east of the Everglades Agricultural Area (EAA), comprise an area of about 1,350 square miles, including 1,337 square miles of the original Everglades, which averaged some 40 miles in width and extended approximately 100 miles southward from Lake Okeechobee to the sea. The WCAs provide a detention reservoir for excess water from the agricultural area and parts of the Lower East Coast region, and for flood discharge from Lake Okeechobee. The WCAs also provide levees needed to prevent Everglades floodwaters from inundating the Lower East Coast, while providing water supply for Lower East Coast agricultural lands and ENP; improving water supply for east coast communities by recharging the Biscayne Aquifer (the sole source of drinking water for southern Palm Beach, Broward, Miami-Dade, and Monroe Counties); retarding salt water intrusion in coastal well fields; and benefiting fish and wildlife in the Everglades.

4.4.5.1 Water Conservation Area 1

WCA 1 (Loxahatchee National Wildlife Refuge) is about 21 miles long from north to south and comprises an area of 221 square miles. The West Palm Beach Canal lies at the extreme northern boundary, and on the south the Hillsboro Canal separates WCA 1 from WCA 2. Ground elevations slope about five feet in 10 miles, both to the north and to the south from the west center of the area, varying from over 16 feet in the northwest to less than 12 feet in the south. The area, which is enclosed by about 58 miles of levee (approximately 13 miles of which are common to WCA 2), provides storage for excess rainfall, excess runoff from agricultural drainage areas of the West Palm Beach Canal (230 square miles) and the Hillsboro Canal (146 square miles), and excess water from Lake Okeechobee. Inflow comes from rainfall and runoff from the EAA through canals at the northern end. Release of water for dry-season use is controlled by structures in the West Palm Beach Canal, the Hillsboro Canal, and in the north-south levee which forms the eastern boundary of the area. When stages exceed the regulation schedule, excess water in WCA 1 is discharged to WCA 2.

4.4.5.2 Water Conservation Area 2

WCA 2 is comprised of two areas, 2A and 2B, measures about 25 miles from north to south, and covers an area of 210 square miles. It is separated from the other Water Conservation Areas by the Hillsboro Canal on the north and the North New River Canal on the south. Ground elevations slope southward about two to three feet in 10 miles, ranging from over 13 feet NGVD in the northwest to less than seven feet NGVD in the south. The area is enclosed by about 61 miles of levee, of which approximately 13 miles are common to WCA 1 and 15 miles to WCA 3. An interior levee across the southern portion of the area reduces water losses due to seepage into an extremely pervious

aquifer at the southern end of the pool and prevents overtopping of the southern exterior levee by hurricane waves. The upper pool, WCA 2A, provides a 173-square-mile reservoir for storage of excess water from WCA 1 and a 125-square-mile agricultural drainage area of the North New River Canal. Storage in WCA 2A provides water supply to the east coast urban areas of Broward County. Water enters the area from Water Conservation Area 1 and the Hillsboro Canal on the northeast side and from the North New River Canal on the northwest side. Water in excess of that required for efficient operation of WCA 2A is discharged to WCA 3 via structures into C-14, the North New River Canal, and Water Conservation Area 2B. WCA 2B has ground elevations ranging from 9.5 feet NGVD in the northern portions down to 7.0 feet NGVD in the southern portions of the area. The area experiences a high seepage rate, which does not allow for long term storage of water, and as a result, water is not normally released from the area.

4.4.5.3 Water Conservation Area 3

WCA 3 is also divided into two parts, 3A and 3B. It is about 40 miles long from north to south and comprises about 915 square miles, making it the largest of the conservation areas. Ground elevations, which slope southeasterly 1 to 3 feet in 10 miles, range from over 13 feet NGVD in the northwest to 6 feet NGVD in the southeast. The Miami Canal traverses the area from northwest to southeast, and the North New River Canal separates it from WCA 2. The area is enclosed by about 111 miles of levee, of which 15 miles are common to WCA 2. An interior levee system across the southeastern corner of the area reduces seepage into an extremely pervious aquifer. The upper pool, WCA 3A, provides a 752-square-mile area for storage of excess water from WCA 2A; rainfall excess from approximately 750 square miles in Collier and Hendry Counties and from 71 square miles of the former Davie agricultural area lying east of Pumping Station S-9 in Broward County; and excess water from a 208-square-mile agricultural drainage area of the Miami Canal and other adjacent areas to the north. Water enters WCA 3A from various sources on the northern and eastern sides. The storage is used to meet the principal water supply needs of adjacent areas, including urban water supply and salinity control requirements for Miami-Dade and Monroe County, irrigation requirements, and water supply for ENP.

4.4.6 <u>Lower East Coast Area</u>

The Lower East Coast area, which consists of the coastal ridge section in Palm Beach, Broward, and Miami-Dade Counties, is a strip of sandy land which lies east of part of the Water Conservation Areas. The ground surface of the flatlands in the west ranges from about 25 feet NGVD in the upper part of the region to about five feet NGVD in lower Miami-Dade County. The Atlantic Coastal Ridge is comprised of broad, low dunes and ridges with elevations ranging from 10 to 25 feet NGVD. This ridge area ranges from two to four miles in width at its northern edge to its southern edge in Miami. South of Miami the ridge becomes less pronounced but significantly wider. The Lower East Coast area is the most densely populated part of the state. The largest population centers are near the coast and include the cities of Miami, West Palm Beach, Fort Lauderdale, and

Hollywood. Water levels in coastal canals are controlled near the coastal shoreline to prevent over-drainage and to resist salt water intrusion. Low water levels in these canals may enable salt water to migrate into the ground water, well fields, and natural freshwater systems upon which the urban areas depend for a potable water supply.

This area is characterized by sandy flatlands to the west, the sandy coastal ridge, and the coastal marsh and mangrove swamp areas along the Atlantic seaboard. The northern portion, generally that part north of Miami-Dade County, marks the shore of a higher Pleistocene Sea and occurs as one or more relict beach ridges. The southern portion appears to be marine deposited sands or marine limestone. Extensive development has resulted in nearly complete urbanization of the coastal region from West Palm Beach southward through Miami, and these physiographical characteristics of the region have been greatly overshadowed. South of Miami, in Miami-Dade County, this coastal area widens as the Everglades bends to the west to include urban areas and agricultural areas that extend almost to the southern coast. Miami-Dade County's agricultural industry covers more than 83,000 acres in the southwest of the coastal metropolitan area. Vegetables, tropical fruits, and nursery plants are grown in this area.

4.4.7 Biscayne Bay

Biscayne Bay is a shallow, tidal sound located near the extreme southeastern part of Florida. Biscayne Bay, its tributaries and Card Sound are designated by the state of Florida as aquatic preserves, while Card and Barnes sounds are part of the Florida Keys National Marine Sanctuary. A significant portion of the central and southern portions of Biscayne Bay comprise Biscayne National Park. The original areal extent of Biscayne Bay approximated 300 square miles, but it has since undergone major areal modifications, particularly in its northern portions, as a result of development. The bay extends about 55 miles in a south-southwesterly direction from Dumfoundling Bay on the north to Barnes Sound on the south. It varies in width from less than 1 mile in the vicinity of the Atlantic Intracoastal Waterway passage to Dumfoundling Bay, to about 10 miles between the mainland and the Safety Valve Shoals to the east. While there has been extensive dredging and filling within northern Biscayne Bay, the area still supports a productive and healthy seagrass bed and a few tracts of natural shoreline remain. Northern Biscayne Bay's headwaters are now considered to include dredged areas known as Maule Lake and Dumfoundling Bay, near the northern boundary of Miami-Dade County. Central and, in particular, southern Biscayne Bay have been impacted less by development than northern Bay. For instance, mangrove-lined coastal wetlands extend from Matheson Hammock Park south along the entire shoreline of Biscayne National Park, Card and Barnes Sounds, a distance of approximately 30 miles. These coastal wetlands are the largest tract of undeveloped wetlands remaining in south Florida outside of Everglades National Park, the Big Cypress Preserve, and the Water Conservation Areas.

Biscayne National Park, in southern Biscayne Bay was established in 1980 to protect and preserve this nationally significant marine ecosystem consisting of mangrove shorelines,

a shallow bay, undeveloped islands, and living coral reefs. The park is 180,000 acres in size and 95 percent water. The shoreline of southern Biscayne Bay is lined with a forest of mangroves and the bay bottom is covered with dense seagrass beds. The park has been designated a sanctuary for the Florida spiny lobster. Biscayne Bay and Biscayne National Park support a multitude of marine wildlife such as lobster, shrimp, fish, sea turtles, and manatees. The coral reefs within the Biscayne National Park support a diverse community of marine plant and wildlife. Depending upon the flood stages reached, all C&SF Project canals in adjacent Miami-Dade County can carry floodwaters to Biscayne Bay. However, much of the time, discharges from project canals represent primarily runoff or seepage from within the flood protected area of the county. These flows originate in the extensive networks of secondary drainage canals and storm sewers that discharge into the project canals. Supplementing the complex system of project canals and secondary drainage systems are many hundreds of other stormwater drainage canals and storm sewer outfalls within Miami-Dade County that discharge freshwater directly into Biscayne Bay.

4.4.8 Everglades National Park

ENP encompasses 2,353 square miles of wetlands, uplands, and submerged lands at the southern end of the Florida peninsula. The topography is extremely low and flat, with most of the area below four feet NGVD. The highest elevations are found in the northeastern section of the park and are from six to seven feet NGVD. The saline wetlands, including mangrove and buttonwood forests, salt marshes, and coastal prairie that fringe the coastline are subject to the influence of salinity from tidal action.

ENP, authorized by Congress in 1934 and established in 1947, was established to protect the unique tropical biological resources of the southern Everglades ecosystem. It was the first national park to be established to preserve purely biological (vs. geological) resources. The park's authorizing legislation mandated that it be managed as "…wilderness, [where] no development… 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 condition now prevailing in this area." This mandate to preserve wilderness is one of the strongest in the legislative history of the National Park System. ENP has been recognized for its importance, both as a natural and cultural resource as well as for its recreational value, by the international community and the national and state government. At the international level, the park is a World Heritage Site, an International Biosphere Reserve, and a Wetland of International Significance. In 1978, Congress designated much of the park, (86%) as Wilderness under the Wilderness Act of 1964. In 1997, this area was re-designated the Marjory Stoneman Douglas Wilderness. Hell's Bay Canoe Trail and the Wilderness waterway are designated National Trails. The State of Florida has designated the Park an Outstanding Florida Water.

The ENP preserves a unique landscape where the temperate zone meets the subtropics, blending the wildlife and vegetation of both. The landscape includes sawgrass sloughs,

tropical hardwood hammocks, offshore coral reefs, mangrove forests, lakes, ponds, and bays, providing habitat for dozens of threatened and endangered species of plants and animals. It is the largest designated wilderness, at 1,296,500 acres, east of the Rocky Mountains. It protects the largest continuous stand of sawgrass prairie in North America, the most significant breeding grounds for tropical wading birds in North America, over 230,100 acres of mangrove forest (the largest in the western hemisphere), a nationally significant estuarine complex in Florida Bay and significant ethnographic resources, revealing 2,000 years of human occupation.

4.4.9 Florida Bay, Whitewater Bay, and the Ten Thousand Islands

Florida Bay and the Ten Thousand Islands comprise 1,500 square miles of ENP. The bay is shallow, with an average depth of less than three feet. To the north is the Florida mainland and to the south lie the Florida Keys. Sheet flow across marl prairies of the southern Everglades and 20 creek systems fed by Taylor Slough and the C-111 Canal provide direct inflow of fresh surface water and groundwater recharge. Surface water from Shark River Slough, the sub-region's largest drainage feature, flows into Whitewater Bay and also may provide essential groundwater recharge for central and western Florida Bay. Exchange with Florida Bay occurs as the lower salinity water mass flows around Cape Sable into the western sub-region of the bay.

4.4.10 Florida Keys

The Florida Keys are a limestone island archipelago extending southwest over 200 miles from the southern tip of the Florida mainland to the Dry Tortugas, 63 miles west of Key West. They are bounded on the north and west by the relatively shallow waters of Biscayne Bay, Barnes and Blackwater Sounds, Florida Bay - all areas of extensive mud shoals and seagrass beds – and the Gulf of Mexico. Hawk Channel lies to the south, between the mainland Keys and an extensive reef tract 5 miles offshore. The Straits of Florida lie beyond the reef, separating the Keys from Cuba and the Bahamas. The Keys are made up of over 1,700 islands encompassing approximately 103 square miles. They are broad, with little relief, have a shoreline length of 1,865 miles, and are inhabited from Soldier Key to Key West. Key Largo and Big Pine Key are the largest islands. The Keys are frequently divided into three regions: 1) the Upper Keys, north of Upper Matecumbe Key; 2) the Middle Keys, from Upper Matecumbe Key to the Seven Mile Bridge; and 3) the Lower Keys, from Little Duck Key to Key West. The Florida Keys National Marine Sanctuary encompasses approximately 3,668 square miles of submerged lands and waters between the southern tip of Key Biscayne and the Dry Tortugas Bank. North of Key Largo it includes Barnes and Card Sounds, and to the east and south the oceanic boundary is the 300-foot isobath. The Sanctuary also contains part of Florida Bay and the entire Florida Reef Tract, the largest reef system in the continental United States. The Sanctuary contains components of five distinct physiographic regions: Florida Bay, the Southwest Continental Shelf, the Florida Reef Tract, the Florida Keys, and the Straits of Florida. The regions are environmentally and lithologically unique, and together they form the framework for the Sanctuary's diverse terrestrial and aquatic habitats.

4.4.11 Florida Reef Tract

The Florida Reef Tract is an accurate band of living coral reefs paralleling the Keys. The reefs are located on a narrow shelf that drops off into the Straits of Florida. The shelf slopes seaward at a 0.06 degree angle into Hawk Channel, which is several miles wide and averages 50 feet deep. From Hawk Channel, the shelf slopes upward to a shallower area containing numerous patch reefs. The outer edge is marked by a series of bank reefs and sand banks that are subject to open tidal exchange with the Atlantic. The warm, clear, naturally low-nutrient waters in this region are conducive to reef development.

4.4.12 Big Cypress Basin

Big Cypress Swamp spans approximately 1,205 square miles (771,000 acres) from southwest of Lake Okeechobee to the Ten Thousand Islands in the Gulf of Mexico. The 570,000-acre Big Cypress National Preserve was established by *Public Law 93-440* in 1974 to protect natural and recreational values of the Big Cypress watershed and to allow for continued traditional uses such as hunting, fishing, and oil and gas production. It was also established to provide an ecological buffer zone and protect Everglades National Park's water supply. In 1988, Congress passed the *Big Cypress National Preserve Addition Act* which will add 146,000 acres to the preserve.

4.4.13 Lower West Coast

The Lower West Coast region covers approximately 4,000 square miles in Lee, Hendry, Glades, and Collier Counties and a portion of Charlotte County. This area is generally bounded by Charlotte County to the north, Lake Okeechobee and the EAA to the east, the Big Cypress National Preserve to the south, and the Gulf of Mexico to the west. The area is characterized by the sandy flatlands region of Lee County, which give way to sandy though more rolling terrain in Hendry County; and the coastal marshes and mangrove swamps of Collier County. The Caloosahatchee River sub-watershed includes an area of 550,900 acres in parts of Lee, Glades, Charlotte, and Hendry Counties. From a hurricane gate on the southwest shore of Lake Okeechobee at Moore Haven, the Caloosahatchee Canal drains westerly for about five miles through a very flat terrain into Lake Hicpochee. From there the canal joins the upper reach of the Caloosahatchee River. On its way to the Gulf of Mexico, the river is controlled by navigation locks at Ortona (15 miles downstream from Moore Haven) and at Olga near Fort Myers. Downstream from Ortona Lock, many tributaries join the river along its course to the Gulf. The Caloosahatchee River serves as a portion of the cross-state Okeechobee Waterway, which extends from Stuart on the east coast via the St. Lucie Canal, through Lake Okeechobee and the Caloosahatchee River to Fort Myers on the Gulf of Mexico. The river has been straightened by channelization through most of its 65-mile course from the Moore Haven Lock to Fort Myers. The J. N. "Ding" Darling National Wildlife Refuge Complex includes Pine Island NWR, Island Bay NWR, Matlacha Pass NWR, and Caloosahatchee NWR, all located on the lower west coast. The health of the estuarine ecosystem they embody is directly tied to the water quality, quantity and timing of

flows from the Caloosahatchee watershed and those watersheds which drain into the Caloosahatchee River (i.e. Kissimmee River and Lake Okeechobee watersheds).

5.0 CERP Elements (U.S. Army Corps of Engineers, 1999)

The Restudy Team formulated and evaluated 10 alternative comprehensive plans and more than 25 intermediate computer simulations. Alternative D-13R was selected as the Initial Draft Plan. Alternative D-13R along with the series of Other Project Elements, Critical Projects, water quality treatment facilities, and other modifications that further improve performance of the plan, comprise the recommended Comprehensive Plan. The estimated first cost of the recommended Comprehensive Plan is $7.8 billion; and the annual operation and maintenance costs, including adaptive assessment and monitoring, are $182 million. The plan includes the following structural and operational changes to the existing C&SF Project:

5.1 Surface Water Storage Reservoirs

A number of water storage facilities are planned north of Lake Okeechobee, in the Caloosahatchee and St. Lucie basins, in the EAA, and in the Water Preserve Areas of Palm Beach, Broward and Miami-Dade counties. These areas will encompass approximately 181,300 acres and will have the capacity to store 1.5 million acre-feet of water.

5.2 Water Preserve Areas

Multipurpose water management areas are planned in Palm Beach, Broward and Miami-Dade counties between the urban areas and the eastern Everglades. The WCAs will have the ability to treat urban runoff, store water, reduce seepage, and improve existing wetland areas.

5.3 Manage Lake Okeechobee as an Ecological Resource

Lake Okeechobee is currently managed for many, often conflicting, uses. The lake's regulation schedule will be modified and plan features constructed to reduce the extreme high and low levels that damage the lake and its shoreline. Management of intermediate water levels will be improved, while allowing the lake to continue to serve as an important source for water supply. Several plan components and Other Project Elements are included to improve water quality conditions in the lake. A study is recommended to evaluate in detail the dredging of nutrient-enriched lake sediments to help achieve water quality restoration targets, important not only for the lake, but also for downstream receiving bodies.

5.4 Improve Water Deliveries to Estuaries

Excess stormwater that is discharged to the ocean and the gulf through the Caloosahatchee and St. Lucie rivers is very damaging to their respective estuaries. The CERP will greatly reduce these discharges by storing excess runoff in surface and underground water storage areas. During times of low rainfall, the stored water can be used to augment flow to the estuaries. Damaging high flows will also be reduced to the Lake Worth Lagoon.

5.5 Underground Water Storage

Wells and associated infrastructure will be built to store water in the upper Floridian aquifer. As much as 1.6 billion gallons a day may be pumped down the wells into underground storage zones. The injected fresh water, which does not mix with the saline aquifer water, is stored in a "bubble" and can be pumped out during dry periods. This approach, known as aquifer storage and recovery, has been used for years on a smaller scale to augment municipal water supplies. Since water does not evaporate when stored underground and less land is required for storage, aquifer storage and recovery has some advantages over surface storage. The CERP includes aquifer storage and recovery wells around Lake Okeechobee, in the WCAs, and the Caloosahatchee Basin.

5.6 Treatment Wetlands

Approximately 35,600 acres of manmade wetlands, known as stormwater treatment areas, will be built to treat urban and agricultural runoff water before it is discharged to the natural areas throughout the system. Stormwater treatment areas are included in CERP for basins draining to Lake Okeechobee, the Caloosahatchee River Basin, the St. Lucie Estuary Basin, the Everglades, and the Lower East Coast. These are in addition to the over 44,000 acres of stormwater treatment areas already being constructed pursuant to the Everglades Forever Act to treat water discharged from the EAA.

5.7 Improve Water Deliveries to the Everglades

The volume, timing, and quality of water delivered to the south Florida ecosystem will be greatly improved. The Comprehensive Plan will deliver an average of 26 percent more water into Northeast Shark River Slough over current conditions. This translates into nearly a half million acre-feet of additional water reaching the slough, and is especially critical in the dry season. More natural refinements will be made to the rainfall-driven operational plan to enhance the timing of water sent to the WCAs, ENP, Holey Land, and Rotenberger Wildlife Management Areas.

5.8 Remove Barriers to Sheetflow

More than 240 miles of project canals and internal levees within the Everglades will be removed to reestablish the natural sheetflow of water through the Everglades. Most of

the Miami Canal in WCA 3 will be removed and 20 miles of the Tamiami Trail (U.S. Route 41) will be rebuilt with bridges and culverts, allowing water to flow more naturally into ENP, as it once did. In the Big Cypress National Preserve, a north-south levee will be removed to restore more natural overland water flow.

5.9 Store Water in Existing Quarries

Two limestone quarries in northern Miami-Dade County will be converted to water storage reservoirs to supply Florida Bay, the Everglades, Biscayne Bay, and Miami-Dade County residents with water. The 11,000-acre area will be ringed with an seepage barriers to ensure that stored water does not leak or adjacent groundwater does not seep into the area. A similar facility will be constructed in northern Palm Beach County.

5.10 Reuse Wastewater

The recommended Comprehensive Plan includes two advanced wastewater treatment plants in Miami-Dade County capable of making more than 220 million gallons a day of the county's treated wastewater clean enough to discharge into wetlands along Biscayne Bay and for recharging the Biscayne Aquifer. This reuse of water will improve water supplies to south Miami-Dade County as well as reducing seepage from the Northeast Shark River Slough area of the Everglades. Given the high cost associated with using reuse to meet the ecological goals and objectives for Biscayne Bay, other potential sources of water to provide freshwater flows to the central and southern bay will be investigated before pursuing reuse.

5.11 Pilot Projects

A number of technologies proposed in CERP have uncertainties associated with them -- either in the technology itself, its application, or in the scale of implementation. While none of the proposed technologies are untested, what is not known is whether actual performance will measure up to that anticipated in CERP. The pilot projects, which include wastewater reuse, seepage management, Lake Belt technology, and three aquifer storage and recovery projects are recommended to address uncertainties prior to full implementation of these components.

5.12 Improve Fresh Water Flows to Florida Bay

Improved water deliveries to Shark River Slough, Taylor Slough, and wetlands to the east of Everglades National Park will in turn provide improved deliveries of fresh water flows to Florida Bay. A feasibility study is also recommended to evaluate additional environmental restoration needs in Florida Bay and the Florida Keys.

5.13 Southwest Florida

There are additional water resources problems and opportunities in southwest Florida requiring studies beyond the scope of the Restudy recommended Comprehensive Plan. In this regard, a feasibility study for Southwest Florida is being recommended to investigate the region's hydrologic and ecological restoration needs.

5.14 Comprehensive Integrated Water Quality Plan

The CERP includes a follow-on feasibility study to develop a comprehensive water quality plan to ensure that CERP leads to ecosystem restoration throughout south Florida. The water quality feasibility study would include evaluating water quality standards and criteria from an ecosystem restoration perspective and recommendations for integrating existing and future water quality restoration targets for south Florida water bodies into future planning, design, and construction activities to facilitate implementation of the recommended Comprehensive Plan. Further, water quality in the Keys is critical to ecosystem restoration. The Florida Keys Water Quality Protection Plan includes measures for improving wastewater and stormwater treatment within the Keys. Implementation of the Keys Water Quality Protection Plan is critical for restoration of the south Florida ecosystem.

Overall, CERP will capture and store much of the water that is now lost to the ocean and gulf. This will provide enough water in the future for both the ecosystem, as well as urban and agricultural users. It will continue to provide the same level of flood protection as it does at present for south Florida. The CERP is a system-wide solution for ecosystem restoration, water supply, and flood damage reduction. It is a necessary step towards a sustainable south Florida.

6.0 DESCRIPTION OF LISTED SPECIES AND DESIGNATED CRITICAL HABITAT

6.1 Affected Environment

Southern Florida is characterized by highly productive agricultural regions and rapidly growing urban areas. These areas contain extensive aquatic and wetland ecosystems that are in serious states of decline, largely as a result of water management activities required to support the agricultural and urban systems. An expanding urban population occupies most of the higher elevation areas of the Lower East Coast. Extensive agricultural areas cover much of the interior of the peninsula north and south of Lake Okeechobee and along the western fringes of the Lower East Coast. Both urban and agricultural land uses require increasing levels of water supply and flood control.

A channelized and degraded Kissimmee River is currently undergoing ecological restoration. A diked and highly regulated Lake Okeechobee has been reduced in area by half with the loss of extensive littoral wetlands. It now requires frequent regulatory water releases to maintain lowered water levels defined by water regulation schedules.

The regulatory releases severely damage the St. Lucie and Caloosahatchee estuarine ecosystems.

The Everglades have also been reduced in area by half due to agricultural and urban expansion. The remaining Everglades ecosystem is in a continuing state of decline largely as a result of altered water regimes and degraded water quality, as evidenced by vegetation change, declining wildlife populations and organic soil loss. In contrast, the Big Cypress region, although modified from its natural condition through major man-caused disturbances (eg. logging, oil and gas exploration, residential development, recreation uses and agriculture). is in relatively good condition as an ecosystem. At the downstream end of the system, Florida Bay, the Gulf of Mexico, and Biscayne Bay estuarine ecosystems experience altered salinity regimes due to decreased freshwater heads and inflows from the Everglades, with damaging effects on habitats, nursery grounds, and estuarine fauna.

The situation throughout the project area can be attributed largely to a diminished capacity to retain the huge volume of water that once pooled and sheet flowed across the pre-drainage landscape. These waters are now either discharged in massive volumes through canal systems to tide or are stored at unnaturally high levels in remnant diked wetlands of the Everglades. In hindsight, many of these problems are now recognized to be unanticipated effects of the existing C&SF Project.

6.2 Vegetative Communities

The location of south Florida between temperate and subtropical latitudes, its proximity to the West Indies, the expansive wetland system of the greater Everglades, and the low levels of nutrient inputs under which the Everglades evolved, all combine to create a unique flora and vegetation mosaic. Today nearly all aspects of south Florida's native vegetation have been altered or eliminated by the development, altered hydrology, nutrient inputs, and spread of exotics that have resulted directly or indirectly from a century of water management.

Riparian plant communities of the Kissimmee River and its floodplain are recovering from channelization and drainage. The macrophyte communities of the diminished littoral zone of Lake Okeechobee are now contained within the Herbert Hoover Dike. They remain essential for the ecological health of the Lake but are stressed by extreme high and low lake levels and by the spread of exotics. Below the Lake, all of the pond apple swamp forest and most of the sawgrass plain of the northern Everglades have been converted to the EAA. Also eliminated is the band of cypress forest along the eastern fringe of the Everglades that was largely converted to agriculture after the eastern levee of the WCAs cut off this community from the remaining Everglades. The mosaic of macrophyte and tree island communities of the remaining Everglades within the WCAs and ENP is altered even in seemingly remote areas by changes in hydrology, exotic plant invasion, and/or nutrient inputs.

The problems of the Everglades extend to the mangrove estuary and coastal basins of Florida Bay, where the forest mosaics and submerged aquatic vegetation show the effects of diminished freshwater heads and flows upstream. These problems are exacerbated by sea level rise. The upland pine and hardwood hammock communities of the Atlantic coastal ridge, interspersed with wet prairies and cypress domes and dissected by "finger glades" water courses that flowed from the Everglades to the coast, remain only in small and isolated patches that have been protected from urban development. In contrast, much of the vegetation mosaic in Big Cypress Swamp to the west of the Everglades remains relatively intact.

More detailed documentation of existing vegetation throughout the CERP project area is described in the Restudy (U.S. Army Corps of Engineers, 1999). Those systems include the Everglades peatland, the Everglades marl prairie and rocky glades, and the mangrove estuaries and coastal basins of Florida Bay and southern Biscayne Bay. For purposes of this BA, the following vegetative descriptions focus on the transition zones between coastal wetlands and nearshore habitats.

The primary factors influencing the distribution of vegetation in the transition zone of freshwater and saltwater wetlands are hydropattern, salinity, previous disturbance and nutrient loading and soil type. The plant community can strongly influence wildlife composition and patterns of utilization. The plant community types in these areas include sawgrass glades, spike rush and beak rush flats, muhly prairie, cypress stands, native dominated forested wetlands, tree islands, mangrove flats, hydric hammocks, and exotic-dominated forests. Natural disturbances, such as fire, play an important role in maintaining a diverse mosaic of vegetation communities. Altered hydroperiods, wildfire suppression and human caused fires have disrupted the natural frequency and pattern of fires in the region.

Invasive species present in the wetland transition zones include melaleuca (*Melaleuca quinquenervia*), Australian pine (*Casuarina* spp.), and Brazilian pepper (*Schinus terebinthifolius*), among others. The heaviest impacts from invasive species tend to occur in disturbed areas within the project area, such as abandoned farmland and lands in the immediate vicinity of roads and berms. Such areas are frequently dominated by nearly monotypic stands of invasive plants. Elsewhere, these invasive plants are present in smaller, but no less important numbers in tree islands, marshes, and mangrove forests as a result of long distance seed dispersal.

The mangrove estuary between the freshwater Everglades and Florida Bay and southern Biscayne Bay supports a mosaic of mangrove forests, tidal creeks, salt marshes, coastal lakes, tropical hardwood hammocks, and coastal basins. Red mangrove (*Rhizophora mangle*) swamp dominates the landscape along with stands of buttonwood (*Conocarpus erectus*), black mangrove (*Avicennia germinans*) and white mangrove (*Laguncularia racemosa*). Tidal creeks dissect the mangrove forests and are often bordered by salt

marsh communities of black sedge (*Schoenus nigricans*) and cord grass (*Spartina* spp.). Tropical hardwood hammocks with canopy trees such as West Indian mahogany, Jamaica dogwood (*Piscidia piscipula*), strangler fig (*Ficus aurea*) and holly grow on elevated coastal embankments.

The nearshore habitats, including coastal lakes and basins, support seasonally variable beds of submerged aquatic macrophytes that range from low-salinity communities of bladderwort and widgeon grass (*Ruppia maritima*), to marine seagrasses that include turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*). Additional species include star grass (*Halophila engelmannii*), paddle grass (*Halophila decipiens*), and Johnson's seagrass (*Halophila johnsonii*). Reduction in freshwater heads and flows from the Everglades, in concert with sea level rise, has caused community shifts in the submerged aquatic vegetation of the coastal lakes and basins and apparently has contributed to the filling in of tidal creeks. A salinity regime favoring an increased frequency of high salinity events and a decreased frequency of low salinity events in the coastal lakes and basins has resulted in the loss of the low-to-moderate salinity macrophyte communities that seasonal populations of migratory waterfowl once utilized.

6.3 Federally Listed Species

The Corps has coordinated the existence of federally listed species with NMFS, as appropriate. Specifically, coordination with NMFS includes listed fish, marine plants, and sea turtles at sea. Fifteen federally listed threatened and endangered species under NMFS purview are either known to exist or potentially exist within the project area and, subsequently, may be affected by the proposed action (**Table 6-1**). Many of these species have been previously affected by habitat impacts resulting from wetland drainage, alteration of hydroperiod, wildfire, and water quality degradation.

Federally listed animal species that exist or potentially exist in the project area, include smalltooth sawfish (*Pristia pectinata*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and loggerhead sea turtle (*Caretta caretta*). Other federally threatened or endangered animal species that are known to exist or potentially exist in the project area, but which will likely not be of concern in this study due to the lack of suitable habitat in and within close proximity of the project area include, Gulf sturgeon (*Acipenser oxyrinchus desotoi*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), elkhorn (*Acropora palmata*), and staghorn (*Acropora cervicornis*) stony corals.

A federally listed plant species that may occur in the project area includes Johnson's seagrass (*Halophila johnsonii*). Johnson's seagrass is a rare plant that has a very limited

distribution, often found in coarse sand and muddy substrates and in areas of turbid waters and high tidal currents. The species ranges from central Biscayne Bay to Sebastian Inlet.

Table 6-1. Status of Threatened & Endangered Species Under NMFS Purview Likely to be Affected by CERP Projects – and the Corps Effects Determinations

Common Name	Scientific Name	Status	Agency	May Affect, Likely to Adversely Effect	May Affect, Not Likely to Adversely Effect	No Effect
Mammals						
Blue whale	*Balaenoptera musculus*	E	Federal			X
Fin whale	*Balaenoptera physalus*	E	Federal			X
Humpback whale	*Megaptera novaeangliae*	T	Federal			X
Sei whale	*Balaenoptera borealis*	E	Federal			X
Sperm whale	*Physeter macrocephalus*	E	Federal			X
Reptiles						
Green sea turtle	*Chelonia mydas*	E	Federal		X	
Leatherback sea turtle	*Dermochelys coriacea*	E	Federal		X	
Hawksbill sea turtle	*Eretmochelys imbricata*	E	Federal		X	
Loggerhead sea turtle	*Caretta caretta*	T	Federal		X	
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	Federal		X	
Fish						
Smalltooth sawfish*	*Pristia pectinata*	E	Federal		X	
Gulf sturgeon*	*Acipenser oxyrinchus desotoi*	T	Federal			X
Invertebrates						
Elkhorn coral*	*Acropora palmata*	T	Federal			X
Staghorn	*Acropora*	T	Federal			X

coral*	*cervicornis*					
Plants						
Johnson's seagrass*	*Halophila johnsonii*	E	Federal		X	

* Critical habitat designated for this species
E: Endangered
T: Threatened

6.4 State Listed Species

In addition to federally listed species, portions of project area contain habitat potentially suitable for two state-listed threatened species and nine species of special concern that are under NMFS purview. Threatened species include key silverside (*Mendia conchorum*), and pillar coral (*Dendrogyra cylindricus*). Species of special concern include Alabama shad (*Alosa alabamae*), dusky shark (*Carcharhinus obscurus*), mangrove rivulus (*Rivulas marmoratus*), opossum pipefish (*Microphis brachyurus lineatus*), sand tiger shark (*Carcharias Taurus*), speckled hind (*Epinephelus drummondhayi*), warsaw grouper (*Epinephelus nigritus*), and ivory bush coral (*Oculina varicose*).

While habitats utilized by some of these animal species may be affected by CERP, construction impacts would be minimal and temporary, and not likely to adversely affect any protected species. The majority of protected species is outside of the projects' zone of influence and therefore, is not likely to be adversely affected by project operations. Successful implementation of restoring existing wetlands will improve the overall functional capacity of affected habitats thus benefiting the species utilizing these areas. Therefore, no adverse effects are anticipated to state listed species, or species of concern as a result of this project.

6.5 Designated Critical Habitat

In addition to threatened and endangered species, the project area also includes or is adjacent to designated critical habitats for Johnson's seagrass, Gulf sturgeon, smalltooth sawfish, elkhorn coral, and staghorn coral. Maps of critical habitat locations for these species are depicted in **Figure 6-1 through Figure 6-5**

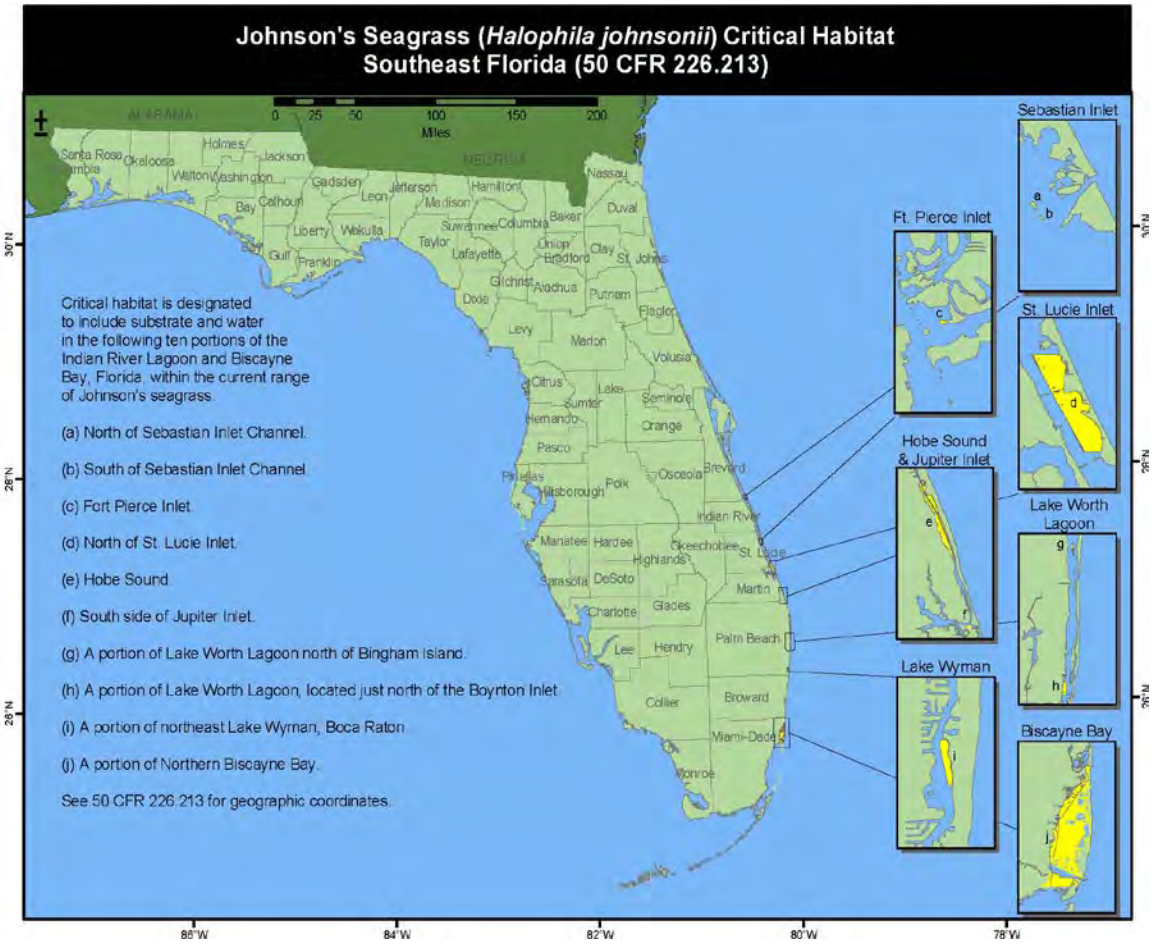

Figure 6-1. Critical Habitat for the Johnson's Seagrass

As defined in the Code of Federal Regulations (50 CFR Part 226, Section 226.213, Vol. 65, 5 April 2000), the Johnson's seagrass critical habitat includes all land and water within the following boundary: Beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; then southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; then southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Anglefish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key; then to the westernmost tip of Middle Cape; then northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; then eastward along a straight line to the northernmost point of Nine-Mile Pond; then northeastward along a straight line to the point of beginning.

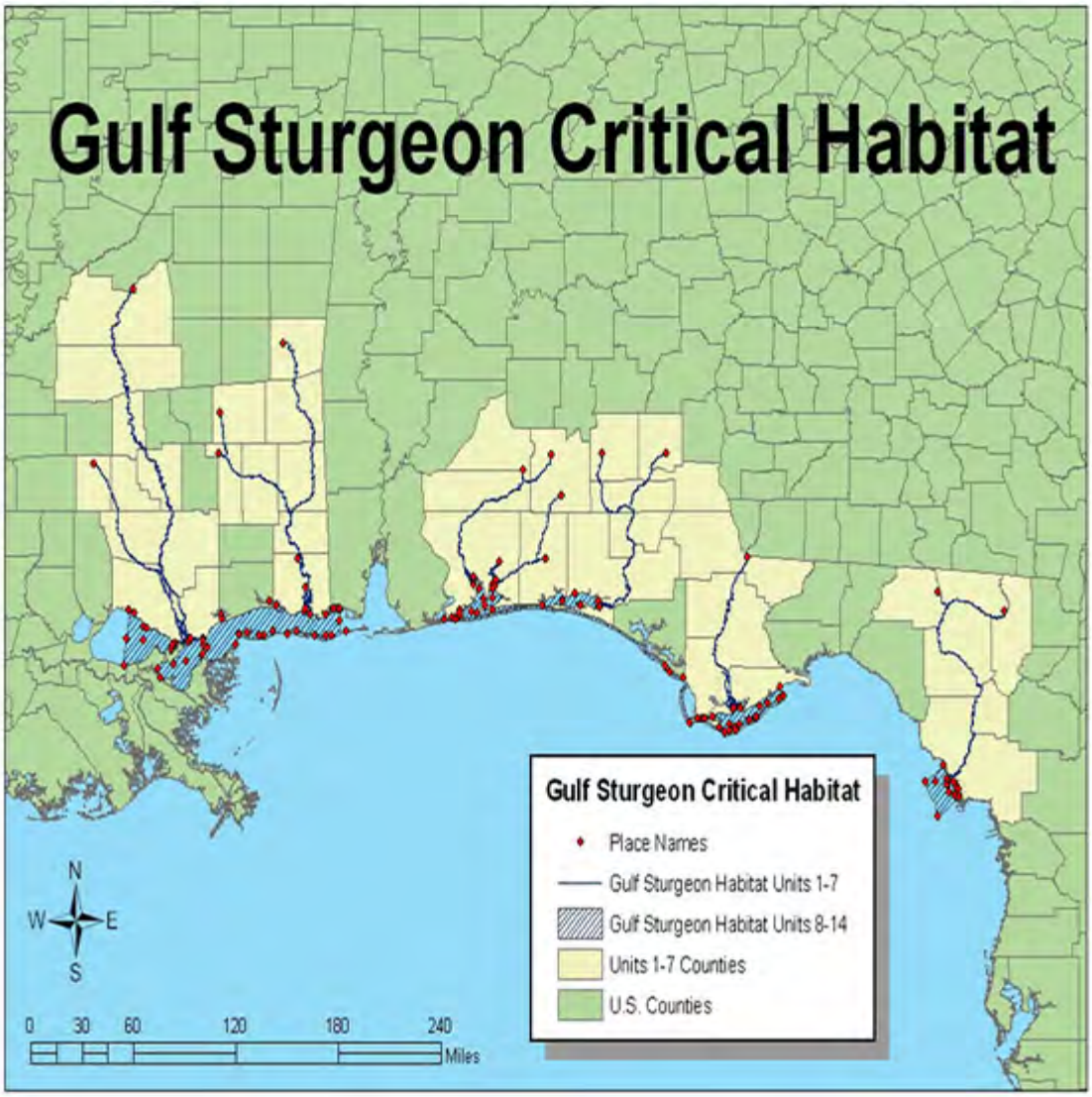

Figure 6-2. Critical Habitat for the Gulf Sturgeon

As defined in the Code of Federal Regulations (50 CFR Part 226, Vol. 68, 19 March 2003), the Gulf Sturgeon critical habitat portions in Florida includes Unit 9, Pensacola Bay System in Escambia and Santa Rosa Counties; Unit 10, Santa Rosa Sound in Escambia, Santa Rosa, and Okaloosa Counties; Unit 11, Florida Nearshore of Mexico Unit in Escambia, Santa Rosa, Okaloosa, Walton, Bay, and Gulf Counties: Unit 12, Chotawhatchee Bay in Okaloosa and Walton Counties; Unit 13, Apalachicola Bay in Gulf and Franklin Counties; and Unit 14, Suwannee Sound in Dixie and Levy Counties.

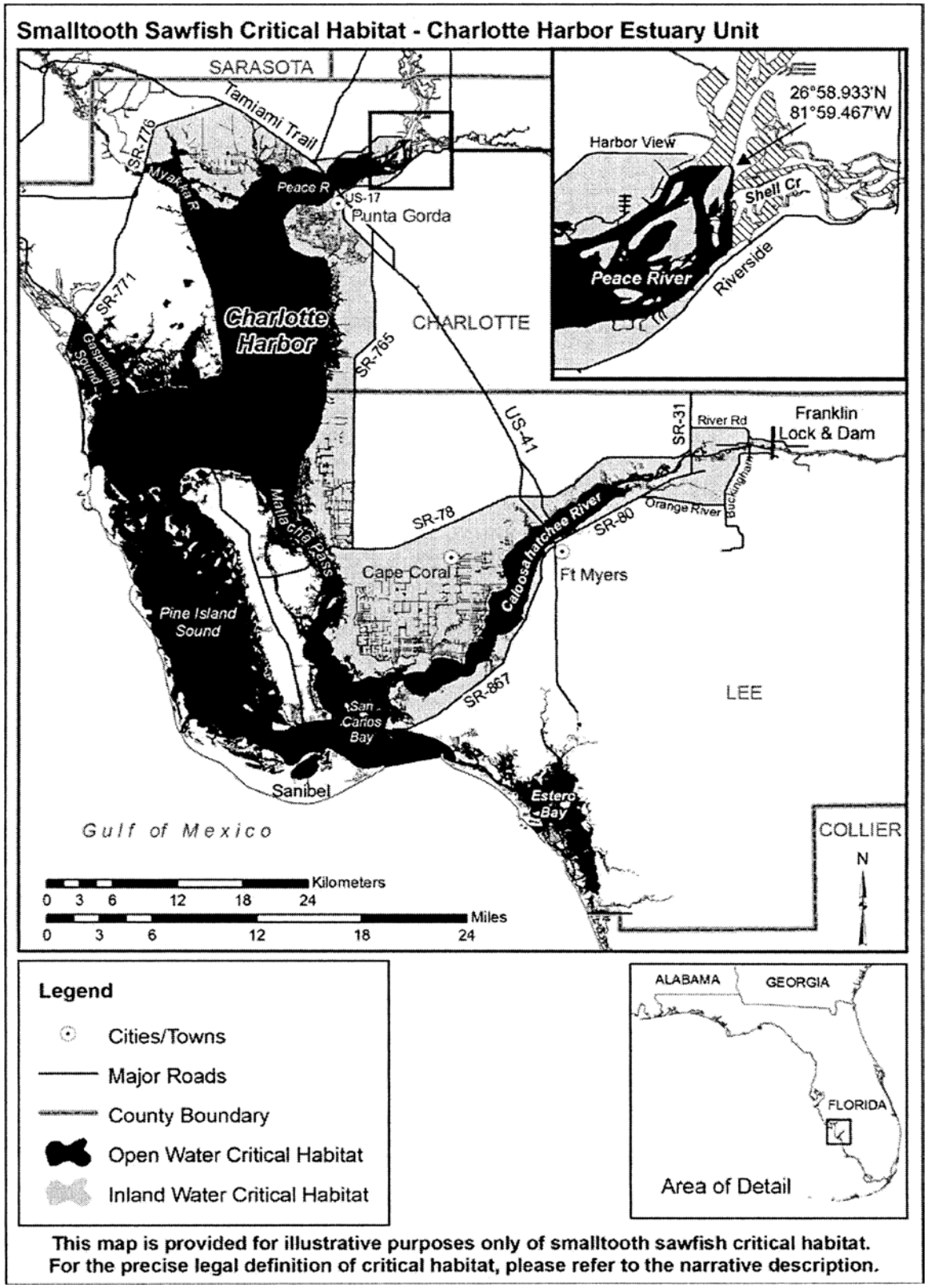

Figure 6-3. Critical Habitat for the Smalltooth Sawfish – Charlotte Harbor Everglades Unit

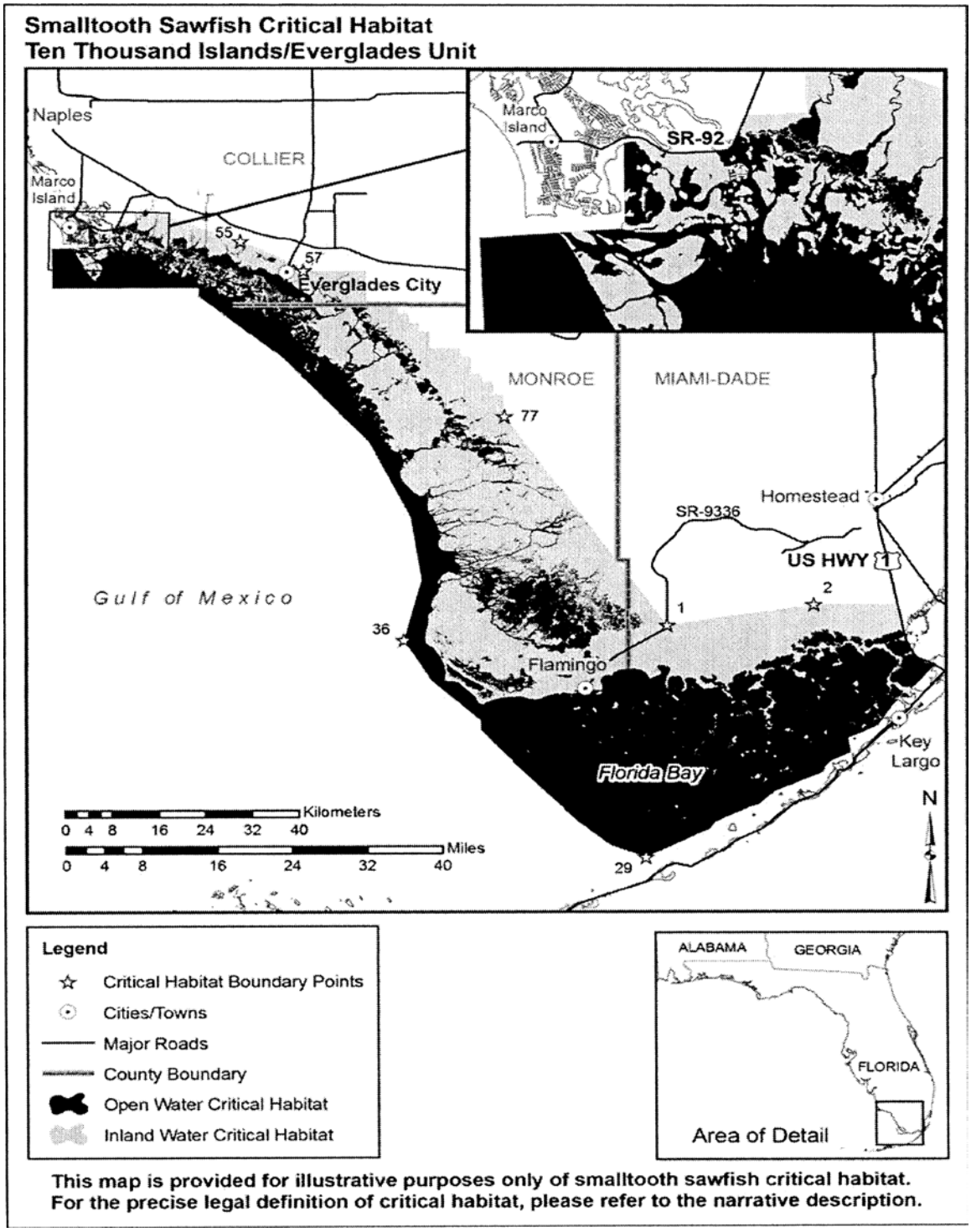

Figure 6-4. Critical Habitat for the Smalltooth Sawfish – 10,000 Islands

As stated in the final rule published in the Federal Register on 2 September 2009, critical habitat consists of two coastal habitat units: the Charlotte Harbor Estuary Unit and the Thousand Islands/Everglades Unit.

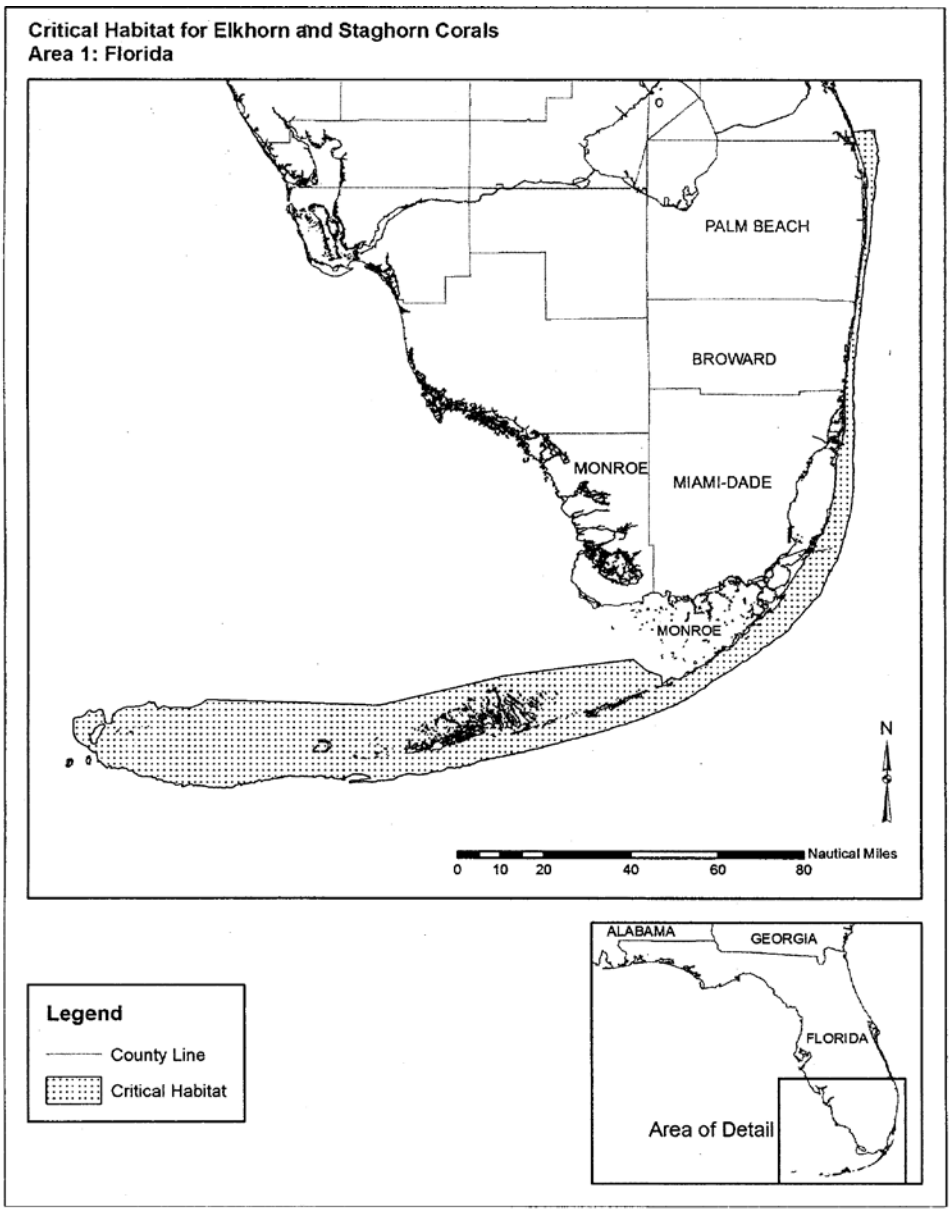

Figure 6-5. Critical Habitat for Elkhorn and Staghorn Corals

In southeast Florida, staghorn coral has been documented along the east coast as far north as Palm Beach County in deeper (16 to 30 m) water and is distributed south and west throughout the coral and hard-bottom habitats of the Florida Keys, through Tortugas Bank. Elkhorn coral has been reported as far north as Broward and Miami-Dade counties, with significant reef development and framework construction by this species beginning at Ball Buoy Reef in Biscayne National Park, extending discontinuously southward to the Dry Tortugas (CFR Vol. 73, No. 25, 02-06-08).

7.0 EFFECTS OF PROPOSED ACTION

7.1 Species Biology and Effect Determination

7.1.1 Elkhorn Coral (*Acropora palmata*)

Elkhorn coral is a large, branching coral with thick and sturdy antler-like branches. The dominant mode of reproduction is asexual, with new colonies forming when branches break off of a colony and reattach to the substrate. Sexual reproduction occurs via broadcast spawning of gametes into the water column once each year in August or September. Individual colonies are both male and female (simultaneous hermaphrodites). Colonies are fast growing: branches increase in length by 2-4 inches (5-10 cm) per year, with colonies reaching their maximum size in approximately 10-12 years. Elkhorn coral was formerly the dominant species in shallow water (3-16 ft (1-5 m) deep) throughout the Caribbean and on the Florida Reef Tract, forming extensive, densely aggregated thickets in areas of heavy surf. Coral colonies prefer exposed reef crest and fore reef environments in depths of less than 20 feet (6 m), although isolated corals may occur to 65 feet (20 m). Elkhorn coral is found on coral reefs in southern Florida, the Bahamas, and throughout the Caribbean. Its northern limit is the Biscayne Bay National Park and it extends south to Venezuela; it is not found in Bermuda. Since 1980, populations have collapsed throughout their range from disease outbreaks with losses compounded locally by hurricanes, increased predation, bleaching, elevated temperatures, and other factors.

7.1.2 Staghorn Coral (*Acropora cervicornis*)

Staghorn coral is a branching coral with cylindrical branches ranging from a few centimeters to over 6.5 feet (2 m) in length. The dominant mode of reproduction for staghorn coral is asexual fragmentation, with new colonies forming when branches break off a colony and attach to the substrate. Similar to elkhorn coral, sexual reproduction occurs via broadcast spawning of gametes into the water column once each year in August or September. Individual colonies are both male and female. This coral exhibits the fastest growth of all known western Atlantic corals, with branches increasing in length by 4-8 inches (10-20 cm) per year. Staghorn coral has been one of the three most important Caribbean corals in terms of its contribution to reef growth and fish habitat. Staghorn coral occur in back reef and fore reef environments from 0-98 feet (0-30 m) deep. The upper limit is defined by wave forces, and the lower limit is controlled by suspended sediments and light availability. Staghorn coral is found throughout the Florida Keys, the Bahamas, and the Caribbean islands. This coral occurs in the western Gulf of Mexico, but is absent from U.S. waters in the Gulf of Mexico. It also occurs in Bermuda and the west coast of South America. The northern limit is on the east coast of Florida, near Boca Raton. The greatest source of region-wide mortality for staghorn coral has been disease outbreaks, mainly of white band disease. Other, more localized losses have been caused hurricanes, increased predation, bleaching,

algae overgrowth, human impacts, and other factors. This species is also particularly susceptible to damage from sedimentation and is sensitive to temperature and salinity variation.

7.1.3 Smalltooth Sawfish (*Pristis pectinata*)

Smalltooth sawfish have been reported in the Pacific and Atlantic Oceans, and the Gulf of Mexico; however, the United States population is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the United States population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras. The current range of this species includes peninsular Florida, but is relatively common only in the Everglades region at the southern tip of the state. Juvenile sawfish use shallow habitats with a lot of vegetation, such as mangrove forests, as important nursery areas. Many such habitats have been modified or lost due to development of the coastal areas of Florida and other southeastern states. The loss of juvenile habitat likely contributed to the decline of this species.

7.1.4 Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)

Gulf sturgeons inhabit coastal rivers from Louisiana to Florida during the warmer months, and the Gulf of Mexico and its estuaries and bays in the cooler months. Sturgeon are primitive fish characterized by bony plates, or "scutes," and a hard, extended snout; they have a heterocercal caudal fin. Adults range from 4-8 feet (1-2.5 m) in length; females attain larger sizes than males. They are bottom feeders, and eat primarily macroinvertebrates, including brachiopods, mollusks, worms, and crustaceans. All foraging occurs in brackish or marine waters of the Gulf of Mexico and its estuaries; sturgeon do not forage in riverine habitat. Historically, Gulf sturgeon occurred from the Mississippi River east to Tampa Bay. Sporadic occurrences were recorded as far west as the Rio Grande River in Texas and Mexico, and as far east and south as Florida Bay. The sub-species' present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi respectively, east to the Suwannee River in Florida. The species is anadromous: feeding in the winter months in the marine waters of the Gulf of Mexico including bays and estuaries, migrating in the spring up freshwater rivers to spawn on hard substrates, and then spending summers in the lower rivers before emigrating back out into estuarine/marine waters in the fall.

7.1.5 Green Sea Turtle (*Chelonia mydas*)

The green sea turtle weighs approximately 150 kg and lives in tropical and sub-tropical waters. Areas that are known as important feeding areas for the green turtles in Florida include the Indian River Lagoon, the Florida Keys, Florida Bay, Homosassa, Crystal River and Cedar Key. Green turtles occupy three habitat types: high energy oceanic beaches,

convergence zones in the pelagic habitat, and benthic feeding grounds in the relatively shallow, protected waters. Females deposit eggs on high energy beaches, usually on islands, where a deep nest cavity can be dug above the high water line. Hatchlings leave the beach and move in the open ocean. Green sea turtles forage in pastures of seagrasses and/or algae, but small green turtles can also be found over coral reefs, worm reefs, and rocky bottoms.

7.1.6 Hawksbill Sea Turtle (*Eretmochelys imbricata*)

The hawksbill sea turtle is a small to medium-sized marine turtle weighing up to 15 kilograms in the United States. The hawksbill lives in tropical and sub-tropical waters of the Atlantic, Pacific, and Indian Oceans. Areas that are known as important feeding areas for hawksbill turtles in Florida include the waters near the Florida Keys and on the reefs off Palm Beach County. Hawksbill turtles use different habitat types at different stages of their life cycle. Post hatchlings take shelter in weed lines that accumulate at convergence zones. Coral reefs are the foraging habitat of juveniles, sub-adults, and adults. They are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore where coral reefs are absent. Hawksbills feed predominantly on sponges and nest on low and high energy beaches, frequently sharing the high-energy beaches with green sea turtles. Nests are typically placed under vegetation.

7.1.7 Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback sea turtle is the largest living turtle and weighs up to 700 kg. The leatherback lives in tropical and sub-tropical waters. Habitat requirements for juvenile and post-hatchling leatherbacks are virtually unknown. Nesting females prefer high-energy beaches with deep unobstructed access. Leatherbacks feed primarily on jellyfish.

7.1.8 Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

The Kemp's ridley sea turtle is the smallest of all sea turtles and weighs up to 45 kg. This species is a shallow water benthic feeder consuming mainly algae and crabs. Juveniles grow rapidly. Juveniles and sub-adults have been found along the eastern seaboard of the United States and in the Gulf of Mexico. However, the major nesting beach for the Kemp's ridley sea turtle is on the northeastern coast of Mexico.

This species occurs mainly in coastal areas of the Gulf of Mexico and in the northwestern Atlantic Ocean. The post-pelagic stages are commonly found dwelling over crab-rich sandy or muddy bottoms. Juveniles frequent bays, coastal lagoons, and river mouths.

7.1.9 Loggerhead Sea Turtle (*Caretta caretta*)

Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. Females select high energy beaches on barrier strands adjacent to continental land masses for nesting. Steeply sloped beaches with gradually sloped offshore approaches are favored. After leaving the beach, hatchlings swim directly offshore and eventually are found along drift lines. They migrate to the near-shore and estuarine waters along the continental margins and utilize those areas as the developmental habitat for the sub-adult stage. Loggerheads are predators of benthic invertebrates.

7.1.10 The Blue Whale (*Balaenoptera musculus*)

The blue whale, a species of baleen and rorqual whale, can grow to lengths in excess of 100 feet (30.48 meters) but are typically found up to 88 feet (26.8 m). Female blue whales tend to be slightly larger than their male counterparts. Sexual maturity is believed to be reached between ages 5-15 years. Blue whale's mating and birthing events usually occur during the winter. Commercial whaling has led to the declination of this species. Populations today are estimated at about 3800-5255 whales. Threats to this population include vessel strikes, fisheries interactions, natural mortality, anthropogenic noise, competition, habitat degradation, and vessel disturbance.

Three subspecies are recognized: the Northern Hemisphere blue whale (*B.m. musculus*), the Antarctic blue whale (*B.m. intermedia*), and the pygmy blue whale (*B.m. brevicauda*). Found across the globe, blue whales are separated into the North Atlantic, North Pacific, and Southern Hemisphere populations. There is also a "resident" population found in the northern Indian Ocean. In the North Atlantic population, most sightings are located off of eastern Canada. The southern border of the whales feeding range is thought to be near Massachusetts. The North Pacific population is thought to be divided into five subpopulations describing their location. These are southern Japan, northern Japan/Kurils/Kamchatka, Aleutian Islands, eastern Gulf of Alaska, and California/Mexico. The Southern Hemisphere whales are found mainly in high latitudes south of the Antarctic Convergence (*B.m. intermedia*) and also north of the Antarctic Convergence (*B.m. brevicauda*).

It is possible that these whales travel into the Gulf of Mexico and the Caribbean but these occurrences are thought to be rare.

7.1.11 Humpback Whale (*Megaptera novaeangliae*)

Humpback whales are commonly identified by distinct coloration on their flukes. They are also known for their long pectoral fins. Females tend to be larger than males reaching lengths of up to 60 feet (18m). There is an estimated 20,000 whales found in the North Pacific, over 11,000 in the North Atlantic, and an approximate 25,000 whales in the Southern Hemisphere. Threats to humpbacks whales include entanglement, vessel strikes, whale watching harassment, and habitat disturbance.

During the summer, humpbacks can be found in areas of high latitude such as the Gulf of Maine and the Gulf of Alaska. Shallow waters are preferred when humpback whales are feeding and calving. The North Atlantic stock can usually be found along the whole east coast of US, Greenland, St. Lawrence, and Newfoundland/Labrador. During the winter, the whales migrate to the West Indies for mating and calving. The North Pacific stock has three populations of humpback whales: California/Oregon/Washington, Central North Pacific, and Western North Pacific. Whales found in the Southern Hemisphere are found near 20°S for breeding purposes. For feeding, the Southern Hemisphere whales travel to around 40°S and between 102°E and 110°W.

Humpback whales have been reported in the central and eastern Gulf of Mexico in the winter when the whales migrate south.

7.1.12 Sperm Whale (*Physter macrocephalus*)

The sperm whale is an odontocete or toothed whale. Males of this species often grow larger than females reaching 52 ft (16m) while females may reach lengths of up to 36 feet (11m). Sexual maturity for females is reached around 9 years of age and males reach maturity anywhere from 10-20 years of age. Today, there are between 200,000 and 1,500,000 estimated sperm whales approximated from a few areas. Threats to this population include vessel strikes, entanglements, anthropogenic noise, and pollutants.

Found across the world, they are often located in waters deeper than 600m. Migration patterns are not well known but sperm whales follow conditions that are favorable for feeding and breeding. In the Pacific U.S. waters, they are commonly found near the equator but also occur by Alaska, California, Washington, and Oregon. In the Atlantic, they are typically found north of Delaware and Virginia. Sperm whales are typically found far off shore.

There are sperm whales present in the northern Gulf of Mexico year-round, but they are most commonly found there during the summer. This population is thought to have about 1300 individuals. Sperm whales may also be found far off the Florida coast during the winter.

7.1.13 Finback Whale (*Balaenoptera physalus*)

Fin whales, the second largest species of whale have a maximum length of 75-85 feet (22-26 m). Like other baleen whales, females tend to be larger than the males. Sexual maturity is reached from ages 6-10 for males and 7-12 for females. Distinguishing features include a unique coloration: the underside is a shade of white while the dorsal surface and sides are black or shades of brown-gray. The jaw is dark on the left side and white on the right. Commercial whaling led to the declination of this species. There is thought to be over 10,000 whales occupying U.S. waters, but global population

estimates are uncertain due to a small amount of surveys taken. Current threats to these whales worldwide include collisions with vessels, entanglement in fishing gear, reduction in prey abundance, habitat degradation, and disturbance from low-frequency noise.

Fin whales can be found throughout the world but more commonly in temperate to polar latitudes. They typically inhabit deep, offshore waters. There are two identified subspecies of the fin whale found in the North Atlantic (*B. p. physalus*) and the Southern Ocean (*B. p. quoyi*). Another, unnamed subspecies can be found in the North Pacific.

During the winter fin whales travel down to the coast of Florida and the Gulf of Mexico but they are uncommon in this area.

7.1.14 Sei Whale (*Balaenoptera borealis*)

The sei whale can grow to lengths of 40-60 feet (12-18m) and like most other baleen whales, females can be larger than the males. Sexual maturity is thought to be reached between 6-12 years of age. Similar to Bryde's whale, they can be differentiated by a single ridge on their rostrum. Their coloration pattern is noted as dark on the dorsal side and light ventrally. Commercial whaling led to the declination of this species. A current estimate of the sei whale population is about 80,000 whales worldwide. Threats to this population include vessel strikes and fishing gear.

Two subspecies are identified, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere. Their distribution can include subtropical, temperate, and sub polar waters in the Atlantic, Pacific, and Indian oceans. During the summer they can be found areas such as the Gulf of Maine and Georges Bank in the western North Atlantic among other locations. During the winter, it is thought that the whales migrate to more tropical locations. However, their entire distribution and migration patterns are not well known.

Sei whales have been noted in the northeast and southwest Gulf of Mexico.

7.1.15 Johnson's Seagrass (*Halophila johnsonii*)

Johnson's seagrass is a rare plant that may have the most limited distribution of any seagrass in existence. It frequently occurs in small isolated patches from centimeters to a few meters in diameter. Johnson's seagrass appears to reproduce only through asexual branching. There are no known seed banks. The leaves are generally two to five centimeters in length, and the rhizome internodes rarely exceed three to five centimeters in length. Johnson's seagrass prefers to grow in coastal lagoons in the intertidal zone, or deeper than many other seagrasses. It fares worse in the intermediate areas where other seagrasses thrive. The species has been found in coarse sand and muddy substrates and in areas of turbid waters and high tidal currents.

Johnson's seagrass is more tolerant of salinity, temperature, and desiccation variation than other seagrasses in the area. It has a disjunct and patchy distribution along the east coast of Florida from central Biscayne Bay to Sebastian Inlet. The largest patches have been documented inside Lake Worth Inlet. The southernmost distribution is reported to be in the vicinity of Virginia Key in Biscayne Bay.

7.2 Projects with "No Effect" Determination (Consultation Completed)

Federally threatened or endangered species that are known to potentially exist within close proximity of CERP project areas, but which will not likely be of concern are discussed in detail below:

7.2.1 Biscayne Bay Coastal Wetlands Project

7.2.1.1 Project Summary

The primary purpose of the Biscayne Bay Coastal Wetlands project is to redistribute freshwater runoff from the watershed away from the existing canal discharges and into the coastal wetlands adjoining Biscayne Bay to provide a more natural and historic overland flow through existing coastal wetlands. The Restudy identified a need to replace lost overland flow, rehydrate coastal wetlands and reduce point source freshwater discharges to Biscayne Bay using a system of pumps, and interconnections between coastal canals and operational changes to coastal structures **(Figure 7-1)**.

7.2.1.2 Existing Conditions

Historically, freshwater runoff entered Biscayne Bay via overland flow from the Everglades through estuarine coastal wetlands and artesian up-wellings. The water quality in the late 1800s was low in nutrients, low in turbidity, and high in light transmittance; such conditions allowed an abundant coverage of seagrass beds. The Biscayne Bay water quality was still within natural conditions at the time the City of Miami was founded in 1896. As development progressed, canal networks were constructed for flood protection and prevention of aquifer saltwater intrusion. The canal network, a system of managed water, had replaced the natural sloughs. Freshwater flow into Biscayne Bay is now dominated by pulse-released direct canal discharges.

7.2.1.3 Project Effects

Construction includes building pumps, levees, canals and other structures that will displace existing natural areas. Diversion of canal discharges into coastal wetlands, as opposed to their direct discharge into the Bay, is expected to re-establish productive nursery habitat along the shoreline and reduce the abrupt freshwater discharges that

are physiologically stressful to fish and benthic invertebrates in the bay near canal outlets.

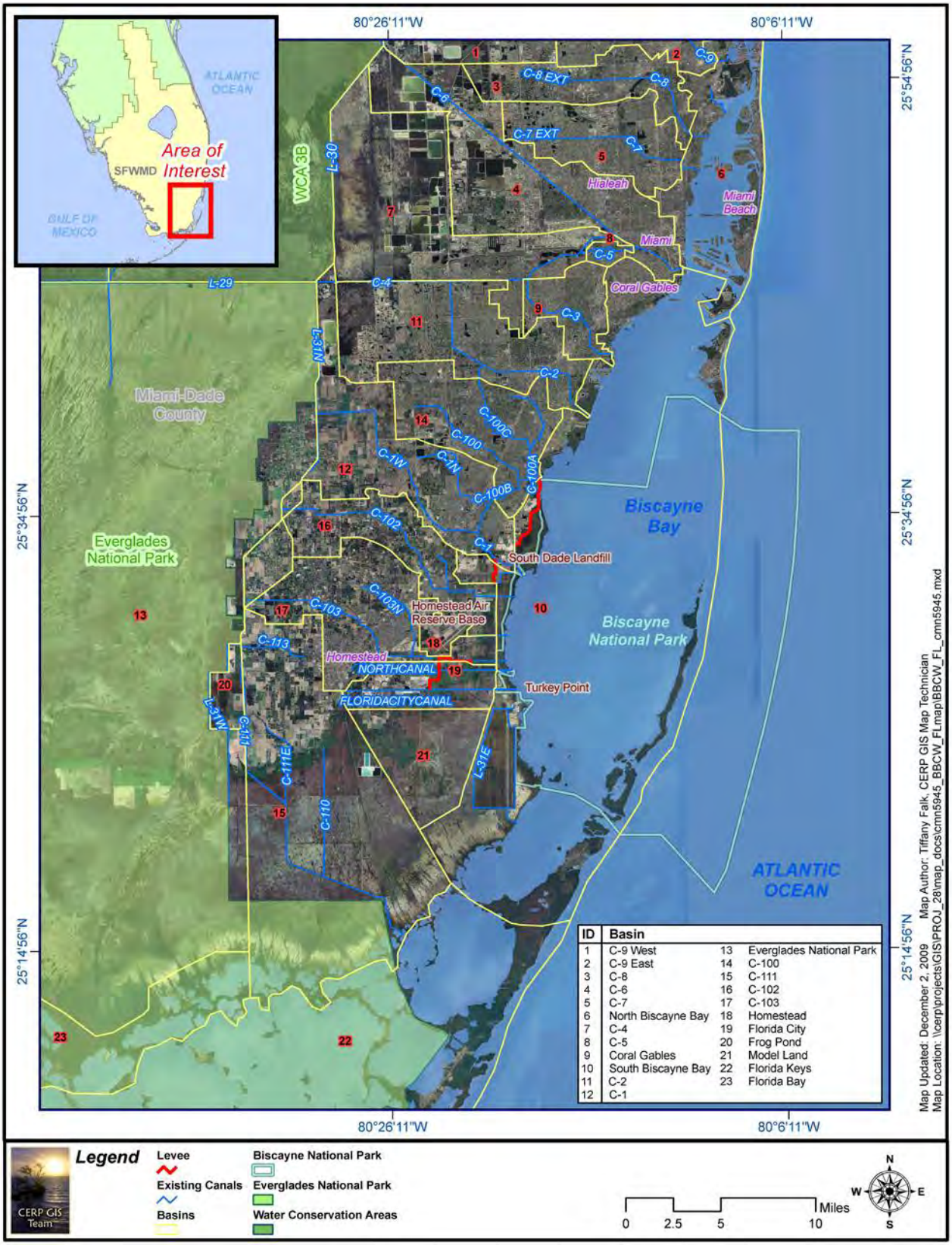

Figure 7-1. Biscayne Bay Coastal Wetlands Location Map

7.2.1.4 Status of ESA Consultation with NMFS

By letter dated August 30, 2007, NMFS concurred with the Corps' determination that implementation of the BBCW Acceler8 (initial phase of the project) may affect, but is not likely to adversely affect, smalltooth sawfish. By letter dated 3 November 2011, the NMFS concurred with the Corps' determination that the BBCW project is not likely to adversely affect any listed species under NMFS's purview and subsequently concurred with the Corps' determination that proceeding with the project will not violate sections 7(a)(2) and 7(d) pending completion of a recommended programmatic consultation for any remaining individual CERP projects.

Smalltooth Sawfish and "May Affect, But Not Likely to Adversely Affect" Determination

The smalltooth sawfish has the potential to be found within Biscayne Bay, and juveniles could potentially occur and feed in red mangrove wetlands. With the proposed project, the smalltooth sawfish may benefit as a result of the redistribution of freshwater runoff from the watershed away from the existing canal discharges into the coastal wetlands adjoining Biscayne Bay to provide a more natural and historic overland flow. With the expectation of improved wetland habitat, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the smalltooth sawfish may be affected, but is not likely to be adversely affected, by the proposed project.

Green Sea Turtle and "May Affect, But Not Likely to Adversely Affect" Determination

Although green sea turtles are expected to be found foraging in nearshore seagrass habitats within Biscayne Bay, the increased freshwater flows associated with the Biscayne Bay Coastal Wetlands Phase I project may alter seagrass species composition but should not have an adverse effect on the overall biomass available for sea turtle feeding habits. Additionally, no green sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the green sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Hawksbill Sea Turtle and "May Affect, But Not Likely to Adversely Affect" Determination

Although hawksbill sea turtles are expected to be found foraging near coral reef habitats within Biscayne Bay, the increased freshwater flows associated with Phase 1 of the Biscayne Bay Coastal Wetlands project may reduce nearshore salinity concentrations

but should not have an adverse effect on sponges or other food sources utilized by this species. Additionally, no hawksbill sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the hawksbill sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Leatherback Sea Turtle and "May Affect, But Not Likely to Adversely Affect" Determination

Although leatherback turtles are expected to be found foraging in nearshore habitats within Biscayne Bay, the increased freshwater flows associated with the Biscayne Bay Coastal Wetlands Phase 1 project may reduce nearshore salinity concentrations but should not have an adverse effect on jellyfish or other food sources utilized by this species. Additionally, no leatherback sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the leatherback sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Kemp's Ridley Sea Turtle and "May Affect, But Not Likely to Adversely Affect" Determination

Although Kemp's ridley sea turtles could be found foraging in nearshore habitats within Biscayne Bay, this species is not expected to be found within the direct area of influence associated with the Biscayne Bay Coastal Wetlands Phase 1 project. Additionally, no Kemp's ridley sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the Kemp's ridley sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Loggerhead Sea Turtle and "May Affect, But Not Likely to Adversely Affect" Determination

Although loggerhead sea turtles are expected to be found foraging in nearshore habitats within Biscayne Bay, the increased freshwater flows associated with the Biscayne Bay Coastal Wetlands Phase 1 project may reduce nearshore salinity concentrations but should not have an adverse effect on crustaceans, mollusks or other invertebrate food sources utilized by this species. Additionally, no loggerhead sea turtles would attempt

to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the loggerhead sea turtle may be affected, but would not likely be adversely affected by the proposed project.

Elkhorn Coral and "No Effect" Determination

Elkhorn coral may be found outside the waters of Biscayne Bay, specifically within the offshore reef track in Biscayne National Park where salinities are stable (35 ppt) and more representative of open ocean conditions. The reef tract is approximately five to eight miles seaward of the shoreline. Anticipated salinity alterations resulting from project activities are not expected to occur beyond 1,500 meters from shore. Because the reef tract where elkhorn coral resides is several miles outside of any projected salinity changes, the Corps has determined the proposed project would have no effect on elkhorn coral.

Elkhorn Coral Critical Habitat

Salinities, due to project operations, will not be altered in the vicinity of critical habitat; therefore, the project would have no effect on critical habitat for elkhorn coral.

Staghorn Coral and "No Effect" Determination

Staghorn coral may be found outside the waters of Biscayne Bay, specifically within the offshore reef track in BNP where salinities are stable (35 ppt) and more representative of open ocean conditions. The reef tract is approximately five to eight miles seaward of the shoreline. Anticipated salinity alterations resulting from project activities are not expected to occur beyond 1,500 meters from shore. Because the reef tract where staghorn coral resides is several miles outside of any projected salinity changes, the Corps has determined the proposed project would have no effect on staghorn coral.

Staghorn Coral Critical Habitat

Salinities, due to project operations, will not be altered in the vicinity of critical habitat designated for staghorn coral; therefore, the project would have no effect on critical habitat for this species.

Johnson's Seagrass and "No Effect" Determination

Johnson's seagrass is not expected to be found within the project site since the southernmost distribution is reported to be in the vicinity of Virginia Key in Biscayne Bay (FR Vol. 63, No.177. 1998). Since the northernmost project limits are south of Virginia

Key, the U.S. Army Corps of Engineers has determined the project would have no effect on Johnson's seagrass.

Johnson's Seagrass Critical Habitat

Since the northernmost project limits are south of the known distribution area for this species, the project would have no effect on critical habitat for Johnson's seagrass.

7.2.2 C-111 Spreader Canal Western Project

7.2.2.1 Project Summary

The purpose of the C-111 SC Western project is to improve the quantity, timing, and distribution of water delivered to Eastern Florida Bay via Taylor Slough. It is anticipated that these improvements will be realized through the establishment of a hydraulic ridge between Taylor Slough and the C-111 Canal, which will reduce seepage from Taylor Slough, and from its headwaters. The project is also anticipated to resolve critical uncertainties related to the ability to reduce seepage losses from Taylor Slough, and resulting flood control responses of the drainage system. The project is designed to eliminate ecologically damaging flows through C-111 Basin to Barnes Sound and Florida Bay while improving habitat, functional quality of existing natural areas, and increase spatial extent where practicable.

7.2.2.2 Existing Conditions

As a consequence of past and current water management practices, land development and sea level rise, freshwater wetlands in the project area have been reduced in areal extent, altered and degraded. Currently much of this area is drained. Water elevations are generally held close to or below land surface in the northern project area, or starved of water as in the Model Lands area where water is diverted by drainage structures toward other basins. The current operation of the systems has resulted in an inland migration of saline conditions in both the groundwater and surface waters such that the expansion of moderate to high salinity zones have diminished the spatial extent of freshwater wetland habitats, and have allowed the landward expansion of saltwater and mangrove wetlands, including low-productivity, sparsely vegetated dwarf mangroves communities typical of the hypersaline "white zone." Some wetlands have been impacted by invasive exotic vegetation as a result of physical disturbance and/or hydrologic isolation.

7.2.2.3 Project Effects

Implementation of the C-111 SC Western project would result in short-term impacts to and displacement of the natural environment. In addition, some temporary, short-term effects would likely occur during the construction phase of the project, including fill

placement for the canal plugs. The project is expected to have long-term positive effects that will contribute to the restoration of Everglades National Park and the adjacent southeast Florida ecosystem.

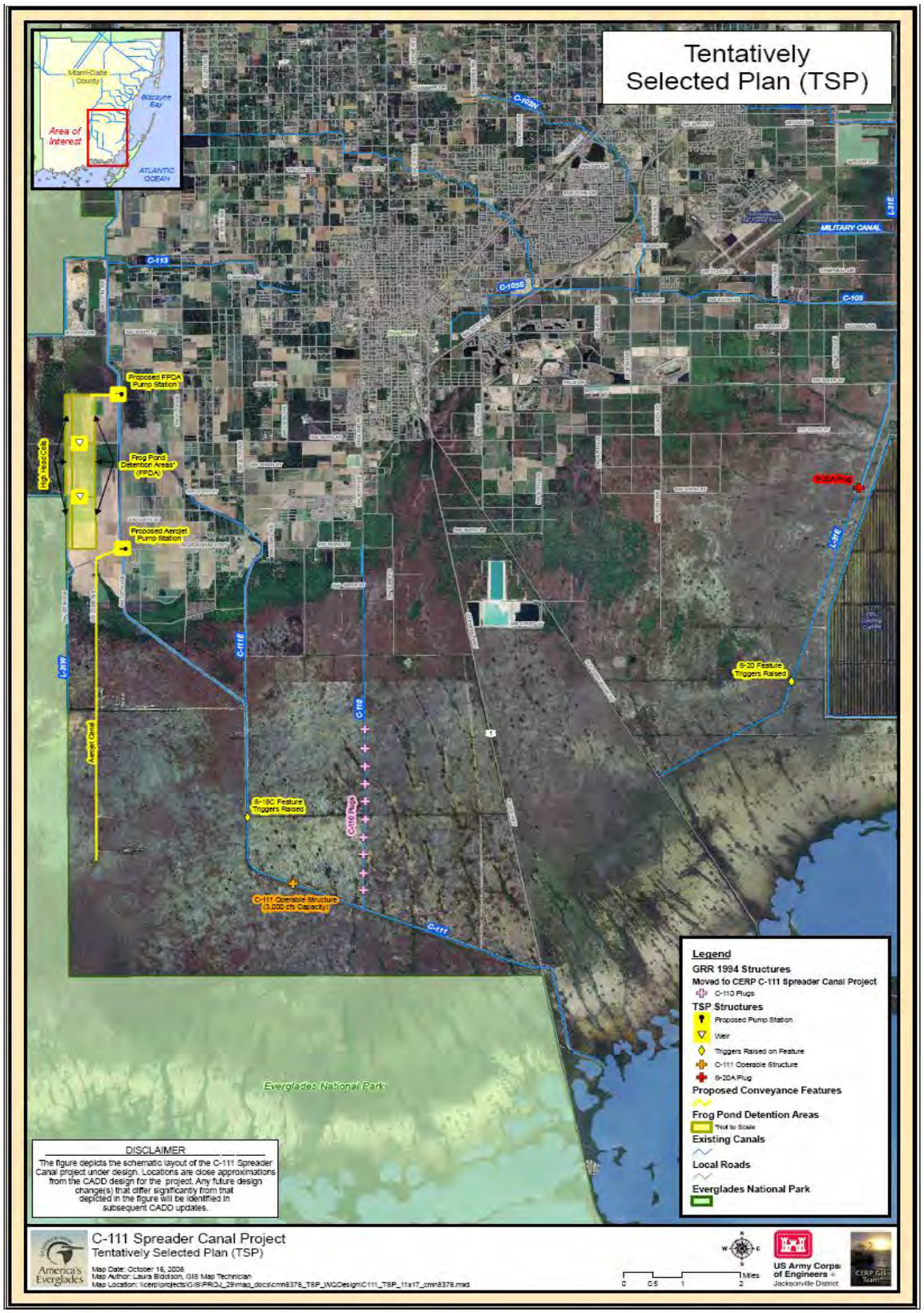

Figure 7-2. C-111 Spreader Canal Tentatively Selected Plan

7.2.2.4 Status of ESA Consultation with NMFS

On 7 May 2009, the Corps requested concurrence with NMFS on its determination of may affect, but is not likely to adversely affect smalltooth sawfish and sea turtles. In addition, the Corps determined that the project would not modify critical habitat for elkhorn or staghorn coral. Critical habitat for the smalltooth sawfish had not been designated until after publication of the final PIR/EIS. After further discussion with NMFS, the Corps changed their determinations to no effect for each species and their designated critical habitat, and NMFS concurred by email on 6 August 2009. Construction is complete for this project; therefore, re-initiation is not required.

Smalltooth Sawfish and "No Effect" Determination

The smalltooth sawfish has the potential to be found within Florida Bay, and the juveniles could potentially occur and feed in coastal wetlands. With the proposed project, the smalltooth sawfish may benefit as a result of freshwater flows from Taylor Slough into the coastal wetlands adjoining Florida Bay to provide a more natural and historic overland flow. With the expectation of improved wetland habitat, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project would have no effect on the smalltooth sawfish.

Green Sea Turtle and "No Effect" Determination

Although green sea turtles are expected to be found foraging in nearshore seagrass habitats within Florida Bay, the increased freshwater flows associated with Phase 1 of the C-111 SC project may alter seagrass species composition but should not have an adverse effect on the overall biomass available for sea turtle feeding habits. Additionally, no green sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project would have no effect on the green sea turtle.

Hawksbill Sea Turtle and "No Effect" Determination

Although hawksbill sea turtles are expected to be found foraging near hardbottom habitats within Florida Bay, the increased freshwater flows associated with Phase 1 of the C-111 SC project may reduce nearshore salinity concentrations but should not have an adverse effect on sponges or other food sources utilized by this species. Additionally, no hawksbill sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved

nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project would have no effect on the hawksbill sea turtle.

Leatherback Sea Turtle and "No Effect" Determination

Although leatherback turtles are expected to be found foraging in nearshore habitats within Florida Bay, the increased freshwater flows associated with Phase 1 of the C-111 SC project may reduce nearshore salinity concentrations but should not have an adverse effect on jellyfishes or other food sources utilized by this species. Additionally, no leatherback sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project would have no effect on the leatherback sea turtle.

Kemp's Ridley Sea Turtle and "No Effect" Determination

Although Kemp's ridley sea turtles could be found foraging in nearshore habitats within Florida Bay, this species is not expected to be found within the direct area of influence associated with Phase 1 of the C-111 SC project. Additionally, no Kemp's ridley sea turtles would attempt to utilize areas for nesting purposes since their main nesting location is on a single stretch of beach on the Gulf Coast of Mexico. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project would have no effect on Kemp's ridley sea turtle.

Loggerhead Sea Turtle and "No Effect" Determination

Although loggerhead sea turtles are expected to be found foraging in nearshore habitats within Florida Bay, the increased freshwater flows associated with Phase 1 of the C-111 SC project may reduce nearshore salinity concentrations but should not have an adverse effect on crustaceans, mollusks or other invertebrate food sources utilized by this species. Additionally, no loggerhead sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project would have no effect the loggerhead sea turtle.

Elkhorn Coral and "No Effect" Determination

Elkhorn coral may be found outside the waters of Florida Bay, specifically within the offshore reef track of the Florida Keys where salinities are stable (35 ppt) and more representative of open ocean conditions. The reef tract is approximately 10 to 20 miles seaward of the shoreline. Anticipated salinity alterations resulting from project activities are not expected to occur beyond 1500 meters from shore. Because the reef tract where elkhorn coral resides is several miles outside of any projected salinity changes, the Corps has determined the proposed project would have no effect on elkhorn coral.

Elkhorn Coral Critical Habitat

Salinities, due to project operations, will not be altered in the vicinity of critical habitat; therefore, the project would have no effect on critical habitat for elkhorn coral.

Staghorn Coral and "No Effect" Determination

Staghorn coral may be found outside the waters of Florida Bay, specifically within the offshore reef track of the Florida Keys where salinities are stable (35 ppt) and more representative of open ocean conditions. The reef tract is approximately 10 to 20 miles seaward of the shoreline. Anticipated salinity alterations resulting from project activities are not expected to occur beyond 1500 meters from shore. Because the reef tract where staghorn coral resides is several miles outside of any projected salinity changes, the Corps has determined the proposed project would have no effect on staghorn coral.

Staghorn Coral Critical Habitat

Salinities, due to project operations, will not be altered in the vicinity of critical habitat designated for staghorn coral; therefore, the project would have no effect on critical habitat for this species.

7.2.3 Site 1 Impoundment Project

7.2.3.1 Project Summary

The Site 1 Impoundment is a component of CERP, designed to capture and store local runoff during wet periods and then use that water to supplement water deliveries to the Hillsboro Canal during dry periods thus reducing demands for releases from Lake Okeechobee and the Arthur R. Marshall Loxahatchee National Wildlife Refuge (LNWR) **(Figure 7-3)**. Constructing and operating the impoundment will reduce the need for releases from LNWR during the dry season to meet local water demands and will facilitate the maintenance of more natural, desirable, and consistent water levels within the LNWR. The impoundment will also reduce groundwater seepage from LNWR. The ability to achieve and maintain more natural hydroperiods and hydropatterns within LNWR by retaining more rainfall and inflows from upstream will enhance habitat

function and quality and will also improve native plant and animal species abundance and diversity. In addition, there will be benefits to the downstream estuaries as a result of reducing peak freshwater flows from local storm water runoff and pulsed releases from Lake Okeechobee.

7.2.3.2 Existing Conditions

Additional storage in the project area is needed to reverse declines in ecological function and productivity in the LNWR and WCA-2A and to provide an alternate source of water to meet water supply and water resource protection demands in the Lower East Coast Service Area 1. Regional adverse ecological conditions in the vicinity of the project area include prolonged unnatural and undesirable water levels (stages) during both wet and dry periods in LNWR and WCA-2A (natural areas). Although the primary function of these natural areas is water storage, these areas are also designated as wildlife refuges for the protection of fish and wildlife. The current managed hydrologic regime which results in too much water during wet periods and too little during dry periods is not conducive to attaining and preserving desirable fish and wildlife habitat functions. During severe dry periods, freshwater releases from the natural areas to meet municipal, industrial, and resource protection (prevention of salt water intrusion into the aquifer) demands in the project area (Lower East Coast Service Area 1) are not sufficient, resulting in the imposition of water shortage rules to curtail water use. In addition, discharges of excessive volumes of freshwater from the Hillsboro Canal into the Atlantic Intracoastal Waterway also adversely affect marine life in the estuarine area at the mouth of the Hillsboro Canal between the Hillsboro Inlet to the south and the Boca Raton Inlet to the north.

In 2009, the Miami-Dade Limestone Products Association constructed a 1,000 foot long, 18 foot deep slurry wall to reduce seepage between ENP and rock mine properties to the east of ENP. In July 2012, the Association completed construction of a 2 mile long, 35 foot deep seepage wall in this same location south of Tamiami Trail. It is unknown whether this new test will effectively reduce seepage to the east, or whether the Association will construct an additional wall if this new test is effective. The association also has an “option” to construct an additional 5 miles of seepage wall south of the 2-mile seepage wall if approved by committee and permitted.

7.2.3.3 Project Effects

The project includes construction of a 1,660-acre above-ground reservoir, an inflow pump station, gated discharge culvert, emergency overflow spillway and a seepage control canal with associated features. Construction impacts will be offset by improving habitat function and quality and restoring native plant and animal abundance and diversity in the LNWR, WCA-2A, and in the estuarine portion of the Hillsboro Canal, thereby increasing the spatial extent of functional habitats in those areas. The project will achieve these beneficial effects by reducing seepage and the amount of water

withdrawn from the natural system for water supply and aquifer protection in developed area of Palm Beach and Broward Counties. Some incidental level of flood damage reduction is also anticipated due to increased storage capacity for fresh water. Recreational opportunities are also provided, including boardwalks, viewing platforms, picnic shelters, canoe launches and information kiosks at two sites within the project footprint.

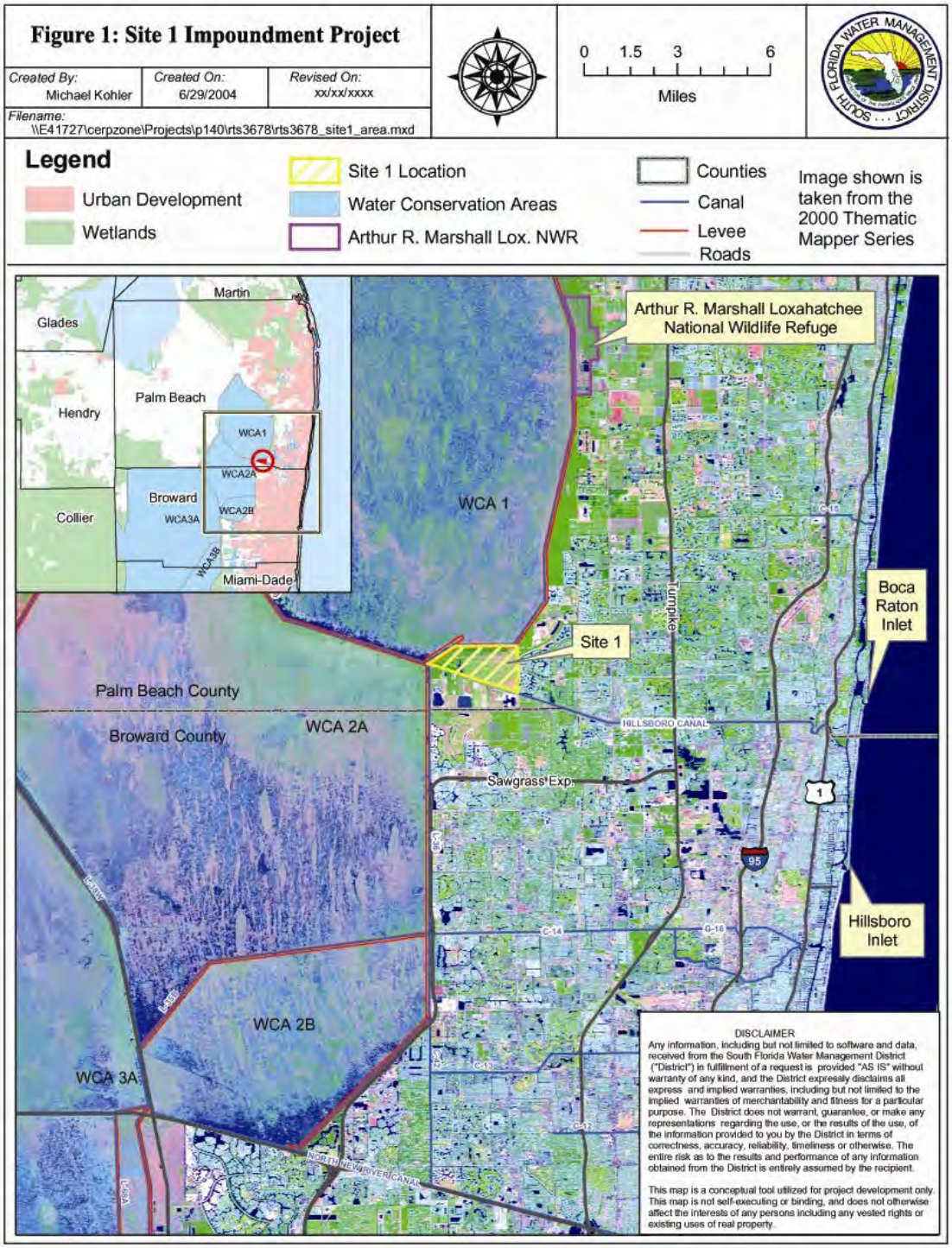

Figure 7-3. Site 1 Impoundment Project Area Map

7.2.3.4 Status of ESA Consultation with NMFS

On 16 February 2005, the Corps requested concurrence with NMFS on its determination of no effect on the smalltooth sawfish and opossum pipefish downstream of the project area. By letter dated 18 February 2005, NMFS concurred with the Corps' no effect determination. Construction is on-going for this project; therefore, re-initiation is not required.

Opossum Pipe Fish and "No Effect" Determination

Opossum pipefish are not likely to inhabit or utilize waterways of the project site due to little or no existing emergent vegetation along the adjacent canals. Effects downstream are not anticipated as the recommend plan would improve water quality and salinity levels in estuarine environment. Therefore, no effect is anticipated to the listed species from Site 1 implementation.

Smalltooth Sawfish and "No Effect" Determination

Smalltooth sawfish are typically found in the southern Everglades and south tip of Florida and are not anticipated to be affected within the proposed project area or downstream reaches of the Hillsboro Canal. However, implementation of the Site 1 project would reduce the freshwater, nutrient laden flows to the estuarine environment. Therefore, it is anticipated that no effect would be attributable to the proposed implementation of the Site 1 project and in fact, conditions for the species are expected to improve.

Projects with "May Affect, But Not Likely to Adversely Affect" Determination (Consultation Summaries and New Information)

Federally listed plant and animal species, including critical habitat, which may have the potential to be affected by CERP projects are discussed in detail below:

7.2.4 Indian Driver Lagoon South Feasibility Project

7.2.4.1 Project Summary

The Indian-River Lagoon-South Project is a CERP Project that is located within Martin and St. Lucie Counties **(Figure 7-4)**. The purpose of the project is to improve surface-water management in the C-23/C-24, C-25, and C-44 basins for habitat improvement in the St. Lucie River Estuary and southern portions of the Indian River Lagoon. Project features include the construction and operation of four above ground reservoirs to capture water from the C-44, C-23, C-24, and C-25 canals for increased storage (130,000 acre-ft), the construction and operation of four stormwater treatment areas to reduce

sediment, phosphorous, and nitrogen to the estuary and lagoon, the restoration of upland and wetland habitat, the redirection of water from the C-23/24 basin to the north fork of the St. Lucie River to attenuate freshwater flows to the estuary, muck removal from the north and south forks of the St. Lucie River and middle estuary; and the creation of oyster shell, reef balls and artificial submerged habitat near muck removal sites for added for habitat improvement. The project is expected to provide significant water-quality improvement benefits to both the St. Lucie River and Estuary and Indian River Lagoon by reducing the load of nutrients, pesticides, and suspended materials from basins runoffs.

7.2.4.2 Existing Conditions

The southern Indian River Lagoon estuary system has been degraded by heavy and rapidly occurring discharges of freshwater during the rainy season, and by an excessive accumulation of muck in estuary and lagoon bottoms. These stressors have reduced water clarity and exceeded the salinity tolerances of submerged vegetation and benthic animals.

7.2.4.3 Project Effects

Project features include building pumps, levees, canals and other structures that will displace existing natural areas. These features are required in order to operate and interconnect project features, provide a mechanism for re-directing freshwater discharges to the north fork of the St. Lucie River, and facilitate muck removal and habitat restoration actions inside the estuaries. Impacts due to construction of these features are offset by the redirection of flow and reduction of damaging high volume flows into the estuary during the wet season.

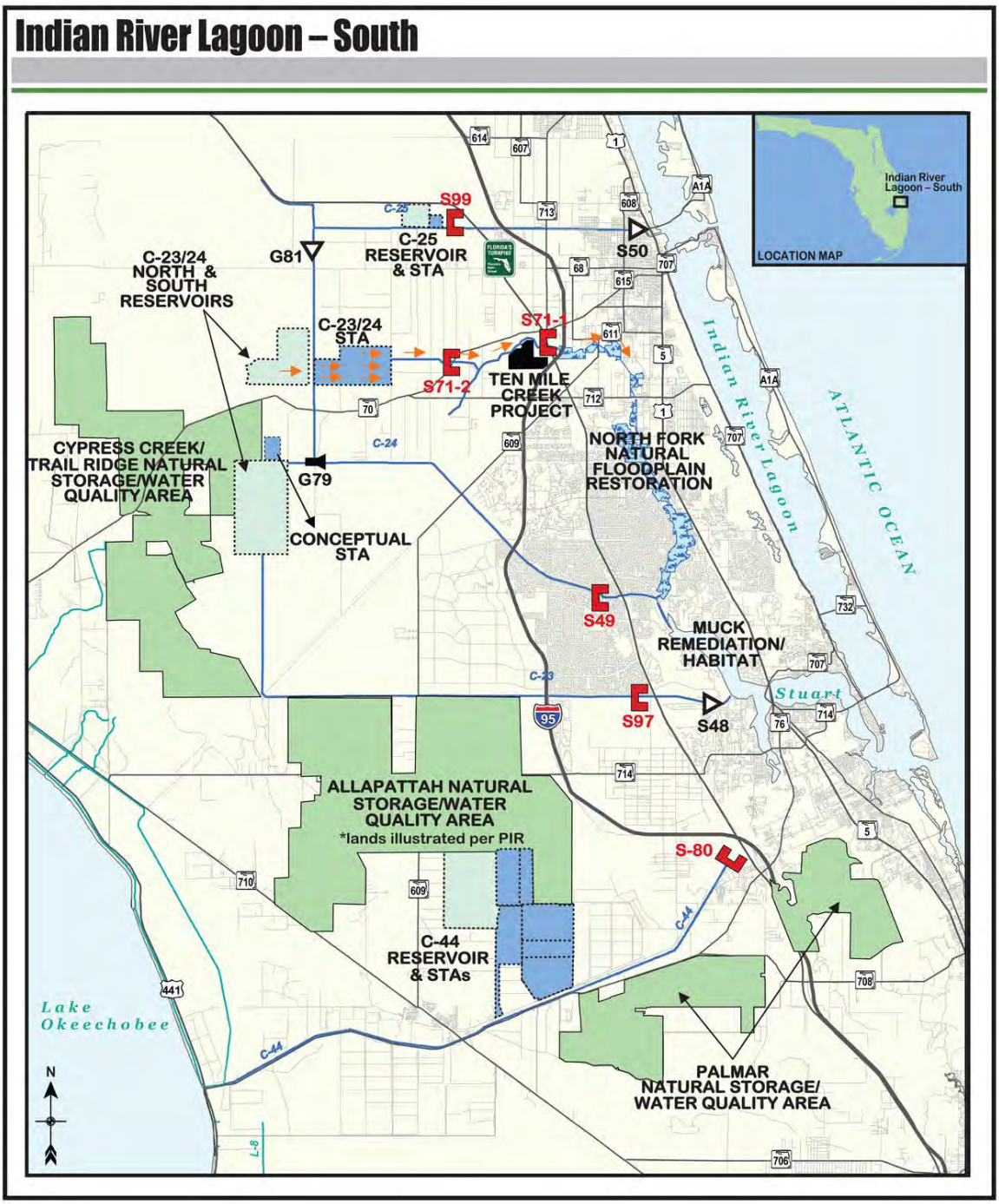

Figure 7-4. Indian River Lagoon South Project Area Map

7.2.4.4 Status of ESA Consultation with NMFS

On 18 March 2002, NMFS concurred with the Corps' determination that the project may affect, but is not likely to adversely affect, sea turtles, Johnson's seagrass, and Johnson's seagrass designated critical habitat (see note below). On 1 April 2003, the smalltooth sawfish (*Pristis pectinata*) was listed as endangered under the ESA. Construction is not complete and re-initiation of ESA Section 7 consultation with NMFS is required to evaluate any potential effects on the smalltooth sawfish due to project implementation. Consultation will focus exclusively on the species since the project is not located in designated critical habitat for smalltooth sawfish.

(NMFS) Letter dated March 18, 2002

Section 7 Coordination
"Sea turtles and Johnson's seagrass may occur within the Indian River Lagoon system. The NMFS Protected Resources Division concurs with the Corps' determination that implementation of the preferred plan will not adversely affect listed species nor designated critical habitat under the Service's purview. This concludes consultation responsibilities under Section 7 of the Endangered Species Act."

Additional Consultation and Request for Determination Concurrence

<u>Smalltooth Sawfish and "No Effect" Determination</u>

Smalltooth sawfish observations have been very rare throughout the St. Lucie estuary. By redirecting flows, removing muck, and restoring estuarine habitat, conditions are expected to benefit the habitat necessary to enhance recovery of the species. Therefore, the Corps determines that implementation of the proposed project will have no effect on smalltooth sawfish.

7.2.5 Caloosahatchee River (C-43) West Basin Storage Reservoir Project

7.2.5.1 Project Summary

The Caloosahatchee River (C-43) West Basin Storage Reservoir Project is a CERP Project that is located within Hendry County **(Figure 7-5)**. The purpose of the project is to improve the timing, quantity, and quality of freshwater flows to the Caloosahatchee River and Estuary. The project provides approximately 170,000 acre-feet of above-ground storage volume in a two-cell reservoir. Major features of the project include external and internal embankments, and environmentally responsible design features to provide fish and wildlife habitat such as littoral areas in the perimeter canal and deep water refugia within the reservoir. The project contributes toward the restoration of ecosystem function in the Caloosahatchee Estuary by reducing the number and severity

of events where harmful amounts of freshwater from basin runoff and Lake Okeechobee releases are discharged into the estuary system. The project also helps to maintain a desirable minimum flow of freshwater to the estuary during dry periods. These two primary functions help to moderate unnatural changes in salinity that are detrimental to estuarine communities.

7.2.5.2 Existing Conditions

South Florida's flood reduction system stores water in Lake Okeechobee during the annual dry season. Excess water is released when the lake rises to a level that threatens the integrity of the Herbert Hoover Dike and the health of the lake's delicate ecosystem. The resulting, unnatural surges of freshwater to the Caloosahatchee River reduce estuarine salinity levels. Alternately, during the dry season when irrigation demands are high, water managers may release little or no water to the river. This causes an increase in salinity levels. Both high and low salinity levels can trigger die-offs of sea grasses and oysters, species that are indicators of the estuary's overall health.

7.2.5.3 Project Effects

The C-43 West Basin Storage Reservoir will help ensure a more natural, consistent flow of freshwater to the estuary. To restore and maintain the estuary during the dry season, the project will capture and store basin stormwater runoff, along with a portion of water discharged from Lake Okeechobee. Managers will slowly release water into the Caloosahatchee, as needed to benefit the river and estuarine conditions.

Figure 7-5. Caloosahatchee River (C-43) West Basin Storage Reservoir Site Map

7.2.5.4 Status of ESA Consultation with NMFS

By letter dated 18 March 2002, NMFS stated that only the Gulf sturgeon could potentially be affected by the proposed action, but concluded that the project would not adversely affect the species. On 10 January 2007, the Corps submitted a revised BA to NMFS. By letter dated 20 July 2007, NMFS concurred with the Corps' determination that the project may affect, but is not likely to adversely affect sea turtles and smalltooth sawfish. On 2 September 2009, NMFS designated critical habitat for smalltooth sawfish. Although the project site is not located within critical habitat, it is located upstream from smalltooth sawfish critical habitat. Since construction has not been completed for this project, the Corps is reinitiating Section 7 consultation to evaluate potential effects to designated critical habitat for smalltooth sawfish.

Previous Consultation (10 January 2007)

The smalltooth sawfish may benefit from indirect project impacts which include salinity regime improvements to the downstream Caloosahatchee Estuary. This potential beneficial effect is supported by findings in Simpfendorfer (2006); this study suggests that the species may travel upstream in the Caloosahatchee River in the spring when flow is limited. It is anticipated that the project may affect, but is not likely to adversely affect, the smalltooth sawfish, and will likely benefit the species.

Sea turtles including loggerhead turtle, green turtle, leatherback turtle, Kemp's ridley turtle, and hawksbill turtle are listed as endangered by NMFS with the exception of the loggerhead turtle, which is listed as threatened. These are marine species with a presence in south Florida waters and are known to utilize bays and estuarine habitats, such as the Caloosahatchee Estuary, for feeding and resting. Sea turtles may benefit from indirect project effects which include salinity regime improvements to the downstream Caloosahatchee Estuary. The project may affect, but is not likely to adversely affect, sea turtles and will likely benefit these sea turtle species.

Additional Consultation and Request for Determination Concurrence

Smalltooth Sawfish Critical Habitat

With the capacity of storing excess water during the wet season, the C-43 Project will have the ability to provide supplemental freshwater flows, as needed, to regulate salinities and sustain the health and productivity of the Caloosahatchee River and Estuary. As a result of project implementation, salinities are expected to stabilize into preferred ranges for estuarine biota, including smalltooth sawfish. Since a more natural freshwater flow regime will be established through project restoration efforts with no physical changes to existing habitat, the Corps has determined that the C-43 Project will have no adverse effect on critical habitat for the smalltooth sawfish.

7.2.6 Picayune Strand Restoration Project

7.2.6.1 Project Summary

The Picayune Strand Restoration Project (PSRP) **(Figure 7-6)** involves the restoration of natural water flow across 85 square miles in western Collier County that were drained in the early 1960s in anticipation of extensive residential development. This subsequent development dramatically altered the natural landscape, changing a healthy wetland ecosystem into a distressed environment. The PSRP will restore wetlands in Picayune Strand and in adjacent public lands by reducing over-drainage, while restoring a natural and beneficial sheetflow of water to the Ten Thousand Islands National Wildlife Refuge. Project features include 83 miles of canal plugs, 227 miles of road removal, and the addition of pump stations (3) and spreader swales to aid in rehydration of the wetlands. Restoration benefits include wetland restoration and subsequent reemergence of foraging wading birds and native flora. In addition to restoring fresh water wetlands, the project will improve estuarine water quality by increasing groundwater recharge and reducing large and unnatural freshwater inflows.

7.2.6.2 Existing Conditions

Restoring the Picayune Strand entails plugging 48 miles of canals that were originally dug to provide flood protection for a sprawling residential area that was never built. Golden Gate Estates (GGE) was planned as an extensive residential subdivision by Gulf American Corporation (GAC) beginning in the 1950s. GAC constructed roads and canals in the 1960s and early 1970s, but the residential development failed before many of the planned houses were built. These roads and four large canals have over-drained the area resulting in the reduction of aquifer recharge, greatly increased freshwater point source discharges to the receiving estuaries to the south, invasion by upland vegetation, loss of ecological connectivity and associated habitat, and increased frequency of forest fires. The construction of Interstate 75, also known as Alligator Alley, split the GGE subdivision in half forming Northern Golden Gate Estates and Southern Golden Gate Estates.

7.2.6.3 Project Effects

Through PSRP, estuarine resources will be positively affected by the restoration of a more natural water flow regime. The features of PSRP Plan (Alternative 3D from 2004 PIR/FEIS) will increase freshwater flows to Faka Union Bay, Pumpkin Bay, and Blackwater Bay. Under the current baseline conditions **(Figure 7-7, 7-8, and 7-9)**, freshwater enters the estuaries through the Faka Union Canal. Faka Union Bay and Santina Bay are most affected by this point discharge. The salinities in these areas are low and in other nearby estuaries are higher. After the PSRP is implemented, the freshwater discharge will be distributed more evenly to the coastal estuaries. It was estimated in the 2004 PIR/FEIS that in Faka Union Bay the restoration is estimated to

match natural conditions by over 80 percent in the wet season and by over 60 percent in the dry season. In Pumpkin Bay, flows will meet natural conditions by less than 50 percent; however, there will still be an increase of freshwater flows over current conditions. In Blackwater Bay, during the critical wet season months flows will match natural conditions by over 60 percent (PSRP PIR/FEIS 2004). Since, salinity is important to the smalltooth sawfish and freshwater input appears to be an important element of their habitat (Simpfendorfer et al. 2011), the PSRP should be beneficial to the smalltooth sawfish and may increase available habitat in southwestern Florida.

Figure 7-6. Picayune Strand Restoration Project Site Map

7.2.6.4 Status of ESA Consultation with NMFS

On 20 October 2004, the Corps requested concurrence with NMFS on its no effect determination on the smalltooth sawfish, the green sea turtle, Kemp's ridley sea turtle and the loggerhead sea turtle. As stated in the BA published in the 2004 Final PIR/EIS, NMFS concurred with the Corps' effect determination for those species. This project is intended to re-establish sheetflow to the Ten Thousand Islands National Wildlife Refuge, which on 27 August 2009, was designated as critical habitat for the smalltooth sawfish; therefore, re-initiation of consultation with NMFS to evaluate potential effects is required, and an evaluation of potential effects are discussed below.

Sea Turtles, Smalltooth Sawfish, and "No Effect" Determination

The hydrologic restoration of SGGE under the recommended plan would redistribute freshwater flows from the Faka Union Canal system to other parts of Study Area estuaries and bays within the Ten Thousand Islands Region. Reestablishing a more natural hydrology would restore the slow year-round influx of freshwater needed to maintain the salinity in the natural range that is optimal for estuarine organisms. The only truly estuarine endangered species found in the region is the smalltooth sawfish. Improvements in estuarine salinity gradients will in turn benefit estuarine secondary productivity, which will benefit the sawfish by favoring development of forage fish and invertebrate communities. No effects are expected on marine turtles, which are not normally present in the inner estuaries, although the lower Ten Thousand Islands region is an important habitat for the endangered Kemp's ridley sea turtle. The Faka Union Canal weir #1 that is just north of US Highway 41 will remain in place as a barrier to salt water intrusion. It will act as a barrier to any upstream movement of these species thus protecting them during construction. Implementation of the recommended plan should have a favorable impact on estuarine habitats used by the smalltooth sawfish and sea turtles.

Additional Consultation and Request for Determination Concurrence

Smalltooth Sawfish Critical Habitat

By re-establishing sheetflow to the downstream estuaries, including the Ten Thousand Islands National Wildlife Refuge, salinities are expected to stabilize into a preferred range for estuarine biota, including the smalltooth sawfish. Since all construction activities are well outside of designated critical habitat, and a more natural freshwater flow regime will be established through project restoration efforts, the Corps has determined that the PSRP will have no adverse effect on designated critical habitat for the smalltooth sawfish.

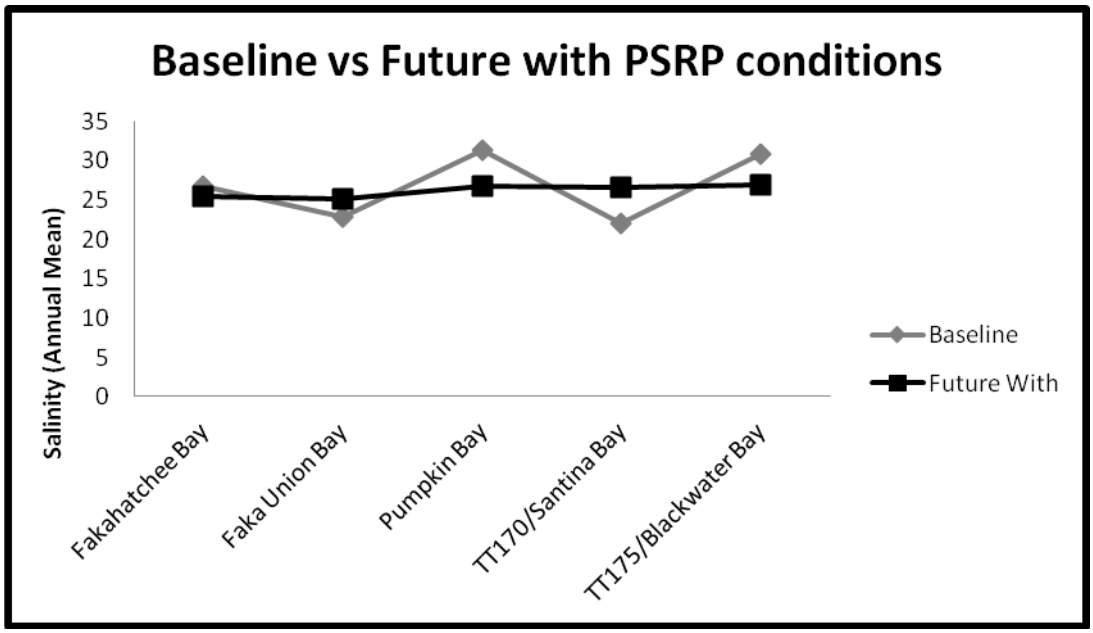

Figure 7-7. **Baseline vs. Future conditions for average annual salinity**

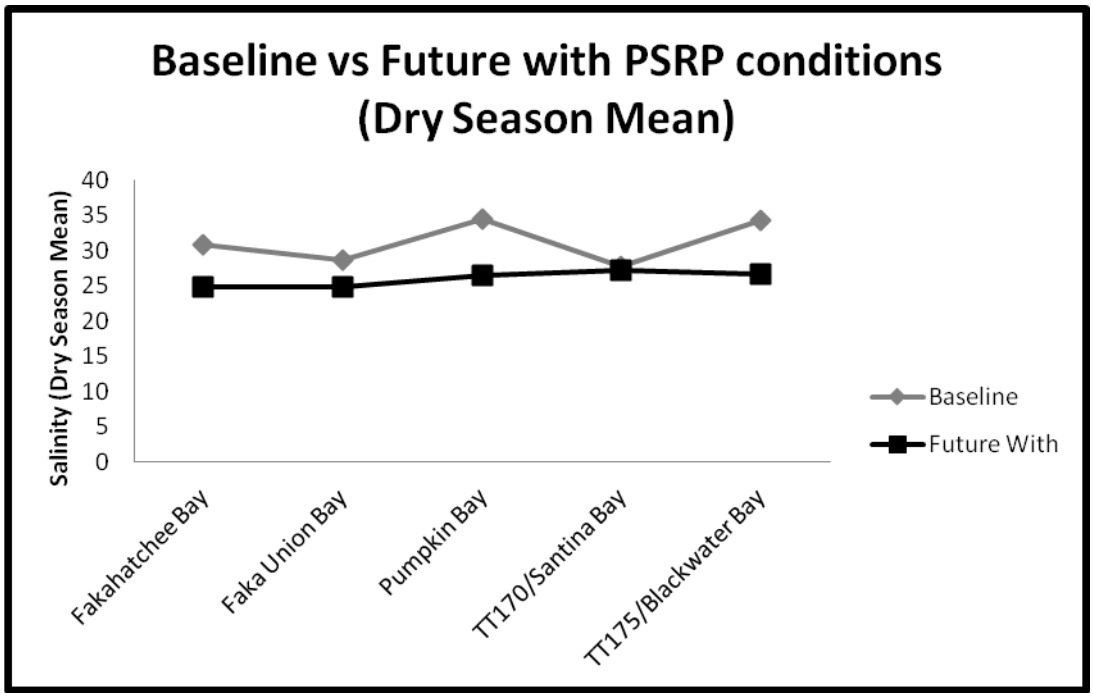

Figure 7-8. Baseline vs. Future with project conditions for dry season mean

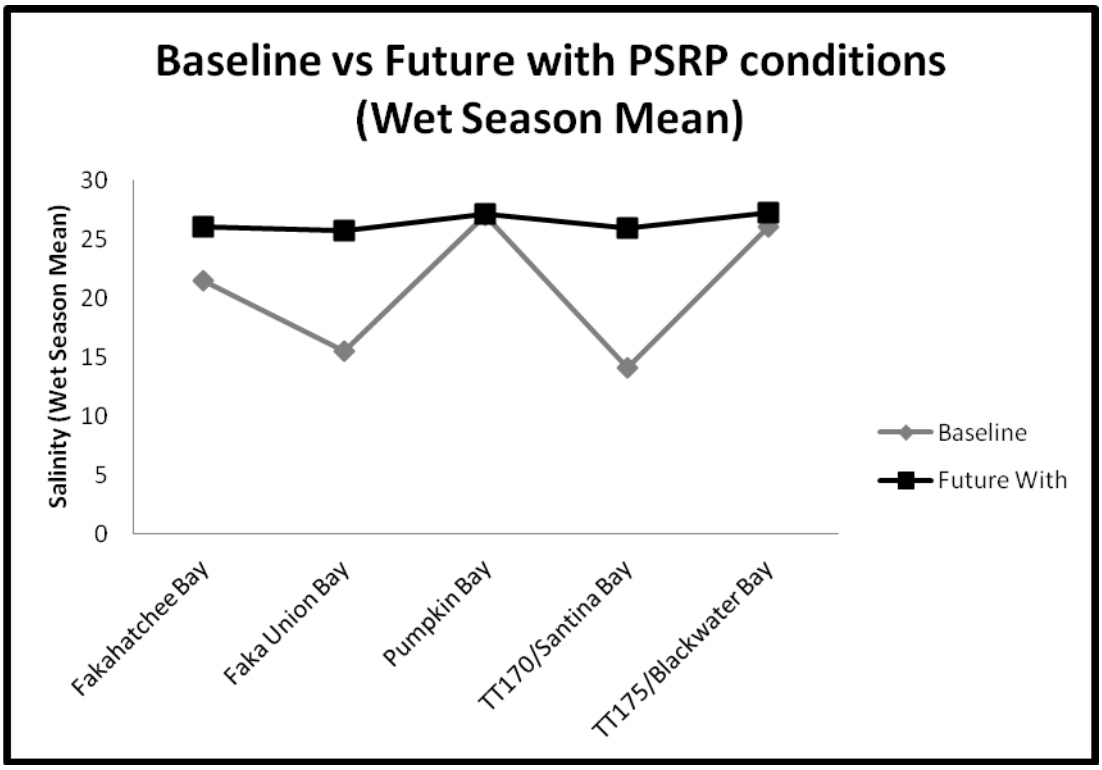

Figure 7-9. Baseline vs. Future with project conditions for wet season mean

7.2.7 Everglades National Park Seepage Management Project

7.2.7.1 Project Summary

The project as envisioned (U.S. Army Corps of Engineers. 1999) is composed of three components: L-31N Improvements for Seepage Management (Component FF), S-356 Structures (Component V), and Bird Drive Recharge Area. These three components would work to improve water deliveries to Northeast Shark River Slough (NESRS) and restore wetland hydroperiods and hydropatterns in Everglades National Park (ENP) via seepage management. The CERP L-31N Improvements for Seepage Management and S-356 Structures components included relocating and enhancing L-31N, groundwater wells, and sheetflow delivery system adjacent to ENP. More detailed planning, design, and pilot studies were to be conducted to determine the appropriate technology to control seepage from ENP. Also included was a feature to relocate the Modified Water Deliveries Structure S-357 to provide more effective water deliveries to ENP. In 2009, the Miami-Dade Limestone Products Association constructed a 1,000 foot long, 18 foot deep slurry wall to reduce seepage between ENP and rock mine properties to the east of ENP. In July 2012, the Association completed construction of a 2 mile long, 35 foot deep seepage wall in this same location south of Tamiami Trail. It is unknown whether this new test will effectively reduce seepage to the east, or whether the Association will construct an additional wall if this new test is effective. The Association also has an

"option" to construct an additional 5 miles of seepage wall south of the 2-mile seepage wall if approved by committee and permitted.

This project has recently been incorporated into CEPP. The project details and species effects determination are discussed in Section 7.2.8.

7.2.8 Central Everglades Planning Project

7.2.8.1 Executive Summary

Consistent with CERP, the goal of CEPP is to improve the quantity, quality, timing and distribution of water in the Northern Estuaries, WCA 3, and ENP in order to restore the hydrology, habitat and functions of the natural system. The project area includes Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), Lake Okeechobee, a portion of the Everglades Agricultural Area, the Water Conservation Areas; Everglades National Park, the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast.

Species and critical habitat identified during informal consultation as potentially affected by the proposed CEPP project includes fifteen federally listed threatened or endangered species; along with designated critical habitat for Johnson's seagrass, elkhorn coral, staghorn coral, and the smalltooth sawfish.

Based on the information contained in this section of the Programmatic BA, the Corps has determined that implementation of the CEPP Recommended Plan may affect, but is not likely to adversely affect smalltooth sawfish, green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, and loggerhead sea turtle. Potential effects are minimized through the overall project restoration opportunities; the expectation of improved water quality and deliveries to coastal and nearshore habitats; and the inclusion of project commitments and conservation measures described herein.

Other federally threatened or endangered species that are known to exist or potentially exist within close proximity of the project area, but which will not likely be of concern in this study due to the lack of suitable habitat include Johnson's seagrass, blue whale, finback whale, humpback whale, sei whale, sperm whale, elkhorn coral, and staghorn coral.

7.2.8.2 INTRODUCTION

The federal action evaluated in this section of the Programmatic BA is CEPP, which contains features designed to improve the flow of water through the system by constructing, modifying, or removing existing levees, canals, culverts, and pump stations. The goal of the Recommended Plan is to improve the quantity, quality, timing and distribution of water in the Northern Estuaries, WCA 3, and ENP in order to restore

the hydrology, habitat and functions of the natural system. Improvements to native flora and fauna, including threatened and endangered species, will occur as a result of the restoration of hydrologic conditions.

7.2.8.3 CONSULTATION SUMMARY

The Corps has coordinated with NMFS pertaining to potential action effects on listed species under their purview by letter dated 10 January 2012. In a letter dated 23 January 2012, NMFS provided concurrence with the Corps finding of listed species that may be encountered or adjacent to the action area. Federally listed species under the purview of NMFS include blue whale (*Balaenoptera* musculus), finback whale (*Balaenoptera* physalus), humback whale (*Megaptera* novaeangliae), sei whale (*Balaenoptera* borealis), sperm whale (*Physeter* macrocephalus), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), Kemp's ridley sea turtle (*Lepidochelys kempii*), leatherback sea turtle (*Dermochelys coriacea*), loggerhead sea turtle (*Caretta caretta*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), smalltooth sawfish (*Pristis pectinata*), elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), and Johnson's seagrass (*Halophila johnsonii*). In addition, the action study area contains designated critical habitat for smalltooth sawfish, elkhorn coral, staghorn coral, and Johnson's seagrass.

7.2.8.4 PROJECT DESCRIPTION

7.2.8.4.1 Project Authority

The Water Resources Development Act (WRDA) of 2000 provided authority for the CERP in Section 601(b)(1)(A). Specific authorization for the CEPP will be sought under Section 601(d) as a future CERP project. The purpose of the CEPP is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades and downstream estuaries.

7.2.8.4.2 Description of Proposed Project

The proposed project incorporates restoration components primarily intended to benefit freshwater wetlands and estuarine resources by distributing freshwater flows through WCA 3A, WCA 3B and ENP. The project would decrease the large pulses of Lake Okeechobee water that currently are sent east to the St. Lucie and west to the Caloosahatchee estuaries and send this water southward through Everglades Agricultural Area canals to flowage equalization basins (FEB). This reduction of the existing high flows to the St. Lucie and Caloosahatchee estuaries would help restore these estuaries. The FEBs would deliver water to existing stormwater treatment areas, which would reduce phosphorus concentrations in the water. The treated water would be released at the northwestern end of WCA 3A to flow through and restore much of WCA 3A, WCA 3B, ENP, and Florida Bay. Several existing levees, canals, and culverts,

and pump stations would be constructed, modified, or removed to improve the flow of water through the system. Specific project features of the tentatively selected plan, Alternative 4R, are summarized in **Figure 7-10**.

7.2.8.4.3 Project Goals, Objectives, and Performance Measures

Consistent with WRDA 2000, CERP included goals for enhancing economic values and social well being with specific objectives towards improving other project purposes of the C&SF project, including agricultural, municipal and industrial water supply. Section 601(h) of WRDA 2000 states "*the overarching objective of the Plan is the restoration, preservation, and protection of the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection*".

These same objectives apply to CEPP study efforts. Specifically, the goal of the CEPP is to improve the quantity, quality, timing and distribution of water in the Northern Estuaries, WCA 3, and ENP in order to restore the hydrology, habitat and functions of the natural system. Identified below, are the goals and objectives of CEPP, and CERP (**Table 7-1**).

Table 7-1. Goals and Objectives of CERP and CEPP

CERP GOAL: Enhance Ecological Values	
CERP Objective	**CEPP Objective**
Increase the total spatial extent of natural areas	
Improve habitat and functional quality	Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades System
	Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, the frequency of damaging peat fires, the decline of tree islands, and salt water intrusion
	Reduce high volume discharges from Lake Okeechobee to improve the quality of oyster and SAV habitat in the northern estuaries
Improve native plant and animal species abundance and diversity	Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization
	Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function
CERP GOAL: Enhance Economic Values and Social Well Being	
Increase availability of fresh water (agricultural/municipal &	Increase availability of water supply to the Lake Okeechobee Service Area

industrial)	
Reduce flood damages (agricultural/urban)	
Provide recreational and navigation opportunities	
Protect cultural and archeological resources and values	

7.2.8.5 Project Location

The study area for CEPP encompasses the Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), Lake Okeechobee, a portion of the Everglades Agricultural Area, the Water Conservation Areas; Everglades National Park, the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast. A description of each region is summarized in **Table 7-2**, and a map of the study area is presented in **Figure 7-10.**

Table 7-2: Description of CEPP Study Area Regions

CEPP Study Area Region	Description of the Study Area Region
Lake Okeechobee	Lake Okeechobee is a large, shallow lake (surface area ~73 square miles) 30 miles west of the Atlantic coast and 60 miles east of the Gulf of Mexico. It is the principal water supply reservoir for south Florida, is used for navigation, flood control, and recreation. It is impounded by a system of levees, with 6 outlets: St. Lucie Canal eastward to the Atlantic Ocean, Caloosahatchee Canal/River westward to the Gulf of Mexico, and four agricultural canals (West Palm Beach, Hillsboro, North New River and Miami).
Northern Estuaries	Lake Okeechobee discharges into the 2 Northern Estuaries. The St. Lucie Canal feeds into the St. Lucie Estuary, part of a larger system, the Indian River Lagoon (designated an Estuary of National Significance and is part of the U.S. Environmental Protection Agency (USEPA)-sponsored National Estuary program). The Caloosahatchee Canal/River feeds into the Caloosahatchee Estuary to the west.
Everglades Agricultural Area (EAA)	The EAA is ~700,000 acres in size and is immediately south of Lake Okeechobee. Much of this rich, fertile land is devoted to sugarcane production, and is crossed by a network of canals that are strictly maintained to manage water supply and flood protection.
Water Conservation Areas (WCAs)	The WCAs, WCA 1 (Loxahatchee National Wildlife Refuge), WCA 2, and, WCA 3 (the largest of the three) are situated southeast of the EAA and are ~1,350 square miles (~40 miles wide and 100 miles long) from Lake Okeechobee to Florida Bay. Provides floodwater retention, public water supply, and are the headwaters of Everglades National Park.
Everglades National Park (ENP)	ENP was, established in 1947, covering ~2,353 square miles (total elevation changes of only 6 feet from its northern boundary of Tamiami Trail south to Florida Bay). Landscape includes sawgrass sloughs, tropical hardwood hammocks, offshore coral reefs, mangrove forest, lakes, ponds, and bays.
Southern Estuaries	Florida Bay comprises a large portion of ENP, and is a shallow estuarine system (average depth less than 3 feet). Florida Bay is the main receiving water of the greater Everglades, heavily influenced by changes in timing, distribution, and quantity of freshwater flows into the southern estuaries.
Lower East Coast (LEC)	The LEC encompasses Palm Beach, Broward, and Miami-Dade Counties, the most densely populated area in Florida. Water levels in this area are highly controlled by the Central and Southern Florida (C&SF) water management system to prevent overdrainage and manage saltwater intrusion at the shoreline, provides flood control and water supply. Only portions of the LEC adjacent to the natural areas and susceptible to seepage will be considered in CEPP planning.

Figure 7-10: Central Everglades Planning Project Study Area

7.2.8.6 Model Description

The CEPP planning model was specifically developed to evaluate project alternatives within CEPP domain. The primary areas to be evaluated include the northern estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), the Water Conservation Areas (WCA 3A and 3B) and ENP. Performance measures (PM) are used to make the correlation between hydrologic output and ecosystem functions and evaluate the degree to which proposed alternative plans will meet restoration

objectives. Performance measure scores are generated from hydrologic models. Each PM has a predictive metric and a desired target representative of historical conditions or pre-drainage hydropatterns within the study area. The desired targets are based on hydrologic requirements necessary to meet empirical or theoretical ecological thresholds.

7.2.8.6.1 Hydrologic Models

The performance measures are hydrologic metrics based on output from regional hydrologic models. These models provide daily, detailed estimates of hydrology across the 41-year period of record (January 1965 – December 2005. The regional models proposed as the primary tools for the CEPP assessment include the Regional Simulation Model Basins (RSMBN) version 2.3.2 and the South Florida Regional Simulation Model Glades LECSA Implementation (RSMGL) version 2.3.2. These models were developed by the Hydrologic and Environmental Systems Modeling Department of the South Florida Water Management District (SFWMD).

The RSMBN is a link-node model designed to simulate the transfer of water from a pre-defined set of watersheds, lakes, reservoirs or any "water body" that receives or transmits water to another adjacent water body. The model domain covers Lake Okeechobee and four major watersheds related to the northern portion of the project area: Kissimmee, Lake Okeechobee, St. Lucie River, Caloosahatchee River and the Everglades Agricultural Area.

The RSMGL is a sub-regional model which includes Palm Beach, Broward, and Miami-Dade Counties, the WCAs, ENP, and Big Cypress National Preserve (BCNP). The model uses historical and modeled boundary condition data for the purpose of defining flows at water control structures, tidal stages, etc. RSMGL simulates hydrology on a daily basis using climatic data for the January 1965 – December 2005 period of record, which includes both drought and wet periods. The RSMGL simulates major components of south Florida's hydrology including evapotranspiration, infiltration, overland and groundwater flow, canal flow, canal-groundwater seepage, levee seepage and incorporates current or proposed water management control structures and operational rules.

Performance measures targets were primarily based on output from the Natural System Model (NSM) version 4.6.2, which simulates the hydrologic response of a pre-drained Everglades. The NSM has been used as a planning tool in several Everglades restoration projects.

7.2.8.7 Description of Project Performance Measures

Rehydration within the Greater Everglades would improve habitat for fish and wildlife resources within the project area. In order to evaluate potential impacts to these

resources, performance measures and ecological targets were developed for indicator species and their habitats. Ecological targets are designed to support the intention of the performance measures. Performance measures and ecological targets relative to the evaluation of impacts to threatened and endangered species in estuarine or nearshore habitats are identified below.

To make the correlation between hydrologic output and ecosystem functions, the project team utilized PMs developed from the Northern Estuaries; the Greater Everglades Ridge; and Slough Conceptual Ecological Models (CEMs) (Barnes 2005, Ogden 2005a, Sime 2005). Conceptual ecological models, as used in the Everglades restoration program, are non-quantitative planning tools that identify the major anthropogenic drivers and stressors on natural systems, the ecological effects of these stressors, and the best biological attributes or indicators of these ecological responses (Ogden et al. 2005b).

7.2.8.7.1 Northern Estuaries Performance Measure - Salinity Envelopes

Caloosahatchee Estuary - PM 6.1 Low Flow Targets and PM 6.2 High Flow Targets

Overall restoration goals include; re-establishment of a salinity range favorable to juvenile marine fish, shellfish, oysters and submerged aquatic vegetation (SAV), re-establishment of seasonally appropriate freshwater flows of favorable quality that maintain low salinities in the upper estuary and re-establishment of more stable salinities and ranges in the lower estuary.

Targets are based on freshwater discharges from to C-43 canal at the S-79 structure where the mean monthly inflow should be maintained between 450 and 2,800 cubic feet per second (cfs). Targets were developed to reduce minimum discharge and mediate high flow events to the estuary to improve estuarine water quality and protect and enhance estuarine habitat and biota. Ultimately, the low flow target is no months during October to July when the mean monthly inflow from the Caloosahatchee watershed, as measured at S-79, falls below a low-flow limit of 450 cfs (C-43 basin runoff and Lake Okeechobee regulatory releases). Ultimately, the high flow target is no months with mean monthly flows greater than 2,800 cfs, as measured at the S-79, from Lake Okeechobee regulatory releases in combination with flows from the Caloosahatchee River (C-43) basin.

St. Lucie Estuary - PM 6.1 Low Flow Targets and PM 6.2 High Flow Targets

Overall restoration goals include maintaining a salinity range favorable to fish, benthic invertebrates, oysters and SAV. This requires addressing high volume, long duration discharge events from Lake Okeechobee, the C-44, C-23 and C-24 watersheds. The flow targets are designed to result in a favorable salinity envelop in the mid estuary of 8 to 25 psu salinity. For the CEPP the flow targets for the St. Lucie Estuary focus on flows from

Lake Okeechobee only. This is due to the fact that the watershed flow targets are being addressed in the Indian River Lagoon South Project which is included in the 2050 base conditions. Full restoration targets are estimated to be 31 months where mean flow is less than 350 cubic feet per second (cfs) and 0 Lake Okeechobee regulatory discharge events (14 day moving averages > 2000 cfs).

7.2.8.7.2 Spatial Extent of Performance Measures

Performance measures within the northern estuaries will be used to measure the suitability for oyster and submerged aquatic vegetation habitat based on target flows from structures S-79 and S-80. CEPP will improve conditions for estuarine and marine resources throughout the northern estuaries by restoring more natural timing, volume, and duration of freshwater flows to the Caloosahatchee and St. Lucie estuaries with the potential to provide a more appropriate range of salinity conditions by reducing extreme salinity fluctuations. Performance measure scores within the northern estuaries will be generated from the RSMBN at S-79 and S-80. Calculation of habitat benefits achieved by each of the project alternatives is restricted to portions of the estuary where changes in salinity in relation to freshwater flows at S-79 and S-80 can be reasonably predicted.

For analytical purposes, the areas within the Caloosahatchee and St. Lucie Estuary systems that have the potential to be beneficially affected by the project are assumed to encompass the entire system which is approximately 85,973 acres (70,979 acres for the Caloosahatchee Estuary (Zone CE-1) (**Figure 7-11**) and 14,994 acres for the St. Lucie Estuary (Zone SE-1) (**Figure 7-12**)).

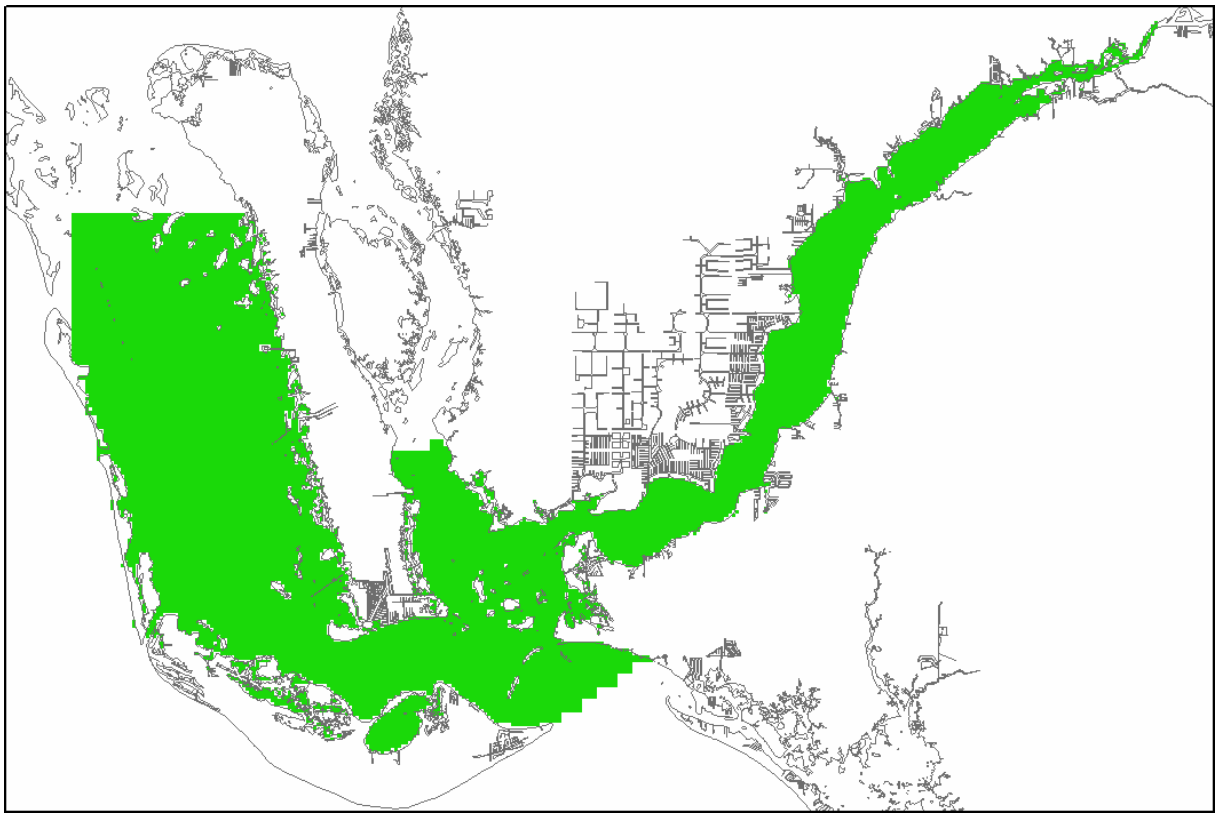

Figure 7-11: Estimate of the Maximum Area of Potential Ecological Benefit for the Caloosahatchee Estuary (Zone CE-1)

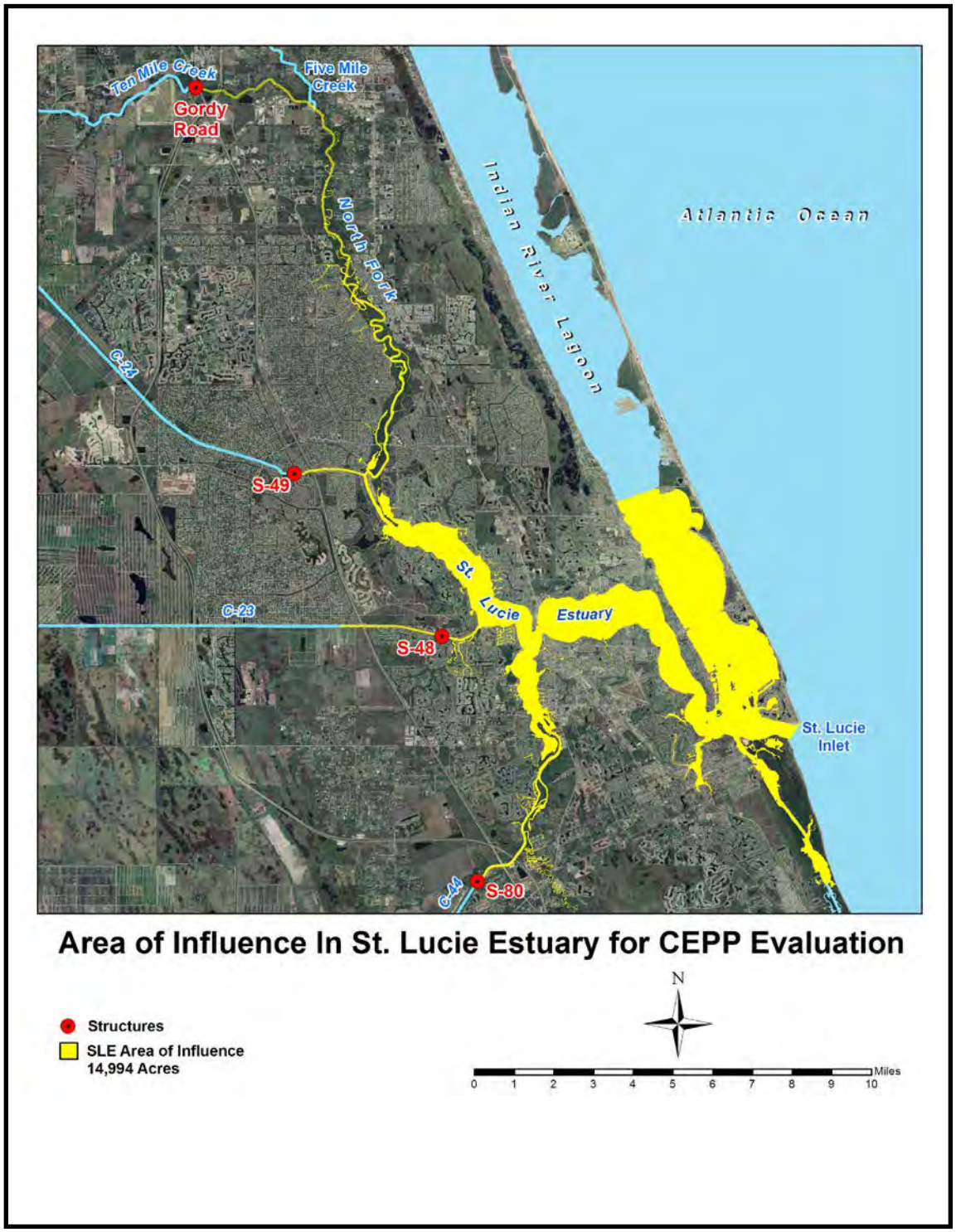

Figure 7-12. Estimate of the Maximum Area of Potential Ecological Benefit for the St. Lucie Estuary (Zone SE-1)

7.2.8.7.3 Southern Estuaries

CEPP Hydrological Model

A desired result of restored hydroperiods through CEPP is to increase densities of small fishes and macroinvertebrates throughout the Everglades, especially in the southern Everglades. Because small fishes are the most abundant vertebrates in the Everglades and are consumed by apex predators, the Trophic Hypothesis predicts that an increase in density of small fish will benefit higher trophic-level predators such as wading birds, reptiles, and larger fish that depend on them as a food source. This CEPP model (Cantano and Trexler, 2013) compares freshwater fish densities in the Water Conservation Areas (3-A and 3-B), Shark River Slough, and Taylor Slough of existing conditions against future without project conditions, and CEPP alternatives.

Results of these model comparisons (**Table 7-3**) agree that abundance of both small fishes and largemouth bass would increase under the CEPP hydrological model scenarios compared to the Existing Conditions Baseline (ECB) hydrology or the 2050 future conditions without CERP (2050FWO). The increased fish productivity under CEPP is linked to longer hydroperiods and reduced severity of drying events in regions south of the L-5 canal (WCA 3A, WCA 3B, Shark River Slough, Southern Marl Prairies, Taylor Slough). CEPP alternative scenarios 3 and 4 yielded the greatest benefits for fish production. There were relatively small differences between these two scenarios in the predicted benefits on small fish density and largemouth bass CPUE. Fishes are a system-wide indicator of the ecological functioning of the Greater Everglades because of their significance in trophic interactions among wildlife (Doren et al. 2009). Therefore, restoring hydrology under CEPP may have ecological benefits for the Everglades ecosystem.

Table 7-3. Percent change in average fish density per m² between Existing Conditions Baseline (ECB) and 2050 conditions without CERP (2050FWO).

Region	CEPP1		CEPP2		CEPP3		CEPP4	
	ECB	FWO	ECB	FWO	ECB	FWO	ECB	FWO
2A	**0.70**	-12.96	**0.70**	-12.96	**0.70**	-12.96	**0.71**	-12.95
3A	**5.46**	**9.36**	**4.75**	**8.62**	**4.46**	**8.31**	**5.20**	**9.08**
3B	-0.43	**4.87**	**2.59**	**8.04**	**1.25**	**6.64**	-1.30	**3.96**
LOX	-2.71	-0.46	-2.71	-0.46	-2.71	-0.46	-2.71	-0.46
SMP	**16.05**	**18.42**	**14.85**	**17.20**	**28.65**	**31.28**	**27.45**	**30.05**
SRS	**13.39**	**16.04**	**13.64**	**16.30**	**18.66**	**21.44**	**20.48**	**23.30**
TS	**0.04**	**0.55**	-0.11	**0.39**	**0.05**	**0.56**	-0.01	**0.49**

Pink Shrimp Model

A pink shrimp model developed for CEPP by the NMFS (Browder 2013) simulates growth, survival, and potential harvests from a specified monthly cohort, as a function of salinity and temperature. Coefficients for functional relationships were determined from laboratory trials with 2000 juvenile shrimp from Florida Bay. Treatments ranged from 2-55 ppt and18-33°C for salinity and temperature, respectively. Daily salinity was calculated for CEPP and future without project scenarios using a period of record from 1965-2005, and daily water temperature was used from the year 2007.

Although small (3.5-6.8%), results from Whipray to Johnson Key basins in Florida Bay produced a greater potential harvest of shrimp compared to a future without project scenario. This implies that conditions with CEPP implemented have the potential to improve the productivity of estuarine and nearshore biota in areas of Florida Bay (**Figure 7-13**).

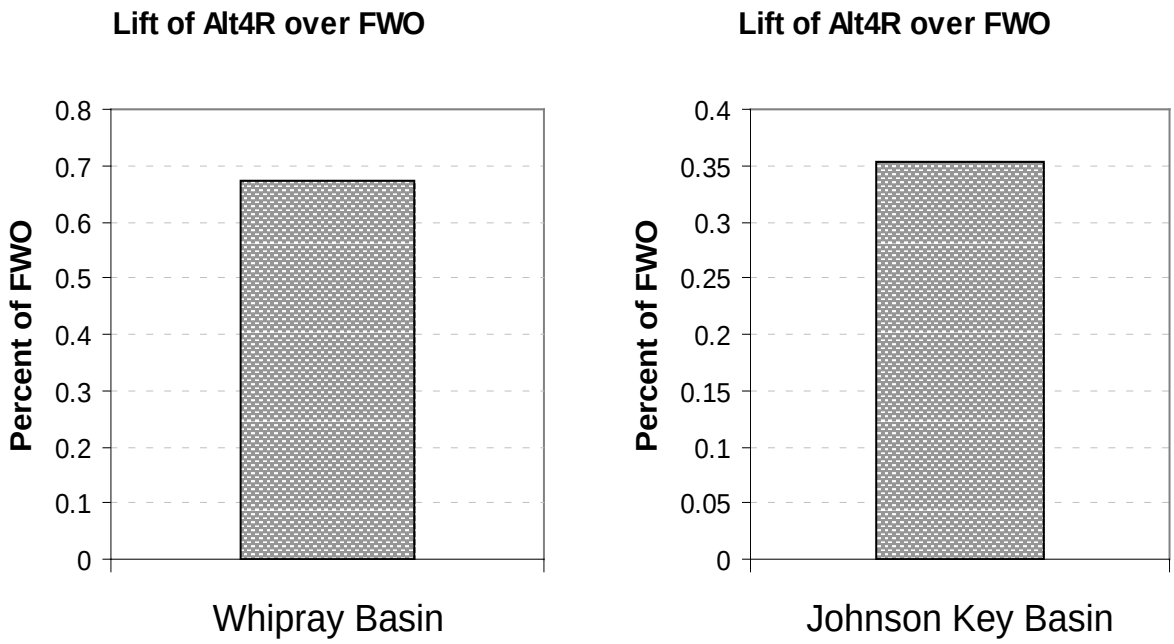

Figure 7-13. Lift of Alternative 4R over Future Without Project Conditions

7.2.8.8 Recommended Plan Elements

Features in the Everglades Agricultural Area include construction of the 14,000 acre A-2 FEB (perimeter levees, internal distribution channels, inlet structures, outlet structures, and channels connecting the FEB to the Miami Canal north of S-8. Operation of the A-2 FEB would be integrated with the operation of the A-1 FEB, a state-funded and state-constructed FEB.

Conveyance features in WCA 2A and northern WCA 3A include: a gated spillway to deliver water from the L-6 Canal to the L-5 Canal, a new gated spillway to deliver water from STA 3/4 to the L-5 Canal, enlarge ~13.6 miles of the L-5 Canal, degrade ~2.9 miles of the southern L-4 Levee, a 200 cfs pump station to move water within the L-4 Canal to maintain Tribal water supply deliveries west of the L-4 Canal, gated culverts to deliver water from the Miami Canal (south of the S-8 Pump Station) and the L-5 Canal to the L-4 Canal, and backfill ~13.5 miles of the Miami Canal and include upland mounds between a point 1.5 miles south of the S-8 Pump Station and Interstate Highway I-75.

Additional conveyance features would be located in southern WCA 3A, WCA 3B, and the northern edge of ENP: a 1,000 cfs gated spillway adjacent to S-333, a 500 cfs gated culvert in L-67A Levee and an associated 6,000 foot gap in L-67C Levee, a flowway through the western end of WCA 3B (2 gated culverts in L-67A Levee, removal of ~8 miles of L-67C Levee, removal of ~4.3 miles of L-29 Levee, construct new ~8.5 mile levee), a gated spillway in L-29 Canal to control water movement in the L-29 Canal and provide access to the L-29 Levee, remove ~5.5 miles of the L-67 Extension Levee, remove ~6 miles of Old Tamiami Trail between Tram Road and L-67 Extension Levee, and remove spoil mounds along the northwestern side of the L-67A Canal adjacent to the new structures in the L-67A Levee, and incidental remove vegetation along agricultural ditches.

Features primarily for seepage management along the eastern edge of ENP include a new 1,000 cfs pump station to replace the existing temporary S-356 pump station and a ~4 mile long, 35 feet deep tapering seepage barrier cutoff wall along the L-31N Levee just south of Tamiami Trail.

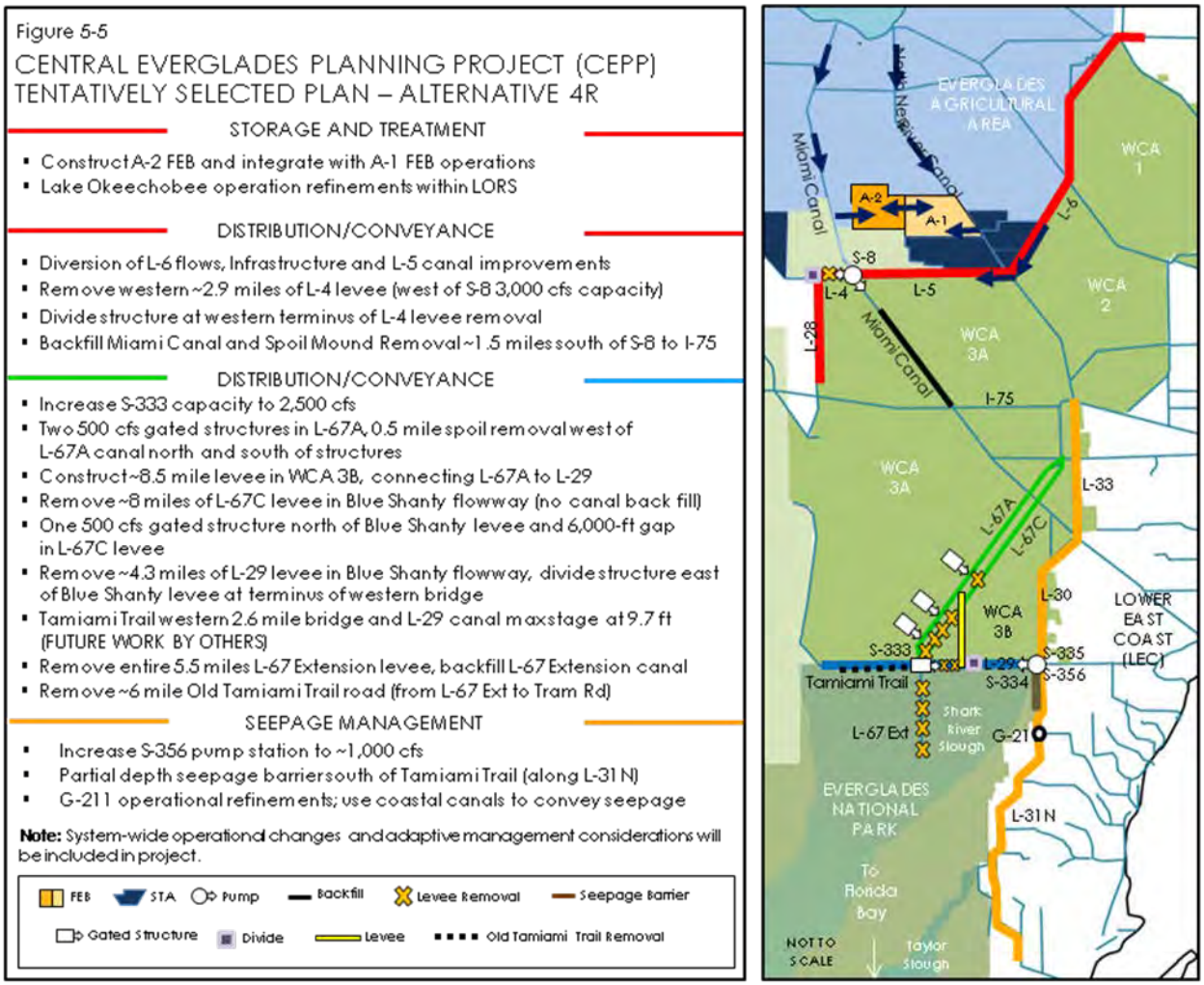

Figure 7-14. Project Features of the CEPP Recommended Plan

7.2.8.9 DESCRIPTION OF LISTED SPECIES AND DESIGNATED HABITAT

7.2.8.9.1 Affected Environment

The project area encompasses the Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), Lake Okeechobee, a portion of the Everglades Agricultural Area, the Water Conservation Areas, Everglades National Park, the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast. For the purpose of evaluating environmental effects related to marine and estuarine species, this section focuses on estuarine, coastal, and nearshore habitats within the project area.

Northern Estuaries

The Northern Estuaries are composed of two different systems that receive discharges from Lake Okeechobee. The eastern portion is composed of the St. Lucie Canal which feeds into the St. Lucie Estuary, part of a larger system known as the Indian River Lagoon. It has been designated an Estuary of National Significance and is part of the U.S. Environmental Protection Agency-sponsored National Estuary program. The western portion is composed of the Caloosahatchee Canal and River, and the Caloosahatchee Estuary.

Everglades National Park

Everglades National Park (ENP) is located to the south of the Water Conservation Areas, and is the third largest National Park in the continental U.S. The ENP covers approximately 2,353 square miles and is extremely low and flat, with total elevation changes of only 6 feet from Tamiami Trail south to Florida Bay. Established in 1947, ENP possesses a unique landscape comprised of sawgrass sloughs, tropical hardwood hammocks, offshore coral reefs, mangrove forest, and lakes, ponds and bays.

Southern Estuaries

Biscayne Bay, a shallow tidal sound, approaches 300 square miles in size. Although the northern and central portions have been greatly affected by development and human encroachment, the southern portion of the Bay includes Biscayne National Park with Card and Barnes Sounds having been designated part of the Florida Keys National Marine Sanctuary. Florida Bay comprises a large portion of Everglades National Park, and is a shallow estuarine system with an average depth of less than three feet. Florida Bay is the main receiving water of the greater Everglades system and is heavily influenced by changes in the timing, distribution and quantity of freshwater flows into the estuaries.

Lower East Coast

The Atlantic Coastal Ridge, generally referred to as the Lower East Coast (LEC) Area, is mostly urbanized and encompasses Palm Beach, Broward and Miami-Dade Counties. The LEC is the most densely populated area in Florida, and includes the population centers of West Palm Beach, Fort Lauderdale and Miami. Water levels in this area are tightly controlled near the shoreline to prevent over-drainage and manage saltwater intrusion, and the entire area is dependent upon operation of the C&SF system for flood control and water supply.

Vegetative Communities (Estuarine/Marine)

The Everglades landscape is dominated by a complex of freshwater wetland communities that includes open water sloughs and marshes, dense grass- and sedge-dominated marshes, forested islands, and wet marl prairies. The primary factors influencing the distribution of dominant freshwater wetland plant species of the Everglades are soil type, soil depth, and hydrological regime (FWS 1999). These communities generally occur along a hydrological gradient with the slough/open water marsh communities occupying the wettest areas (flooded more than nine months per year), followed by sawgrass marshes (flooded six to nine months per year), and wet marl prairie communities (flooded less than six months per year) (FWS 1999). The freshwater wetlands of the Everglades eventually grade into intertidal mangrove wetlands and subtidal seagrass beds in the estuarine waters of Florida Bay.

Development and drainage over the last century have dramatically reduced the overall spatial extent of freshwater wetlands within the Everglades, with approximately half of the pre-drainage 1.2 million hectares of wetlands being converted for development and agriculture (Davis and Ogden 1997). Alteration of the normal flow of freshwater through the Everglades has also contributed to conversions between community types, invasion by exotic species, and a general loss of community diversity and heterogeneity. Vegetative trends in ENP have included a substantial shift from the longer hydroperiod slough/open water marsh communities to shorter hydroperiod sawgrass marshes (Davis and Ogden 1997; Armentano et al. 2006). In addition, invasion of sawgrass marshes and wet prairies by exotic woody species has led to the conversion of some marsh communities to forested wetlands (Gunderson 1997).

The estuarine communities of Florida Bay have also been affected by upstream changes in freshwater flows through the Everglades. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance have affected mangrove community composition and may have contributed to a large-scale die-off of seagrass beds (FWS 1999). For purposes of this biological assessment, descriptions will focus on vegetative types encountered in estuarine systems.

Northern Estuaries

Submerged aquatic vegetation (SAV) is one of the most important vegetation communities of the St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary. The SAV converts sunlight into food for fish, sea turtles, manatees, and a myriad of invertebrates, among other species. Seagrass meadows improve water quality by removing nutrients, dissipating the effects of waves and currents, and by stabilizing bottom habitats thereby reducing suspended solids within the water column. Seagrass beds support some of the most abundant and diverse fish populations in the Indian River Lagoon. Seagrass and macro algae (collectively referred to as SAV) are highly productive areas and are perhaps the most important habitat of the Indian River Lagoon (IRL CCM, 1996). Many commercial and recreational fisheries (i.e. clams, shrimp, lobster, fish) are associated with healthy seagrass beds (US Fish and Wildlife

Service (FWS 1999). Currently, many SAV beds are stressed and have been reduced or eliminated from their former areas by extreme salinity fluctuations, increased turbidity, sedimentation, dredging, damage from boats, and nutrient enrichment which causes algal blooms that, in turn, restrict light penetration.

Upper Caloosahatchee River and Estuary

In terms of distribution and abundance, tape grass (*Vallisneria americana)* has been the dominant species in the upper Caloosahatchee River and Estuary, colonizing littoral zones in water less than one meter in depth (Chamberlain and Doering 1998a). In the early 1990s, SAV covered approximately 1,000 acres and about 60% of the coverage occurred within an 8-kilometer (km) stretch between Beautiful Island and the Fort Myers Bridge (Hoffacker 1994). Total longitudinal cover ranged from 14 to 32 km upstream from Shell Point (Chamberlain and Doering 1998b). Tape grass can typically tolerate salinities of 3 to 5 practical salinity units (psu) with few long-term effects if light conditions are sufficient (Haller et al. 1974, French and Moore 2003, Jarvis and Moore 2008). Dramatic declines in Tape grass were observed beginning in late 2006 as a result of salinities exceeding the species' tolerance (Bourn 1932, Haller et al. 1974, Doering et al. 1999, Kraemer et al. 1999, Doering et al. 2001). During this period widgeon grass (*Ruppia maritime)* was the dominant species although it never achieved even the minimum abundance recorded for Tape grass (Burns et al. 2007).

Lower Caloosahatchee River and Estuary

Historically, two species of SAV have been routinely reported during surveys in the lower Caloosahatchee River Estuary upstream of Shell Point. These include shoal weed (*Halodule beuadettei*), shoal grass (*Halodule wrightii*) and turtle grass (*Thalassia testudinum)* (Chamberlain and Doering 1998a, Wilzbach et al. 2000, Burns et al. 2007). In more recent reports, manatee grass (*Syringodium filiforme*) has been reported in San Carlos and Tarpon Bays (Wilzbach et al. 2000, Burns et al. 2007). Shoal grass coverage, described as abundant, has been at 300 acres; about 75% of this occurred between 2 and 8 kilometers (km) upstream of Shell Point (Chamberlain and Doering 1998b).

From 2004 to 2008, the lower estuary was dominated by shoal grass. Although widgeon grass was observed occasionally (Burns et al. 2007); only very low densities were found in the lower estuary when surveys were searching specifically for it. High salinity fluctuations with tides and shading by shoal grass may limit its growth. Low salinities during higher rainfall periods and discharge events observed since 2004 likely prevented the survival of seagrass species including turtle grass (Burns et al. 2007). Water clarity was poor in 2004 and 2005 preventing SAV growth in waters greater than 0.7 meter deep. Water clarity conditions improved in 2007 and were sufficient for growth down to 1.2 meters.

Hurricane effects lowering SAV abundance in 2005 and 2006 and subsequent *shoal grass* recovery in 2007 were evident with cover in 2007 exceeding 2004 levels. Salinities of 1 psu or less occurred each year from 2004 to 2006. The large drop in cover and density in fall 2007 prior to the usual winter dieback could have been caused by grazing.

St. Lucie Estuary

The SAV communities in the St. Lucie Estuary and Southern Indian River Lagoon include seagrass and macro algae. The estuaries support six species of seagrass including shoal grass, manatee grass, turtle grass, paddle grass (*Halophila decipiens*), star grass (*Halophila engelmannii*) and the threatened Johnson's seagrass (*Halophila johnsonii*). Johnson's seagrass was listed as threatened under ESA in 1998, and critical habitat was designated in 2000. The species has a very limited distribution along the east coast of Florida from central Biscayne Bay to Sebastian Inlet. Major threats include propeller scarring, dredging, sedimentation and degraded water quality. Shoal grass and manatee grass are the dominant canopy species in the lagoon (Thompson 1978, Dawes et al. 1995, Morris et al. 2000). While all of these species are most successful in salinities greater than 20 psu, *shoal grass* can tolerate a wide range of salinity and salinity variations. However, manatee grass is not as tolerant of low salinities or widely varying salinities (Irlandi 2006).

SAV distribution has been mapped in the St. Lucie Estuary and the Southern Indian River Lagoon every two to three years since 1986, including annual mapping from 2005 through 2007 to help assess hurricane impacts. Historic SAV maps show SAV extending throughout the estuary. In 2007, very sparse (< 10% cover in most areas) SAV was present in the lower and middle estuary, but not in either of the forks. Three seagrass species occurred within the estuary: shoal grass, Johnson's seagrass and paddle grass. The majority of the SAV occurred in small isolated patches. The dominant SAV species in 2007 was Johnson's seagrass. It also extended farther upstream than any other SAV species.

This region was impacted by hurricanes and associated freshwater discharges in 2004 and 2005. Following the hurricanes, observed impacts to Southern Indian River Lagoon SAV communities included large coverage and density declines and smaller direct impacts due to burial by shifting bottom sediments. Lush manatee grass beds were documented through 2004, however, low salinities and associated poor water quality following the 2004 and 2005 hurricanes greatly impacted manatee grass in the area. The hurricanes also altered bathymetry on the east and west edges of the estuary, covering seagrasses. The steepest decline in percent occurrence of manatee occurred in 2005 after Hurricane Wilma. Johnson's seagrass followed by shoal grass colonized the former manatee grass habitat and recruited throughout the site. Available data indicates a clear trend toward recovery of the manatee grass beds.

Southern Estuaries

Nearly all aspects of south Florida's native vegetation have been affected by development, altered hydrology, nutrient inputs, and spread of non-native species that have resulted directly or indirectly from a century of water management. Habitat types that dominate the southern coastal regions within the project area include submerged aquatic vegetation (primarily seagrasses and algae), mangrove forests, saline emergent wetlands, freshwater wetlands, and non-native dominated wetlands (primarily wetlands dominated by Australian pine, *Casaurina* spp. or Brazilian pepper, *Schinus terebinthifolius*).

The estuarine communities of south Florida have been affected by upstream changes in freshwater flows through the Everglades. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance have affected mangrove community composition and may have contributed to a large-scale die-off of seagrass beds (FWS 1999). Mangrove communities occur within a range of salinities from 0 to 40 practical salinity units (psu). Florida Bay experiences salinities in excess of 40 psu on a seasonal basis. Implementing CEPP will provide increased freshwater flows to Florida Bay and the Southwest Coast, thereby aiding to lower salinities levels within these areas to better encompass mangrove salinity tolerance range.

Mangroves

Mangrove communities are forested wetlands occurring in intertidal, low-wave-energy, estuarine and marine environments. Within the project area, extensive mangrove communities occur in the intertidal zone of Florida Bay. Mangrove forests have a dense canopy dominated by four species: red mangrove (*Rhizophora mangle*), black mangrove (*Avicennia germinans*), white mangrove (*Laguncularia racemosa*), and buttonwood (*Conocarpus erectus*). Mangrove communities occur within a range of salinities from 0 to 40 parts per thousand (ppt). Florida Bay experiences salinities in excess of 40 ppt on a seasonal basis. Declines in freshwater flow through the Everglades have altered the salinity balance and species composition of mangrove communities within Florida Bay. Changes in freshwater flow can lead to an invasion by exotic species such as Australian pine (*Casuarina equisetifolia*) and Brazilian pepper (*Schinus terebinthifolius*).

The mangrove species found in the Biscayne Bay area are the red mangrove (*Rhizophora mangle*); the black mangrove (*Avicennia germinans*); the white mangrove (*Laguncularia racemosa*); and the buttonwood (*Conocarpus erectus*). Most of the mangrove habitat in the project area can be sub-divided into four forest types (Gaiser and Ross, 2003). Closest to the bay shoreline is the coastal mangrove forest, whose canopy is comprised mainly of red and black mangroves exceeding 30 feet in height. Landward of this zone is the interior mangrove forest that is dominated by black and white mangroves approximately 15-30 feet tall, with an understory of red mangroves. Adjacent to and landward of the interior mangrove forest is the transitional mangrove forest. This vegetative type is dominated by white mangroves, approximately 7-15 feet high, with

red and black mangroves, and buttonwood found emerging from the canopy. The most landward forest type is the dwarf mangrove forest, which is dominated by red mangroves generally less than 6 feet in stature.

Seagrass Beds

Seagrasses are submerged vascular plants that form dense rooted beds in shallow estuarine and marine environments. This community occurs in subtidal areas that experience moderate wave energy. Within the project area, extensive seagrass beds occur in Florida Bay. The most abundant seagrasses in south Florida are turtle grass (*Thalassia testudinum*), manatee grass (*Syringodium filiforme*), and shoal grass (*Halodule wrightii*). Additional species include star grass (*Halophila engelmannii*), paddle grass (*Halophila decipiens*), and Johnson's seagrass (*Halophila johnsonii*). Widgeon grass may also occur in seagrass beds in areas of low salinity. Seagrasses have an optimum salinity range of 24 to 35 ppt, but can tolerate considerable short term salinity fluctuations. Large-scale seagrass die-off has occurred in Florida Bay since 1987, with over 18% of the total bay area affected. Suspected causes of seagrass mortality include high salinities and temperatures during the 1980s and long-term reductions of freshwater inflow to Florida Bay (RECOVER 2009).

Federally Listed Species (Under NMFS Purview)

Fifteen federally listed threatened and endangered species under NMFS purview are either known to exist or potentially exist within the project area and, subsequently, may be affected by the proposed action (**Table 7-4**). These marine species include the smalltooth sawfish (*Pristia pectinata*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and the loggerhead sea turtle (*Caretta caretta*). Other federally threatened or endangered species that are known to exist or potentially exist in the project area, but which will likely not be of concern in this study due to the lack of suitable habitat in and within close proximity of the project area include, Johnson's seagrass (*Halophila johnsonii*), the Gulf sturgeon (*Acipenser oxyrinchus desotoi*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), and the elkhorn (*Acropora palmata*), and staghorn (*Acropora cervicornis*) stony corals.

Table 7-4: Status of Threatened & Endangered Species Under NMFS Purview Likely to be Affected by CEPP – and the Corps' Effects Determinations

Common Name	Scientific Name	Status	Agency	May Affect, Likely to Adversely Effect	May Affect, Not Likely to Adversely Effect	No Effect

					Effect	
Mammals						
Blue whale	*Balaenoptera musculus*	E	Federal			X
Fin whale	*Balaenoptera physalus*	E	Federal			X
Humpback whale	*Megaptera novaeangliae*	T	Federal			X
Sei whale	*Balaenoptera borealis*	E	Federal			X
Sperm whale	*Physeter macrocephalus*	E	Federal			X
Reptiles						
Green sea turtle	*Chelonia mydas*	E	Federal		X	
Leatherback sea turtle	*Dermochelys coriacea*	E	Federal		X	
Hawksbill sea turtle	*Eretmochelys imbricata*	E	Federal		X	
Loggerhead sea turtle	*Caretta caretta*	T	Federal		X	
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	Federal		X	
Fish						
Smalltooth sawfish*	*Pristia pectinata*	E	Federal		X	
Gulf sturgeon*	*Acipenser oxyrinchus desotoi*	T	Federal			X
Invertebrates						
Elkhorn coral*	*Acropora palmata*	T	Federal			X
Staghorn coral*	*Acropora cervicornis*	T	Federal			X
Plants						
Johnson's seagrass*	*Halophila johnsonii*	E	Federal			X

* Critical habitat designated for this species
E: Endangered
T: Threatened

State Listed Species

Portions of project area contain habitat potentially suitable for two state-listed threatened species and nine species of special concern that are under NMFS purview (see Section 6.4). The majority of protected species is outside of the projects' zone of influence and therefore, is not likely to be adversely affected by project operations. Successful implementation of restoring existing wetlands will improve the overall functional capacity of affected habitats thus benefiting the species utilizing these areas. Therefore, no adverse impacts are anticipated to state listed species, or species of concern as a result of this project.

Designated Critical Habitat (Under NMFS Purview)

NMFS has designated critical habitat for Johnson's seagrass, the Gulf sturgeon, smalltooth sawfish, elkhorn coral, and staghorn coral (see Figures 6.1 – 6.5). Critical habitat is not contained within the study area for the Gulf sturgeon; therefore, no effect is anticipated. Critical habitat for Johnson's seagrass, along with elkhorn and staghorn corals does exist within the study action area but is unlikely to be affected by CEPP.

7.2.8.9.2 EFFECTS OF PROPOSED ACTION

Species Biology and Effect Determination

A description of the biology and distribution of threatened and endangered species potentially occurring in the project area that are under NMFS purview is contained in Section 7.0.

"No Effect" Determination

Federally threatened or endangered species that are known to potentially exist within close proximity of the project area, but which will not likely be of concern are discussed below:

<u>Gulf Sturgeon and "No Effect" Determination</u>

Although historical records indicate that the Gulf sturgeon ranged from the Mississippi River east to Tampa Bay and south to Florida Bay, the present range extends from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi, and east to the Suwannee River in Florida. Since all project effects will occur south of any known species locale, the Corps has determined the proposed project would have no effect the Gulf sturgeon nor its designated critical habitat.

<u>Blue, Finback, Humpback, Sei and Sperm Whales and "No Effect" Determination</u>

Although ocean whales have been reported migrating along the Florida coastlines of the Gulf of Mexico and Atlantic Ocean seeking warmer waters during the winter months,

they are typically found far off shore, away from any potential influences of the proposed project. Since project effects are anticipated to be limited to land-based wetlands, estuarine systems and near shore habitats, the Corps has determined the proposed project will have no effect the blue, finback, humpback, sei or sperm whales.

Elkhorn Coral, Staghorn Coral and "No Effect" Determination

Elkhorn and staghorn corals may be found offshore of bay habitats including Biscayne and Florida Bay outer reef tracts where salinities are stable (35 ppt) and representative of open ocean conditions. The reef tract is approximately 10 to 20 miles seaward of the shoreline. Anticipated salinity alterations resulting from project activities are not expected to occur beyond 1500 meters from shore. Because the reef tract where elkhorn and staghorn coral resides is several miles outside of any projected salinity changes, the Corps has determined the proposed project would have no effect on elkhorn or staghorn corals.

Elkhorn Coral and Staghorn Coral Critical Habitat

Project restoration efforts are expected to focus on wetland and estuarine habitats and will not extend offshore into the vicinity of critical habitat; therefore, the project would have no effect on designated critical habitat for elkhorn or staghorn coral.

Johnson's Seagrass and "No Effect" Determination

Johnson's seagrass has a disjunct and patchy distribution along the east coast of Florida from central Biscayne Bay to Sebastian Inlet. The largest patches have been documented inside Lake Worth Inlet including the mouth of the St. Lucie Inlet. Because Johnson's seagrass potentially benefits from the project as a result of fewer high-volume freshwater discharges from Lake Okeechobee, the Corps has determined the project would have no effect on Johnson's seagrass.

Johnson's Seagrass Critical Habitat

The project area includes designated critical habitat for Johnson's seagrass in the St. Lucie estuary. Implementation of the project would result in fewer high volume freshwater discharges from Lake Okeechobee and therefore, may benefit seagrasses in the St. Lucie estuary, including Johnson's seagrass. As a result, the Corps has determined that implementation of the project will not destroy or adversely modify designated critical habitat and will have no adverse effect on critical habitat

"May Effect" Determination

The proposed project would improve the quality, quantity, timing, and distribution of flows to the Greater Everglades, including the coastal areas of the southern estuaries

and Florida Bay. Subsequently, the project will provide significant beneficial effects to listed plant and animal species such as sea turtles, estuarine fishes, and seagrasses. Federally listed species under the purview of the NMFS which may have the potential to be affected by CEPP include the green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, the loggerhead sea turtle, the smalltooth sawfish, and is discussed below:

Green Sea Turtle and "May Affect" Determination

The green sea turtle weighs approximately 150 kilograms and lives in tropical and sub-tropical waters. Areas that are known as important feeding areas for the green turtles in Florida include the Indian River Lagoon, the Florida Keys, Florida Bay, Homosassa, Crystal River and Cedar Key. Green turtles occupy three habitat types: high energy oceanic beaches, convergence zones in the pelagic habitat, and benthic feeding grounds in the relatively shallow, protected waters. Females deposit eggs on high energy beaches, usually on islands, where a deep nest cavity can be dug above the high water line. Hatchlings leave the beach and move in the open ocean. Green sea turtles forage in pastures of seagrasses and/or algae, but small green turtles can also be found over coral reefs, worm reefs, and rocky bottoms.

Although green sea turtles are expected to be found foraging in nearshore seagrass habitats within Florida Bay, the increased freshwater flows associated with CEPP may alter seagrass species composition but should not have an adverse effect on the overall biomass available for sea turtle feeding habits. Additionally, no green sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined green sea turtle may be affected, but is not likely to be adversely affected, by the proposed project.

Hawksbill Sea Turtle and "May Affect" Determination

The hawksbill sea turtle is a small to medium-sized marine turtle weighing up to 15 kilograms in the United States. The hawksbill lives in tropical and sub-tropical waters of the Atlantic, Pacific, and Indian Oceans. Areas that are known as important feeding areas for hawksbill turtles in Florida include the waters near the Florida Keys and on the reefs off Palm Beach County. Hawksbill turtles use different habitat types at different stages of their life cycle. Post hatchlings take shelter in weed lines that accumulate at convergence zones. Coral reefs are the foraging habitat of juveniles, sub-adults, and adults. They are also known to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore where coral reefs are absent. Hawksbills feed predominantly on sponges and nest on low and high energy beaches, frequently sharing

the high-energy beaches with green sea turtles. Nests are typically placed under vegetation.

Although hawksbill sea turtles are expected to be found foraging near hardbottom habitats within Florida Bay, the increased freshwater flows associated with CEPP may reduce nearshore salinity concentrations but should not have an adverse effect on sponges or other food sources utilized by this species. Additionally, no hawksbill sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined hawksbill sea turtle may be affected, but is not likely to be adversely affected, by the proposed project.

Leatherback Sea Turtle and "May Affect" Determination

The leatherback sea turtle is the largest living turtle and weighs up to 700 kilograms. The leatherback lives in tropical and sub-tropical waters. Habitat requirements for juvenile and post-hatchling leatherbacks are virtually unknown. Nesting females prefer high-energy beaches with deep unobstructed access. Leatherbacks feed primarily on jellyfish.

Although leatherback turtles are expected to be found foraging in nearshore habitats within Florida Bay, the increased freshwater flows associated with the CEPP may reduce nearshore salinity concentrations but should not have an adverse effect on jellyfishes or other food sources utilized by this species. Additionally, no leatherback sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined leatherback sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Kemp's Ridley Sea Turtle and "May Affect" Determination

The Kemp's ridley sea turtle is the smallest of all sea turtles and weighs up to 45 kilograms. This species is a shallow water benthic feeder consuming mainly algae and crabs. Juveniles grow rapidly. Juveniles and sub-adults have been found along the eastern seaboard of the United States and in the Gulf of Mexico. However, the major nesting beach for the Kemp's ridley sea turtle is on the northeastern coast of Mexico. This species occurs mainly in coastal areas of the Gulf of Mexico and in the northwestern Atlantic Ocean. The post-pelagic stages are commonly found dwelling over crab-rich sandy or muddy bottoms. Juveniles frequent bays, coastal lagoons, and river mouths.

Although Kemp's ridley sea turtles could be found foraging in nearshore habitats within Florida Bay, this species is not expected to be found within the direct area of influence associated with CEPP. Additionally, no Kemp's ridley sea turtles would attempt to utilize areas for nesting purposes since their main nesting location is on a single stretch of beach on the Gulf Coast of Mexico. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined Kemp's ridley sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Loggerhead Sea Turtle and "May Affect" Determination

Loggerhead sea turtles inhabit the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. Females select high energy beaches on barrier strands adjacent to continental land masses for nesting. Steeply sloped beaches with gradually sloped offshore approaches are favored. After leaving the beach, hatchlings swim directly offshore and eventually are found along drift lines. They migrate to the near-shore and estuarine waters along the continental margins and utilize those areas as the developmental habitat for the sub-adult stage. Loggerheads are predators of benthic invertebrates.

Although loggerhead sea turtles are expected to be found foraging in nearshore habitats within Florida Bay, the increased freshwater flows associated with CEPP may reduce nearshore salinity concentrations but should not have an adverse effect on crustaceans, mollusks or other invertebrate food sources utilized by this species. Additionally, no loggerhead sea turtles would attempt to utilize areas for nesting purposes since there is no suitable habitat for nesting in the project area. With the expectation of improved nearshore habitat, no utilization of the project area for nesting purposes, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined loggerhead sea turtle may be affected, but would not likely be adversely affected, by the proposed project.

Smalltooth Sawfish and "May Affect" Determination

Smalltooth sawfish (*Pristia pectinata*) have been reported in the Pacific and Atlantic Oceans, and the Gulf of Mexico; however, the United States population is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the United States population was common throughout the Gulf of Mexico from Texas to Florida, and along the east coast from Florida to Cape Hatteras. The current range of this species includes peninsular Florida, with some regularity only in south Florida from Charlotte Harbor to Florida Bay. Juvenile sawfish use shallow habitats with a lot of vegetation, such as mangrove forests, as important nursery areas. Many such habitats have been modified or lost due to

development of the coastal areas of Florida and other southeastern states. The loss of juvenile habitat likely contributed to the decline of this species.

Although the main Florida population resides in the Caloosahatchee River and adjacent Charlotte Harbor estuaries, smalltooth sawfish have the potential to be found in the southern estuaries where the juveniles could potentially occur and feed in red mangrove wetlands. By implementation of the proposed project, the smalltooth sawfish may benefit from increased freshwater flows into the coastal wetlands adjoining Florida Bay, which would provide more natural and historic overland flows.

Discharging large volumes of freshwater from Lake Okeechobee to the Caloosahatchee River during the wet season significantly reduces salinities and increases nutrient loading; all of which has a profound adverse effect on estuarine flora and fauna. As a result, the smalltooth sawfish may benefit from the project's ability to reduce excessive freshwater flows by improving the salinity regime throughout the Caloosahatchee estuary. With the expectation of improved wetland habitat, and the implementation of agency approved Sea Turtle and Smalltooth Sawfish Construction Conditions, the Corps has determined the proposed project may affect, but is not likely to adversely affect, smalltooth sawfish.

Smalltooth Sawfish Critical Habitat

Critical habitat includes two areas (units) located along the southwest coast of peninsular Florida. The northern unit is the Charlotte Harbor Estuary Unit and the southern unit is the Ten Thousand Islands/Everglades (TTI/E) Unit (**Figures 6.3-6.4**). The units encompass portions of Charlotte, Lee, Collier, Monroe, and Miami-Dade Counties. By reducing the number and severity of freshwater pulses to the Caloosahatchee River and estuary, CEPP has the potential of having a beneficial effect to the Caloosahatchee's portion of designated sawfish critical habitat. Since a more natural freshwater flow regime will be established through project restoration efforts, the Corps has determined that CEPP will have no adverse effect on critical habitat for the smalltooth sawfish.

7.2.8.10 CONCLUSION (CEPP)

The Corps, Jacksonville District, acknowledges the potential existence of fifteen federally listed threatened and endangered species under NMFS purview within the boundaries of the CEPP study area. Based on available information, it is evident that green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), loggerhead sea turtle (*Caretta caretta*) and smalltooth sawfish (*Pristia pectinata*), resides, travels, and/or forages within the study area. Although project related impacts through restoration efforts will ultimately benefit estuarine and nearshore communities and associated biota, these species could be affected by the implementation of CEPP.

Other federally threatened or endangered species that are known to exist or potentially exist in the CEPP project area, but which will likely not be of concern in this study due to the lack of suitable habitat in and within close proximity of the project area include, Johnson's seagrass (*Halophila johnsonii*), Gulf sturgeon (*Acipenser oxyrinchus desotoi*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), elkhorn (*Acropora palmata*), and staghorn (*Acropora cervicornis*) stony corals.

8.0 CONSERVATION MEASURES (CERP)

The Corps acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within the CERP study area. In recognition of this, disturbance to listed species will be minimized or avoided by implementing the Sea Turtle and Smalltooth Sawfish Construction Conditions dated March 23, 2006.

9.0 CONCLUSION (CERP)

The Corps, Jacksonville District, acknowledges the probable existence of fifteen federally listed threatened and endangered species under NMFS purview within the boundaries of the CERP study area. Based on available information, it is evident that smalltooth sawfish (*Pristia pectinata*), green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempii*), and loggerhead sea turtle (*Caretta caretta*) resides, travels, and/or forages within the study area and could be affected by CERP implementation.

Other federally threatened or endangered species that are known to exist or potentially exist in the CERP project area, but which will likely not be of concern in this study due to the lack of suitable habitat in and within close proximity of the project area include, Johnson's seagrass (*Halophila johnsonii*), the Gulf sturgeon (*Acipenser oxyrinchus desotoi*), blue whale (*Balaenoptera musculus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), sei whale (*Balaenoptera borealis*), sperm whale (*Physeter macrocephalus*), and the elkhorn (*Acropora palmata*), and staghorn (*Acropora cervicornis*) stony corals.

The Corps recognizes that until completion of the CERP there are few opportunities within the current constraints of the C&SF system to completely avoid effects to listed species. However, the purpose of CERP is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades and downstream estuaries. The Corps will continue discussions with U. S. Fish and Wildlife Service (FWS), NMFS and Fish and Wildlife Conservation Commission (FWC) in the event of CERP project modifications.

This document is being submitted for formal consultation with the NMFS pursuant to Section 7 of the Endangered Species Act.

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APPENDIX 1: STANDARD PROTECTION MEASURES

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

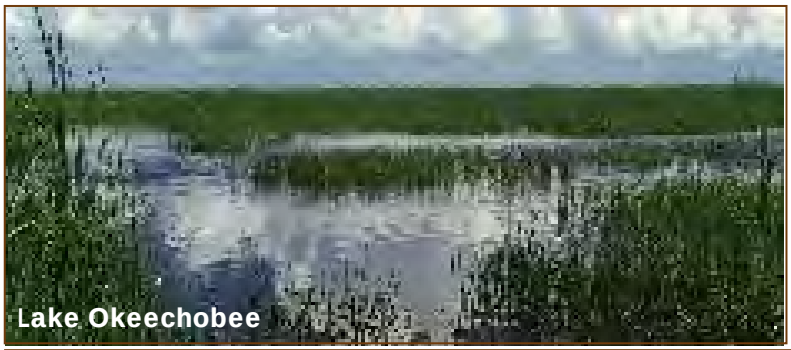
g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

A.3.2 Lake Okeechobee Watershed Restoration Project Biological Assessment Submitted to the U.S. Fish and Wildlife Service

LAKE OKEECHOBEE WATERSHED RESTORATION PROJECT
CHARLOTTE, GLADES, HIGHLANDS, MARTIN, OKEECHOBEE, AND ST LUCIE COUNTIES

BIOLOGICAL ASSESESSMENT



June 2018

1 INTRODUCTION

The purpose of a Biological Assessment (BA) is to evaluate the potential effects of a Federal action on both listed species and those proposed for listing, including designated and proposed critical habitat, and determine whether the continued existence of any such species or habitat are likely to be adversely affected by the Federal action. The Federal action analyzed in this BA is the Lake Okeechobee Watershed Restoration Project (LOWRP) Tentatively Selected Plan (TSP) described in Section 3.1. The BA is also used to determine whether formal consultation or a conference is necessary (50 CFR Section 402.12(a)). This is achieved by:

- Reviewing the results of an on-site inspection of the area affected by the Federal action to determine if listed of proposed species are present or occurs seasonally.
- Reviewing the views of recognized experts on the species at issue and relevant literature.
- Analyzing the effects of the Federal action on species and habitat including consideration of cumulative effects, and the results of any related studies.
- Analyzing alternative actions considered by the Federal agency for the proposed project (50 CFR Section 402.12(f)).

2 CONSULTATION SUMMARY FOR LAKE OKEECHOBEE WATERSHED RESTORATION PROJECT (LOWRP)

United States Fish and Wildlife Service (USFWS): A species list request was sent to the USFWS on July 1, 2016. The USFWS sent a list with revisions on August 23, 2016. In addition to consultation under the Endangered Species Act (ESA) of 1973, as amended, USFWS has been actively involved throughout the planning process to identify a Tentatively Selected Plan (TSP) with numerous emails, participation in Project Delivery Team (PDT) phone calls/meetings, participation in Eco Subteam phone calls/meetings, input on the Adaptive Management and Monitoring Plan and analyses for the wetland restoration components. The U.S. Army Corps of Engineers, Jacksonville District (Corps) received a Draft Fish and Wildlife Coordination Act Report on June 15, 2018.

National Marine Fisheries Service (NMFS): The Corps provided a Programmatic Biological Assessment for the Comprehensive Everglades Restoration Plan (CERP) to NMFS on July 2, 2013. NMFS provided a Programmatic BO for the CERP to the Corps on December 17, 2013. The 2013 Programmatic BO concurred with the determination that CERP including Lake Okeechobee Watershed Restoration Project (LOWRP), is not likely to adversely affect any listed species or their designated critical habitat under NMFS' purview. The 2013 Programmatic BO determined that the Corp's consultation responsibilities under the ESA for species under the NMFS purview was concluded, noting that consultation must be initiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. No further consultation is necessary for LOWRP under ESA for species under NMFS' purview.

3 PROJECT DESCRIPTION

The LOWRP study area covers a portion of the Lake Okeechobee Watershed (LOW), Lake Okeechobee and the Caloosahatchee and St. Lucie estuaries (**Figure 3-1**). The LOW, as defined hydrologically, spreads over approximately 8,687 square miles (mi^2), almost 13 times the area of the lake itself (Flaig & Havens, 1995). The LOW is a shallow trough that drains south from Orlando to the Florida Everglades, and is bounded by

sand hills of the Lake Wales Ridge on the west and upland marshes of the Osceola Plain to the east (Parker, 1955). It is characterized by low-gradient, poorly drained landscapes with many marshes and sloughs and includes all major basins and subbasins that are direct tributaries to the lake, including those that are hydrologically upstream and/or those from which water is released or pumped into the lake on a regular basis. Four distinct tributary systems (basins) drain naturally into Lake Okeechobee: the Kissimmee River Valley, Lake Istokpoga-Indian Prairie/Harney Pond, Fisheating Creek, and Taylor Creek/Nubbin Slough. With the exception of Fisheating Creek, all major inflows to Lake Okeechobee are controlled by gravity-fed or pump-driven water control structures. The four major basins of the LOW are generally bounded by the drainage divides of the major water bodies and are further divisible into smaller subbasins based on hydrology and geography. Further descriptions of the existing conditions in the area are summarized in **Section 2.0** of the Draft Project Implementation Report// Environmental Impact Statement (PIR/EIS). The Draft PIR/EIS are located at the following locations:
http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx - under Multiple Counties; and
http://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/Lake-Okeechobee-Watershed-Project/

Lake Okeechobee provides water supply to urban areas, agriculture, and downstream estuarine ecosystems during the dry season (November-May) and is used for flood control during the wet season (June-October). In the Lake Okeechobee Service Area (LOSA), the town of Okeechobee Utility Authority is the only remaining public water supply (PWS) utility using water directly from Lake Okeechobee. Clewiston, South Bay, Belle Glade, and Pahokee have discontinued the use of Lake Okeechobee as their supply source and use Floridian aquifer water treated by reverse osmosis for all of their PWS since 2008. The Okeechobee Intercoastal Waterway (OIWW) provides economically and politically important commerce between the eastern and western coasts of Florida. The waterway connects the Atlantic Intracoastal Waterway to the Gulf Intracoastal Waterway and is a congressionally authorized project, with depths and operations required for efficient navigation on the system. The authorized Central and Southern Florida (C&SF) Project depths for Lake Okeechobee navigation are based on 12.56 feet (ft. NGVD).

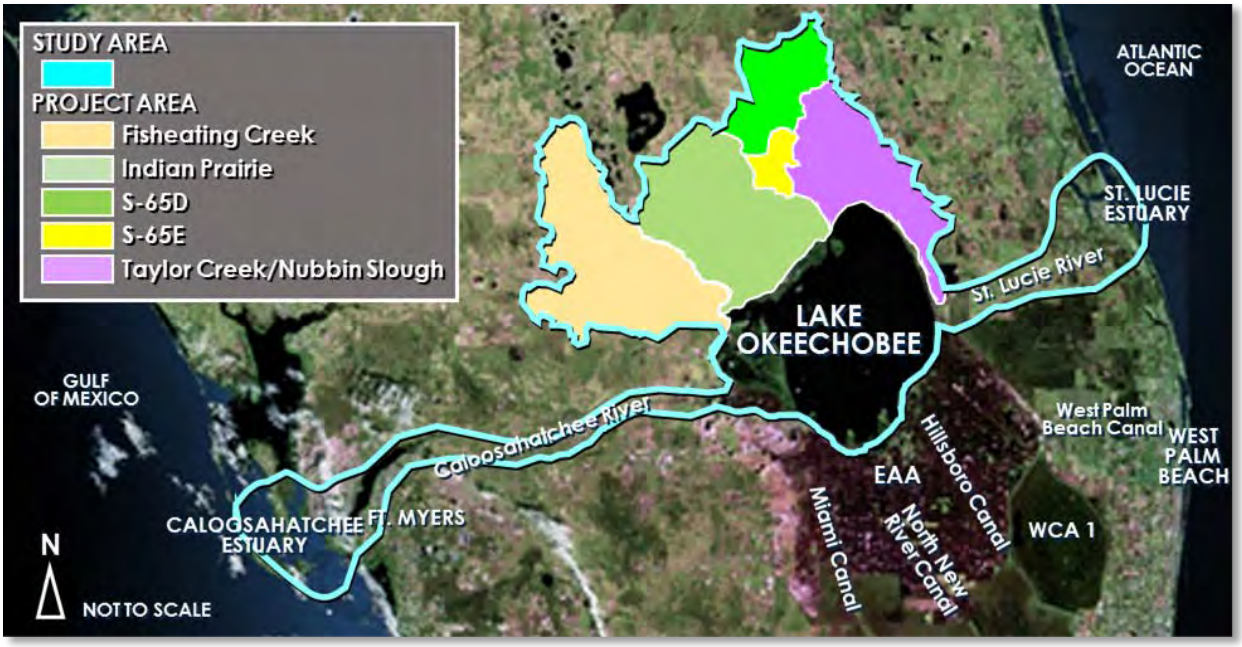


Figure 3-1. Lake Okeechobee Watershed Restoration Project Study Area

The TSP, Alternative 1BW, includes a flow-through wetland attenuation feature (WAF), 80 total Aquifer Storage and Recovery (ASR) wells (55 within the watershed as ASR well clusters (2 or more per cluster), 25 wetland attenuation ASR wells located within the WAF), and the Paradise Run and Kissimmee River Center wetland restoration sites (**Figure 3-2**).

3.1 TSP Features

Wetland Attenuation Feature: The flow-through WAF is located within the Indian Prairie sub-watershed west of the C-38 Canal, north of SR 78, east of the Seminole Tribe of Florida Brighton Reservation, and south of the C-41A Canal. The flow-through WAF will primarily be used for surface water storage to attenuate peak flows into Lake Okeechobee from the Kissimmee River Basin. The secondary purpose is to provide for emergent wetland habitat. Wetland attenuation ASR wells will rehydrate habitat during dry times to ensure that wetland conditions are maintained within the WAF footprint. The WAF footprint, including the embankments, seepage canal, and other perimeter features, is approximately 12,500 acres with a storage capacity of approximately 43,000 acre-feet (ac-ft). The WAF includes a pump station located downstream of the existing S-84 structure on the C-41A canal serves as the water source for the proposed WAF. The pump draws water from the downstream area that is part of Lake Okeechobee.

Aquifer Storage and Recovery Wells: 80 total ASR wells are proposed in clusters in various locations throughout the watershed. The ASR well clusters will include a combination of ASR wells that will utilize either the Upper Floridan Aquifer or the Avon Park Permeable Zone for storage and recovery. The clusters are proposed to have two wells within a three acre footprint. The location of these wells will be further defined during the design phase of this project. USFWS will be coordinated with on the locations in order to reduce any potential effects to listed species.

- **Wetland Attenuation ASR Wells:** Wetland Attenuation ASR wells can be used to increase the total storage capacity of the WAF
    - There are three well clusters (25 wells) co-located with the WAF

- ASR wells will recharge using the WAF and discharge into the WAF prior to release into the Kissimmee River
- Thus, the combination of wetland attenuation ASR wells and the WAF will provide dynamic storage.

- **Watershed ASR wells:** The remaining ASR wells will be located throughout the watershed, with final locations defined during the design phase of the project. The proposed cluster placements are listed below:

Number of Clusters (2 wells per cluster)	Potential Location
1	Adjacent to the C-44 canal in Port Mayaca. This would discharge out of the C-44 into Lake Okeechobee or to the St. Lucie River Estuary.
3	S-191 subwatershed. Some of the wells would be adjacent to the L-63N canal and the rest would be adjacent to the L-63S canal. These would all flow into the Lake at the S-191 structure.
2	Adjacent to the C-38 canal downstream of S-65E that can discharge back into the C-38 canal
1	Along Taylor Creek, downstream of S-192 and upstream of the S-133 pump station which discharges to Lake Okeechobee
1	Along C-40 canal downstream of S-72 that can discharge to Lake Okeechobee.
1	Along C-41 canal downstream of S-71 that can discharge to Lake Okeechobee.
1	Along the C-43 canal in Moore Haven that can discharge to Lake Okeechobee or the Caloosahatchee River

Wetland Restoration Sites: Wetland restoration includes the Paradise Run and Kissimmee River Center features. The Paradise Run site is approximately 4,100 acres containing historic Kissimmee River channel and floodplain. The site is located downstream of S-65E on the west bank of the C-38 Canal, between the C-41A canal and the Buckhead Ridge community. A pump station on the C-41A Canal downstream of S-84 serves as the water source to restore natural flow to the river and hydroperiod to the floodplain wetlands. The pump station will draw water into the historic Kissimmee River channel running through the Paradise Run site. About 24,500 linear feet of channel excavation will be performed. An overflow weir will be placed between the north and south sections of Paradise Run to control the flow and to connect both sides through the L-59 berms. The flow will discharge back into the C-38 Canal by way of a culvert through the Herbert Hoover Dike on the southeast corner of the site. The Kissimmee River Center site is approximately 1,200 acres and is located on the west bank of the C-38 Canal about halfway between S-65D and S-65E. A submerged weir will be placed in the C-38 canal at the north end of the site to divert water to the west into a created river channel mimicking the historic Kissimmee River. About 21,500 feet of channel excavation will be performed to create riverine habitat and new floodplain wetlands.

TSP Operational Considerations: The hydrologic modeling conducted for the TSP to optimize system-wide performance incorporated the current Regulation Schedule management bands of the 2008 Lake Okeechobee Regulation Schedule (LORS), CEPP modifications, and the LOWRP modifications with water supply deliveries to the Northern Estuaries that include:

- Class limits for Lake Okeechobee inflow and climate forecasts, including tributary hydrologic conditions, seasonal climate outlook, and multi-seasonal climate outlook
- Stage level, as delineated by the Regulation Schedule management bands
- Stage trends (whether water levels are receding or ascending)

It is important to note that the 2008 LORS revisions and environmental water supply deliveries to the Northern Estuaries identified in LOWRP are to inform a future LORS and system-wide operational updates. The LOWRP PIR/EIS will not be the mechanism to propose or conduct the required National Environmental Policy Act (NEPA) evaluation of modifications to the LORS and system-wide operational modifications. These actions will be conducted under other authority consistent with the Integrated Delivery Schedule (IDS) for CERP.

The specific feature locations of the TSP are shown **Figure 3-2.**

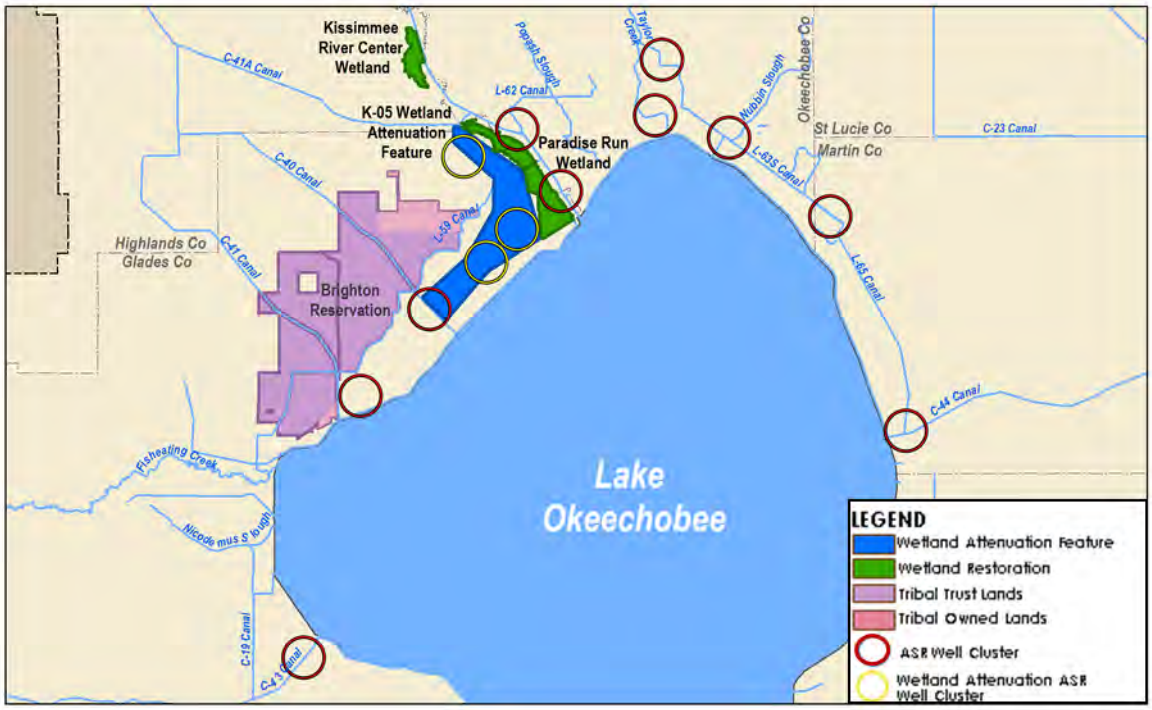


Figure 3-2. LOWRP Tentatively Selected Plan.

3.2 PROJECT GOALS AND OBJECTIVES

The LOWRP goals remain consistent with prior planning efforts of CERP (USACE 1999). Specific LOWRP objectives were created to address the water storage north of Lake Okeechobee to:

- Increase water storage capacity in the watershed, resulting in improved Lake Okeechobee water levels
- Improve the quantity and timing of discharges to the St. Lucie and Caloosahatchee estuaries
- Restore wetlands
- Improve water supply

3.3 PERFORMANCE MEASURES USED IN EVALUATION

In order to achieve the action objective, the Corps, in conjunction with the PDT team, identified a list of performance measures (PMs) for purposes of evaluating the systems response to alternative plans during development of the LOWRP Draft PIR/EIS. Appendix G of the Draft PIR/EIS describes the performance measures and benefit calculations in greater detail:

(http://www.saj.usace.army.mil/About/DivisionsOffices/Planning/EnvironmentalBranch/EnvironmentalDocuments.aspx - under Multiple Counties).

Four performance measures (PM) were developed to measure three restoration objectives (**Table 3-1**) for LOWRP within three ecological zones (**Table 3-2**):

1. **Wetland Restoration PM 1** – Measuring potential wetland benefits of managing hydrologic regimes for major plant communities and reconnecting natural areas.
2. **Lake Okeechobee PM 2** - Hydrologic regimes in Lake Okeechobee specific to three criteria (1-Lake stage envelope; 2-Extreme high and low lake stage; 3-Ecological indicators).
3. **Caloosahatchee Estuary Salinity PM 3** - Seasonal flows to manage salinity in the Caloosahatchee Estuary to benefit native flora and fauna.
4. **St. Lucie Estuary Salinity PM 4** - Seasonal flows to manage salinity in the St. Lucie Estuary to benefit native flora and fauna.

The complete RECOVER-approved Performance Measure Documentation Sheets are located in **Appendix G of the Draft PIR/EIS**.

Table 3-1. LOWRP Objectives Linked to Performance Measures.

LOWRP Objective	PM 1 – Wetland Restoration	PM 2 – Lake Okeechobee Stage	PM 3 – Caloosahatchee Estuary Salinity	PM 4 – St. Lucie Estuary Salinity
1. Improve timing and distribution of flows into Lake Okeechobee to maintain ecologically desired lake stage ranges	**Yes**	**Yes**	N/A	N/A
2. Reduce discharges from Lake Okeechobee to improve the salinity regime and the quality of oyster, SAV, and other estuarine community habitats in the northern estuaries	N/A	N/A	**Yes**	**Yes**
3. Increase spatial extent and functionality of aquatic and wildlife habitat within Lake	**Yes**	N/A	N/A	N/A

LOWRP Objective	PM 1 – Wetland Restoration	PM 2 – Lake Okeechobee Stage	PM 3 – Caloosahatchee Estuary Salinity	PM 4 – St. Lucie Estuary Salinity
Okeechobee and surrounding watershed				

Table 3-2. Ecosystem Zones Linked to Performance Measures (PM)

Ecosystem Zones	PM 1	PM 2	PM 3	PM 4
Watershed Wetlands – Freshwater Flora and Fauna	**Yes**	N/A	N/A	N/A
Lake Okeechobee	N/A	**Yes**	N/A	N/A
Estuaries – Oysters	N/A	N/A	**Yes**	**Yes**

3.4 EXISTING CONDITIONS MODEL ASSUMPTIONS

The LOWRP Existing Conditions Baseline (ECB), relative to the CEPP ECB Baseline (SFWMD et al, 2014a) includes the following:

- The Regional Simulation Model (RSMBN) ECB was expanded to include the Ten Mile Creek Reservoir and STA per Ten Mile Creek Preliminary Operating Plan (SFWMD, June 2015).
- The A-1 Flow Equalization Basin (FEB) north of STA ¾ was added to ECB.
- Addition of the G200 structure into Holey Land per Holey Land Wildlife Management Area Draft Project Operations Manual (SFWMD, March 2015).
- The Stormwater Treatment Areas were expanded for STA2, STA5 and STA6 (Compartment B & C).
- Lake Okeechobee Regulation Schedule (LORS) 2008.

4 DESCRIPTION OF EXISTING CONDITIONS, LISTED SPECIES, AND DESIGNATED CRITICAL HABITAT

The following describes the existing conditions within the LOWRP action area.

4.1 EXISTING CONDITIONS

The following tables show the existing condition acreages of land use types within the wetland attenuation feature (Table 4-1) and the wetland restoration features (Table 4-2).

Table 4-1. Current wetland attenuation land classification

FLUCCS Code Description (2015)	1BW
Improved Pastures	11,051
Unimproved Pastures	135
Citrus Groves	13
Herbaceous Rangeland	27
Shrub and Brushland	59
Palmetto Prairies	0
Upland Hardwood Forest	0
Brazilian Pepper	0
Oak - Cabbage Palm Forest	89
Cabbage Palm	326
Channelized waterways, canals	2
Reservoirs	6
Mixed Wetland Hardwoods	3
Mixed Wetland Hardwoods - Mixed Shrubs	16
Cabbage Palm Savannah	0
Freshwater Marshes	662
Sawgrass	0
Wet Prairies	103
Emergent Aquatic Vegetation	0
Total Storage Area	**12,493**

Table 4-2. Existing land use classifications (FLUCCS) for the Kissimmee River Center and Paradise Run wetland restoration site footprint.

FLUCCS Code Description (2015)	Kissimmee River Center	Paradise Run	Wetland TSP
Improved Pastures	796	1,286	**2,082**
Unimproved Pastures	64	-	**64**

FLUCCS Code Description (2015)	Kissimmee River Center	Paradise Run	Wetland TSP
Herbaceous Rangeland	3	19	**23**
Shrub and Brushland	-	17	**17**
Mixed Rangeland	-	40	**40**
Upland Hardwood Forest	4	35	**39**
Live Oak	3	-	**3**
Oak - Cabbage Palm Forest	1	-	**1**
Cabbage Palm	-	3	**3**
Streams and Waterways	19	76	**95**
Channelized waterways, canals	3	2	**4**
Reservoirs	5	-	**5**
Slough Waters	-	146	**146**
Mixed Wetland Hardwoods	-	32	**32**
Mixed Wetland Hardwoods - Mixed Shrubs	159	184	**344**
Cabbage Palm Savannah	4	15	**19**
Freshwater Marshes	55	493	**548**
Wet Prairies	41	840	**881**
Emergent Aquatic Vegetation	40	885	**925**
Spoil Areas	-	10	**10**
Total Acres	**1,196**	**4,083**	**5,279**

4.1.1 Vegetative Communities

The vegetation within the Lake Okeechobee region has been greatly altered during the last century. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, and pine flatwoods. Although some of these natural areas still exist, the introduction of controlled drainage for agriculture and land development has resulted in a significantly different set of cover types. Landward of the Lake Okeechobee, sugarcane plantations, improved pasture, row crops, and urban lands now prevail. The ecological communities represented in the LOW include: Florida scrub (including its two related variants, scrubby high pine and scrubby flatwoods), mesic temperate hammock, mesic pine flatwoods, hydric pine flatwoods, dry prairie, cutthroat grass communities, freshwater marshes, wet prairies, flowing water swamps, pond swamps, seepage swamps, and aquatic/open water habitats. Historically, the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, pond apple forests, and pine flatwoods.

4.1.1.1 Upland Vegetative Communities

Mesic Temperate Hammock

Mesic temperate hammocks (also known as upland hardwood forest, upland mixed forest, prairie hammock, and xeric and hydric hammock) are temperate broad-leaved evergreen forests. These forested communities are common throughout the project watershed. They are floristically transitional between the tropical forest of southern Florida and the southern mixed hardwood forest of north Florida (Greller, 1980). Mesic temperate hammocks are generally closed canopy forests dominated primarily by live oak (*Quercus virginiana*) and cabbage palm (*Sabal palmetto*). Moist soils have a dense litter layer but are seldom inundated. They are naturally protected by fire because of their transitional position in the landscape. They occur as generally small islands in expanses of dry prairie composed of saw palmetto and graminoid species (FNAI, 1995; Hilsenbeck and Hedges, 1994).

No federally listed plant species inhabit the mesic temperate hammocks, but two state listed species, wild coco and twisted air plant (*Tillandsia flexuosa*), may be present. The wild coco is a terrestrial orchid occurring primarily in the dry prairies and mesic temperate hammock islands. The twisted air plant is an epiphytic bromeliad that grows on trees in mesic hammocks as well as swamps, hydric pine flatwoods, and xeric hammocks.

Mesic Pine Flatwoods

The mesic pine flatwoods (also known as pine savanna, cabbage palm savanna, and pine barrens) are open canopied forests of pines with a dense groundcover of herbs and shrubs. Within the Lake Okeechobee watershed, this community type is found primarily in portions of Glades and Highlands counties. They provide essential forested upland habitat furnishing refuge and cover in the form of tree canopy, tree cavity, and nesting. The Florida Natural Areas Inventory (FNAI) characterizes mesic flatwoods as flatland with a sand substrate visited by annual or frequent fires. Characteristic vegetation includes a slash pine (*Pinus elliotti*) or longleaf pine (*Pinus palustris*) overstory with an understory/groundcover consisting of saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*), and/or wiregrass (*Aristida beyrichiana*) or cutthroat grass (*Panicum abscissum*). These flatwoods provide the principal dry ground in the watershed.

One federal/state endangered plant, Carter's mustard (*Warea carteri*), occurs in the watershed in Highlands County primarily in dry shrub-dominated habitat. It is a fire-dependent annual fall-flowering herb. Additional state-listed plant species include pinewood bluestem (*Andropogon arctatus*), hartwrightia, thick-leaved water willow (*Justicia crassifolia*), southern red lily (*Lilium catesbaei*), and yellow fringeless orchid (*Platanthera integra*).

Hydric Pine Flatwoods

The hydric pine flatwoods (also known as low flatwoods, moist pine barren, hydric flatwoods, and cabbage palm/pine savannah) are seasonally inundated wet flatwoods that function as both a wetland and an upland. Hydric pine flatwoods contain the highest plant species diversity of any habitat in south Florida. It is dominated by a slash pine overstory with a wetland plant understory. Hydric pine flatwoods seasonally function as both a wetland and an upland habitat.

Dry Prairie

The dry prairie community (also known as palmetto prairie, saw-palmetto prairie, and wiregrass prairie) is endemic to central peninsular Florida. The loamy to clayey subsoils are saturated in the wet season, providing substrate for both upland and wetland plant species. This treeless, fire-maintained landscape is dominated by wiregrass, saw palmetto, and runner oak (*Quercus minima*). Harshberger's (1914), Harper

(1927), and Davis (1943) identified extensive areas of dry prairie in the south-central peninsula, encompassing portions of the lower Kissimmee River, Fisheating Creek, and lower Peace River watersheds. No federally listed plant species are known from the dry prairie; the many-flowered grass pink is the only state endangered plant species that may occur.

Cutthroat Grass Communities

Cutthroat Grass communities (also known as cut-throat seeps, cutthroat grass seasonal ponds, and cutthroat grass flatwoods, and swale) are dominated by cutthroat grass (*Panicum abscissum*) and exist almost exclusively within Polk and Highlands counties in association with the sideslope seepages of the central Florida ridges. These diverse communities vary by topography, hydrology, soils, and vegetation, but they are all fire- dependent graminoid-dominated communities (Abrahamson et al., 1984). Cutthroat grass is a state endangered species (Coile, 2000) and is ranked as imperiled at the global and state levels by FNAI (Marois, 1997). The Highlands County soil survey (Carter et al., 1989) recognizes the Basinger-St. Johns-Placid complex as a specific soil mapping unit corresponding to cutthroat seeps in the county. The greatest extent of cutthroat grass communities on the Lake Wales Ridge is on the eastern slope of the ridge in the northwestern fringe of the Lake Okeechobee Watershed. A diverse array of state-listed plant species are quite common in the cutthroat grass community including cutthroat grass, many flowered grass-pink, Edison's ascyrum (*Hypericum edisonianum*), Pine lily (*Lilium catesbaei)*, Blue butterwort (*Pinguicula caerulea)*, White fringed orchid (*P. lutea*, *Platanthera blephariglottis* var. *conspicua)*, *P. integra*, *P. ciliaris*, *P. cristata*, and Hooded pitcher plant (*Sarracenia minor)*.

4.1.1.2 Wetland Vegetative Communities

Freshwater Marshes and Wet Prairies

In the Lake Okeechobee watershed, freshwater marshes and wet prairies are found as zones along topographical gradients around Lake Okeechobee, the Kissimmee River, and Fisheating Creek (Kissimmee Marsh, Indian Prairie, and Fisheating Creek marshes). The higher elevations with shorter hydroperiods and shallower flooding are classified as wet prairies while the lower elevation, long hydroperiod wetlands are designated as freshwater marshes. Freshwater marshes include the saw grass marshes, cattail marshes, flag marshes, sloughs, mixed emergent grass/sedge marshes, open water marshes, submerged vegetation marshes, and floating vegetation marshes. Freshwater marshes are vegetated primarily with sawgrass (*Cladium jamaicense*) and scattered clumps of Carolina willow (*Salix caroliniana*), sweetbay (*Magnolia virginiana*) and cypress (*Taxodium* spp.). Hardwood swamps dominated by red maple (*Acer rubrum*), sweetbay, and sweet gum (*Liquidambar styraciflua*) occur in riverine areas feeding Lake Okeechobee, while cypress swamps are found in depressional areas throughout the region. The wet prairies include saw grass prairies, wiregrass prairies, and savannahs. The distribution of dominant vegetative species in wet prairies and freshwater marshes is dependent on soil type, depth, and hydrological conditions (Kushlan, 1990). Most of these plant associations are found in the Kissimmee River floodplain and Lake Okeechobee perimeter marshes. These plant communities are frequently located within the littoral zones associated with lakes, creeks, and rivers. Soils have changed with shifts in water management practices in Lake Okeechobee reflected in variations in hydrology and vegetative decomposition rates (Brown et al., 1990).

Flowing Water Swamps

Flowing water swamp communities (also known as floodplain swamp, slough, and strand swamp) are seasonally inundated forested wetlands associated with drainage channels. These communities are generally deep swamps with long-term flooding. They are often degraded by silviculture/agriculture

drainage-control activities and agricultural/urban runoff pollution. Exotic species control is also a major concern. Kissimmee River, Fisheating Creek, Taylor Creek, and Nubbin Slough are lined with floodplain swamps.

Pond Swamps

Pond Swamps (also known as basin swamps, dome swamps, cypress swamp, and cypress ponds) are seasonally inundated forested wetland depressions. This includes the swamps associated with lake borders as well as smaller cypress domes and gum ponds. Dome swamps typically appear in sinkhole depression landscapes with peat soils while larger basin swamps are common in landscape depressions with acidic, nutrient-poor peats with an overlying clay lens or other impervious layer. Sugarcane planting destroyed one type, the pond apple swamp that historically bordered the southern edge of Lake Okeechobee. Continuing soil oxidation has further degraded this system. Many other systems have been destroyed/degraded by silviculture, drainage, impoundment, or pollution. The Cypress Creek/Trail Ridge is another example of pond swamp mosaic in the watershed. Typical dome swamp plants include pond cypress (*Taxodium ascendens*), red maple (*Acer rubrum*), dahoon holly (*Ilex cassine*), swamp bay (*Persea palustris*), sweet bay (*Magnolia virginiana*), wax myrtle (*Myrica cerifera*), buttonbush (*Cephalanthus occidentalis*), St. John's wort (*Hypericum* spp.), chain fern (*Woodwardia* spp.), and fireflag (*Thalia geniculata*). Basin swamp plants include blackgum (*Nyssa sylvatica*), cypress, slash pine, red maple, swamp bay, sweet bay, loblolly bay (*Gordonia lasianthus*), and Virginia willow (*Itea virginica*). The endangered Okeechobee gourd was once common in the pond apple swamp along the southern edge of Lake Okeechobee. This gourd occurs inside the levee that encircles Lake Okeechobee (USFWS, 1995).

Seepage Swamps

Seepage Swamps (also referred to as hydric hammock, baygall, bog, wetland hardwood hammocks, shrub bog, and sweetbay swamp) are characterized by their saturated soils and include baygalls and hydric hammocks on low sand or limestone rises within ephemeral wetland systems. These systems only burn every 50 to 100 years because of their hydrology. Baygalls once fringed the Lake Wales Ridge but were cleared for caladium/gladiola farms. Seepage swamps are degraded by hydrological alterations and agricultural/urban runoff. Cabbage palms in hydric hammocks have been removed in large numbers for use in landscaping. Baygalls occur at the base of a slope that has a saturated peat substrate; bog bayheads occur in peat soil depressions; hydric hammocks occur on flat wet limestone-surfaced sandy lowlands. Baygalls and bayheads are composed of evergreen hardwoods including sweetbay, swamp bay, red bay (*Persea borbonia*), and loblolly bay with sphagnum moss/fern groundcover. Hydric hammocks are dominated by cabbage palms, laurel oaks (*Quercus laurifolia*), and other hardwoods with minimal groundcover. Some important seepage slopes in the Okeechobee watershed include Cypress Creek/Trail Ridge at SR 70 and the Bluefield Road area and seepage swamps of Fisheating Creek.

Open Water

Open water habitats in the project watershed consist primarily of the aquatic communities in the Kissimmee Waterway (C-38), Fisheating Creek, Taylor Creek, Harney Pond Canal (C-41), Indian Prairie Canal (C-40), and the numerous other canals in the project watershed. The invasion of exotic vegetation has rapidly expanded throughout the area. Included among these troublesome species are water hyacinth (*Eichornia crassipes*), water lettuce (*Pistia stratiotes*) and hydrilla (*Hydrilla verticillata*).

4.1.1.3 Lake Okeechobee Vegetative Communities

The majority of the surface of Lake Okeechobee (450,000 acres) is not vegetated and provides open water (pelagic and nearshore) habitat. Open water habitat within Lake Okeechobee covers about 75% of the lake's surface area.

A 98,000-acre (154-square-mile) littoral zone is found along Lake Okeechobee's northwestern and western edge and on the islands in its southern shore (Kraemer Island, Torry Island, and Ritta Island, which together encompass 4,000 acres). The littoral zone supports more than 50 species of emergent, submerged, and floating-leaf plants. Emergent vegetation within the littoral zone is dominated by herbaceous species such as cattail (*Typha* spp.), spike rush (*Eleocharis cellulosa*), and the invasive exotic torpedo grass (*Panicum repens*). Other emergent vegetation includes bulrush (*Scirpus californicus*), sawgrass, pickerelweed (*Pontedaria cordata*), duck potato (*Sagittaria* spp.), beakrush (*Rhynochospora tracyi*), wild rice (*Zizania* aquatic), arrowhead (*Sagittaria latifolia*), buttonbush (*Cephalanthus occidentalis*), sand cordgrass (*Spartina bakeri*), fuirena (*Fuirena scirpoidea*), rush (*Scirpus cubensis*), southern cutgrass (*Leersia hexandra*), maidencane (*Panicum hemitomon*), white vine (*Sarcostemma clausum*), dogfennel (*Eupatorium capillifolium*), and mikania (*Mikania scandens*). Woody vegetation consists of primrose willow (*Ludwigia peruviana*), Carolina willow, and the invasive exotic melaleuca (Melaleuca quiquenervia). Over the years, there has been an on-going effort to eradicate melaleuca in the Lake Okeechobee region. The eradication effort has been extremely effective.

Submerged vegetation within Lake Okeechobee is composed almost entirely of hydrilla (*Hydrilla verticillata*), an invasive exotic species, pondweed (*Potoamogeton illinoensis*), bladderwort (*Utricularia foliosa*), Chara (*Chara* spp.), coontail (*Ceratophyllum demersum*) and tape grass (*Vallisneria americana*).

The floating, component of the littoral zone consists of lotus lily (*Nelumbo lutea*), fragrant water lily (*Nymphaea odorate* and *N. mexicana*), the invasive exotic water hyacinth (*Eichhornia crassipes*), water lettuce (*Pistia stratiotes*), duckweed (*Lemna* spp.), coinwort (*Hydrocotyle umbellate*), and ludwigia (*Ludwigia leptocarpa*).

Periods of extended high lake stages can severely impact littoral vegetation, which declined by 60% after the 2004-05 hurricanes. The extended drought in 2007-08 resulted in the littoral zone spreading into more than half of South Bay. The littoral zone emergent and submerged aquatic vegetation recovered under a lowered regulation schedule and several years of favorable rainfall patterns. Since the high-water levels in the winter of 2016 and fall of 2017, the edge of this portion of the littoral zone has moved towards the southern shoreline.

4.1.1.4 Northern Estuaries Vegetative Communities

Submerged aquatic vegetation (SAV), which includes seagrass and macroalgae, is one of the most important vegetation communities of the St. Lucie River, Indian River Lagoon, and the Caloosahatchee River and Estuary (IRL CCMP 1996). These communities are highly productive and provide food and habitat for fish, sea turtles, manatees, a myriad of invertebrates, and other species. Seagrass meadows improve water quality by removing nutrients, dissipating the effects of waves and currents, and by stabilizing bottom habitats thereby reducing suspended solids. Seagrass beds support some of the most abundant and diverse fish populations. Many commercial and recreational fisheries (e.g. clams, shrimp, lobster, and fish) are associated with healthy seagrass beds (US Fish and Wildlife Service (USFWS 1999). Currently, many SAV beds are stressed and have been reduced or eliminated from their former areas by

extreme salinity fluctuations, increased turbidity, sedimentation, dredging, damage from boats, and nutrient enrichment which causes algal blooms that, in turn, restrict light penetration.

4.1.1.4.1 Upper Caloosahatchee River and Estuary

In terms of distribution and abundance, tape grass has been the dominant species in the upper Caloosahatchee River and Estuary, colonizing fresh water and oligohaline littoral zones in water less than one meter deep (Chamberlain and Doering 1998a). In the early 1990s, tape grass covered approximately 1,000 acres and about 60% of the coverage occurred within an 8-kilometer (km) stretch between Beautiful Island and the Fort Myers Bridge (Hoffacker 1994). Total longitudinal cover ranged from 14 to 32 km upstream from Shell Point (Chamberlain and Doering 1998b). Tape grass can typically tolerate salinities of 3 to 5 practical salinity units (psu) with few long-term effects if light conditions are sufficient (Haller et al. 1974, French and Moore 2003, Jarvis and Moore 2008). Declines in tape grass began in 2000 as a result of salinities exceeding the species' tolerance range (Doering et al. 2001). There was some recovery by 2006, however dramatic declines were observed beginning in late 2006 as a result of high salinities (RECOVER 2009). Additional recovery occurred in 2010, only to be lost due to high salinities in 2011 (RECOVER 2014). During this period, widgeon grass, (*Ruppia maritime*) was the dominant species although it never achieved even the minimum abundance recorded for tape grass (Burns et al. 2007).

The effects of hurricane water releases in 2005 resulted in decreased plant cover and density at some sites in the latter half of 2005. Compounding the high turbidity effects from freshwater releases in 2005, drought conditions caused precipitous increases in salinities beginning in October 2006 raising salinity levels to 10 to 25 psu from November 2006 through April 2008. During the December 2005 to April 2006 period, lower water clarity due to high turbidity was associated with lower shoot density and cover. The loss of plants was quite rapid with a significant end-of-year dieback in 2006 followed by no regrowth in spring 2007. Salinities finally declined between April and October 2008, but tape grass recovery has been slow. This may be related to a lack of propagules as nearly all the tape grass was lost during the late 2006 to 2008 high salinity period. It may also be related to herbivory or other effects on the initial recolonization of recruits into the area as leaves were sometimes noted as missing their tips (RECOVER 2009).

4.1.1.4.2 Lower Caloosahatchee River Estuary

Historically, several species of SAV have been routinely reported during surveys in the lower Caloosahatchee River Estuary upstream of Shell Point. These include shoal grass (*H. wrightii*) and turtle grass (*Thalassia testudinum*) (Chamberlain and Doering 1998a, Wilzbach et al. 2000, Burns et al. 2007). In more recent reports, manatee grass (*Syringodium filiforme*) has been reported in San Carlos and Tarpon Bays (Wilzbach et al. 2000, Burns et al. 2007). Shoal grass coverage, described as abundant, has been at 300 acres; about 75% of this occurred between two and eight km upstream of Shell Point (Chamberlain and Doering 1998b).

From 2004 to 2008, the lower estuary was dominated by shoal grass. Although widgeon grass was observed occasionally (Burns et al. 2007); only very low densities of widgeon grass were found in the lower estuary when surveys were searching specifically for it. High salinity fluctuations with tides and shading by shoal grass may limit its growth. Low salinities during higher rainfall periods and discharge events observed since 2004 likely prevented the survival of seagrass species such as turtle grass (Burns et al. 2007). Water clarity was poor in 2004 and 2005 preventing SAV growth in waters greater than 0.7 meter deep. Water clarity conditions improved in 2007 and were sufficient for growth down to 1.2 meters.

Hurricane effects lowering SAV abundance in 2005 and 2006 and subsequent shoal grass recovery in 2007 are evident with cover in 2007 exceeding 2004 levels. Salinities of one psu or less occurred each year from 2004 to 2006 due to high rainfall within the watershed. Shoal grass is capable of recovering from disturbance in one year, but is still vulnerable to high water discharges contributed from Lake Okeechobee, C-43 basin, and the tidal basin (RECOVER, 2014).

4.1.1.4.3 St. Lucie Estuary

The St. Lucie Estuary and Southern Indian River Lagoon support six species of seagrass including shoal grass, manatee grass, turtle grass, paddle grass, star grass *(Halophila engelmannii*), and the threatened Johnson's seagrass (*Halophila johnsonii*). Johnson's seagrass was listed as threatened under the Endangered Species Act (ESA) in 1998, and critical habitat was designated in 2000. The species has a very limited distribution along the east coast of Florida from central Biscayne Bay to Sebastian Inlet. Major threats include propeller scarring, dredging, sedimentation, and degraded water quality. Shoal grass and manatee grass are the dominant canopy species in the lagoon (Thompson 1978, Dawes et al. 1995, Morris et al. 2000). While all of these species are most successful in salinities greater than 20 psu, shoal grass can tolerate a wide range of salinity and salinity variations. However, manatee grass is not as tolerant of low salinities or widely varying salinities (Irlandi 2006).

The SAV distribution has been mapped in the outer St. Lucie Estuary and the Southern Indian River Lagoon every two to three years since 1986, including annual mapping from 2005 through 2007 to help assess hurricane effects. In 2007, very sparse (< 10% cover in most areas) SAV was present in the lower and middle estuary (RECOVER 2009). Three seagrass species occurred within the estuary: shoal grass, Johnson's seagrass, and paddle grass. The majority of the SAV occurred in small isolated patches. The dominant SAV species in 2007 was Johnson's seagrass. It also extended farther upstream than any other SAV species (RECOVER 2009).

This region was impacted by hurricanes and associated freshwater discharges in 2004 and 2005. Following the hurricanes, observed effects to southern Indian River Lagoon SAV communities included large coverage and density declines and smaller direct effects due to burial by shifting bottom sediments. Lush manatee grass beds were documented through 2004, however, low salinities and associated poor water quality following the 2004 and 2005 hurricanes greatly impacted manatee grass in the area. The hurricanes also altered bathymetry on the east and west edges of the estuary, covering seagrasses. The steepest decline in percent occurrence of manatee grass occurred in 2005 after Hurricane Wilma. Johnson's seagrass followed by shoal grass colonized the former manatee grass habitat and recruited throughout the site. The Corps does not currently have information regarding Johnson's seagrass in relation to the hurricanes from 2016 and 2017. However, shoal grass is capable of recovering from disturbance in one year, but is still vulnerable to high water discharges contributed from Lake Okeechobee, C-43 basin, and the tidal basin (RECOVER, 2014).

4.2 FEDERALLY LISTED SPECIES

A list of federally or state listed species that could be present in Okeechobee, Highlands, Charlotte, Glades, Martin, and St. Lucie counties was coordinated with the USFWS and is presented in **Table 4-3**. Many of these species have been previously affected by habitat effects resulting from wetland drainage, alternation of hydroperiod, wildfire, and water quality degradation. Effects determinations as a result of implementation of LOWRP are listed in Table 4-3.

Table 4-3. List of threatened and endangered species known to occur in Okeechobee, Highlands, Charlotte, Glades, Martin, and St. Lucie counties. NE: No Effect; MANLAA: May Affect Not Likely to Adversely Affect; S: Species of Special Concern.

Scientific Name	Common Name	Federal Status	State Status	Effect Determination
Reptiles				
Drymarchon couperi	Eastern indigo snake	Threatened	Threatened	May Affect
Eumeces egregius lividus	Bluetail mole skink	Threatened	Threatened	NE
Neoseps reynoldsi	Sand skink	Threatened	Threatened	NE
Birds				
Ammodramus savannarum floridanus	Florida grasshopper sparrow	Endangered	Endangered	MANLAA
Aphelocoma coerulescens	Florida scrub jay	Threatened	Threatened	NE
Grus Americana	Whooping crane	Endangered	S	NE
Mycteria americana	Wood stork	Endangered	Endangered	MANLAA
Picoides borealis	Red-cockaded woodpecker	Endangered	S	NE
Polyborus plancus audubonii	Northern crested caracara	Threatened	Not listed	May Affect
Rostrhamus sociabilis plumbeus	Snail kite	Endangered	Endangered	MANLAA
Mammals				
Eumops floridanus	Florida bonneted bat	Endangered	Threatened	May Affect
Puma concolor coryi	Florida panther	Endangered	Endangered	MANLAA
Trichechus manatus	Manatee	Endangered	Endangered	MANLAA
Plants and Lichens				
Asimina tetramera	Four-petal pawpaw	Endangered	Endangered	NE
Cladonia perforata	Perforate reindeer lichen	Endangered	Endangered	NE
Cucurbita okeechobeensis	Okeechobee gourd	Endangered	Endangered	MANLAA
Dicerandra immaculate	Lakela's mint	Endangered	Endangered	NE
Halophila johnsonii	Johnson's seagrass	Threatened	Threatened	NE
Jacquemontia reclinata	Beach jacquemontia	Endangered	Endangered	NE
Liatrus ohlingerae	Scrub blazing star	Endangered	Endangered	NE
Paronchia chartacea	Papery whitlow-wort	Threatened	Endangered	NE
Polygala lewtonii	Lewton's polygala	Endangered	Endangered	NE
Polygala smallii	Tiny polygala	Endangered	Endangered	NE
Warea carteri	Carter's mustard	Endangered	Endangered	NE
Critical Habitat				
Rostrahamus sociabilis plumbeus	Everglade snail kite	Endangered	Endangered	MANLAA
Trichechus manatus	West Indian Manatee	Endangered	Endangered	MANLAA

4.2.1 DESIGNATED CRITICAL HABITAT

In addition to threatened and endangered species, the project area also includes or is adjacent to designated critical habitat for Florida manatee and Everglade snail kite. Maps of critical habitat locations for these species are depicted within the species effect determination sections of this BA as appropriate.

5 EFFECTS DETERMINATIONS

Species were evaluated based on a comparison between the existing conditions, which includes the Lake Okeechobee Regulation Schedule (LORS) 2008 as the operating schedule for the watershed and the TSP.

5.1 DESCRIPTION OF CHANGES IN LAKE OKEECHOBEE STAGES AS A RESULT OF THE TSP

Table 5-1 shows the differences in time the existing conditions and TSP are within the preferred ecological depths for Lake Okeechobee stages. Beneficial effects to Lake Okeechobee's littoral vegetation are anticipated as a result of the TSP. The overall effect of the project is to stabilize water levels; maintaining lake stage within the ecologically preferred stage envelope (12.5 – 15.5 ft NGVD) more frequently than the existing conditions. The TSP accomplishes lake stages within the preferred envelope 3.6% of time more than the existing conditions.

The frequency of extreme low stages (<12.56 ft) was reduced from 3.9% to 2.0%, while the frequency of extreme high lake stages (>17.0 ft NGVD) slightly increased compared to ECB, from 0.2% to 1.4%. There may be some concern that reducing the frequency of lower lake stages while also slightly increasing the frequency of extreme high lake stages could have a compounding effect; affecting the ability of marsh and SAV communities to recover at lower elevations after extreme high lake stages occur. However, the overall occurrence of extreme high stages is still very low, at less than 2%; while the return frequency of low lake stages was still at least 4.6% higher than the Restoration Coordination and Verification (RECOVER) target. The Lake Stage Performance Measure for RECOVER suggested a duration of 2.5% for stages <11.0 ft NGVD (3 months per decade) (RECOVER 2007), and the TSP would have durations of 7.8%. While still considerably higher than the target, this allows for improvements from the ECB frequency of 11.2%. This suggests that return frequencies of low lake stage events should be sufficient to offset slight increases in extreme highs, especially given the reduced frequencies of moderately high lake stages (14.5 – 15.5 ft NGVD).

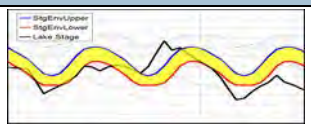
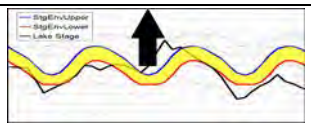
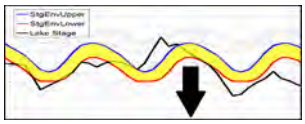
The overall effect of stabilizing lake stages should improve vegetation in the upper and lower marshes by reducing the intra- and inter-annual variation that leads to encroachment of woody vegetation and exotic species at high elevations and conversion of SAV beds to emergent marsh at low elevations. For example, following drying events in the upper marsh, exotic species like torpedograss (*Panicum repens*) can displace spikerush (*Eleocharis* spp.) prairies; a valuable, critical habitat for the endangered snail kite. These invasions can persist indefinitiely and require expensive chemical and/or physical treatments to restore (Smith et al 2009). Woody species like wax myrtle (*Myrica cerifera*) and willow (*Salix caroliniana*) can invade spikerush prairies, sawgrass (*Cladium jamaicense*), and broadleaf marsh habitats during low water, eventually shading out and displacing marsh with forested wetlands. Extreme low lake stages allow large-scale displacement of SAV communities with invasive emergent species like cattail (*Typha* spp.); such an event occurred in southern portions of the Lake following the 2007-2008 drought and subsequent record low water levels.

High lake stages have similar negative effects; greater transport of nutrients into interior marshes converts large areas of diverse habitat into monotypic stands of dense cattail; increased mixing of turbid pelagic water with clearer nearshore water decreases light levels at lower elevations, reducing SAV and emergent

marsh coverage; all ultimately reducing the quantity and quality of littoral habitat (Havens 2002, Havens et al. 2005).

Because the TSP would increase the frequency of moderate lake stages (time inside the preferrred ecological envelope), the effects described above should be less frequent or at short enough durations to be offset by the benefits of more stablized water levels overall.

Table 5-1. Lake Okeechobee Stage Levels Compared to the Existing Conditions

Lake Okeechobee Stage Levels		Existing Conditions	ALT 1BW
% Time Inside Ecologically Preferred Stage Envelope		28.3%	31.9%
%Time Above Stage Envelope		27.2%	28.4%
%Time Below Stage Envelope		44.5%	39.7%
% Time Below Navigational Min. Stage	% TIME < 12.5 ft.	33.1%	26.9%
Extreme High Stage	% TIME > 17 ft.	0.2%	1.4%
Extreme Low Stage	% TIME < 10 ft.	3.9%	2.0%
RECOVER Low Stage Target (2.5% Time < 11 ft)	% TIME < 11 ft.	11.2%	7.8%

5.2 DESCRIPTION OF CHANGES IN THE NORTHERN ESTUARIES AS A RESULT OF THE TSP

Caloosahatchee Estuary

A mean monthly inflow of at least 450 cfs is needed from Structure (S)-79 to ensure that the average monthly salinity at Ft. Myers (Yacht Basin) is < 10 psu (target maximum salinity for tape grass). An important upper estuarine feature is the freshwater-brackish submerged grass, *Vallisneria americana* (tape grass), which when present is located near the shoreline in the upper estuary to a depth of about 1.0 m. Its greatest coverage occurs from Beautiful Island to just past the Ft. Myers bridges (Hoffacker et al. 1994, Chamberlain and Doering 1998b). During times of extended low inflow conditions, when salinity is too high, this grass becomes very sparse and can disappear completely (Chamberlain et al. 1995, Doering et al. 2002, SFWMD 2000). For high flow events, the TSP (Alt 1BW) performed better than the ECB, having fewer months where flows were greater than 2800 cfs (**Table 5-2**). The model output shows that of the number of months flow > 2800 cfs from the C-43 Basin and Lake Okeechobee regulatory releases, 47 of those months are a results of basin runoff. Flows greater than 2800 cfs from direct Lake Okeechobee releases go from 47 (ECB) to 16 in the TSP (**Table 5-2**). For extreme high flow events (mean

monthly flow > 4500 cfs), the TSP reduced the number of months by 18 months. The TSP would provide beneficial effects in the reduction of high flows into the Caloosahatchee Estuary which are beneficial to the SAV in the estuaries.

Table 5-2. Flow results for the Caloosahatchee estuary

Caloosahatchee	ECB	TSP (Alt 1BW)
Number of months flow < 450 cfs	116	24
Mean Monthly Flow > 4500 cfs	43	25
Number of months flow > 2800 cfs from Lake O releases	47	16
Average Annual Flow (acre-ft)	416,071	159,430

St. Lucie Estuary

For the St. Lucie Estuary, the TSP would result in a reduction of 12 months where the low flow criteria is not met (**Table 5-3**). For high flow events, the TSP also results in fewer times where the 14-day moving average flow was greater than 2000 cfs from Lake Okeechobee regulatory releases. For extreme high flow events (mean monthly flow > 3000 cfs), the TSP that had 22 months where the mean monthly flow was greater than 3000 cfs, which is reduced from ECB by 20 months. The TSP captures 66,946 more acre-feet from being lost to the Atlantic Ocean in the St. Lucie on average annually as compared to the ECB. The TSP provides significant beneficial effects for the reduction of high flow events which are beneficial for the SAV in the estuaries.

Table 5-3. Flow results for the St. Lucie estuary

St. Lucie	ECB	TSP (Alt 1BW)
Number of months flow < 350 cfs	95	83
Number of times flow > 2000 cfs from Lake O releases	71	20
Average Annual Flow (acre-ft)	165,000	98,054
Extreme high flow, mean monthly > 3000 cfs	42	22

5.3 "MAY AFFECT" DETERMINATIONS

The Corps recognizes that until completion of CERP there are few opportunities within the current constraints of the Central and South Florida (C&SF) system to completely avoid effects to listed species. However, the proposed project would improve the quantity and timing of flows to the Northern Estuaries as well as improve the duration in which Lake Okeechobee stages are maintained within the preferred range of 12.5 to 15.5 feet. The Corps has determined that the TSP may affect federally listed species occurring within the project area including Eastern indigo snake, Florida grasshopper sparrow, wood stork, Northern crested caracara, Everglade snail kite and its critical habitat, Florida bonneted bat, Florida panther, and Florida manatee and its critical habitat. All standard protection measures for species would be followed during and post construction.

5.3.1 Okeechobee Gourd

The Okeechobee gourd is an annual or perennial, fibrous rooted, high-climbing vine with tendrils. The Okeechobee gourd possesses heart to kidney-shaped leaf blades, with 5 to 7 angular, shallow lobes, and irregularly serrated margins. Young leaves are covered with soft hairs. The cream-colored flowers are bell-shaped. The light green gourd is globular or slightly oblong, with 10 indistinct stripes, and hard shelled with bitter flesh. The seeds are gray-green and flat (USFWS 1999). The Okeechobee gourd was historically found on the southern shore of Lake Okeechobee, in Palm Beach County, and formerly in the Everglades (USFWS

1999). In recent surveys, the species has been found to be restricted to sites along the middle St. Johns River in Volusia County and around Lake Okeechobee in Glades and Palm Beach counties (USFWS 2009). It has been recently documented along the southeastern shore of Lake Okeechobee, including Torry Island, Ritta Island, Kreamer Island, and the southern shore of the Lake Okeechobee Rim Canal (USFWS 2009). The documented population of the Okeechobee gourd around the southeastern shore of Lake Okeechobee is strongly associated with Torry muck, a soil formed in the extensive pond apple forests that once surrounded the lake. However, successful growth and reproduction of the gourd under cultivation suggests that the species can grow in a wider range of soils (USFWS 1999).

Around Lake Okeechobee, the gourd relies on pond apple trees to support its vines above rising water levels during the wet season. Other trees and shrubs, such as willow (*Salix caroliniana*) and cypress (*Taxodium distichum*), may also provide suitable support for the vines. Along the St. Johns River, Okeechobee gourds are most typically found growing on elderberry and common reed (*Phragmites* spp.). The Okeechobee gourd also seems to readily germinate on alligator nests around Lake Okeechobee, which provide suitably elevated soil berms in full sun, with no competition from other plants. These disturbed sites provide areas where competition is reduced and elevated areas that promote the growth of elderberry, button bush, and other erect bushes and shrubs (USFWS 1999).

The decline of the plant is largely attributable to conversion of swamp forests to agriculture and water level management in Lake Okeechobee. For the gourd to maintain viable healthy populations, fluctuations in lake level are necessary. High lake levels facilitate dispersal and inundate and destroy aggressive weeds in local habitats. As lake levels decrease, the cleared open habitats allow the quickly germinating Okeechobee gourd seeds to sprout and begin climbing before they have to compete with other pioneer species. Water regulation practices can greatly influence the timing and duration of flooding and drying cycles across remnant areas of suitable elevation and soils around Lake Okeechobee. Permanent inundation of suitable soils is detrimental to the plant. Another potential threat to this plant is the proliferation of exotic plant species around the edges of Lake Okeechobee (USFWS 1999).

5.3.1.1 Okeechobee gourd "May Affect" Determination

Due to the changes in Lake Okeechobee stages and the increased amount of time that water levels are within the beneficial stage envelopes, the Corps has determined that there may be slight beneficial effects to the Okeechobee gourd.

5.3.2 Northern Crested Caracara (Caracara)

The threatened caracara is a unique raptor scavenger in the family Falconidae that reaches the northern limit of its geographic range in the southern U.S. In Florida, this raptor occurs as an isolated population in the south-central region of the state. Changes in land use patterns throughout central Florida have resulted in this population becoming a subject of concern. This raptor has been documented to occur almost exclusively in cabbage palms on privately owned cattle ranches in the south-central part of the state.

Currently, much of the caracara population is found on improved or semi-improved pastures on private cattle ranches. Available evidence suggests that the most serious threat to Florida's caracara population is loss or degradation of nesting and feeding habitat. Such loss is most commonly due to conversion of pasture and other grassland habitats and wetlands to citrus, sugar cane, other agriculture, and urban development.

Adult caracaras exhibit high site- and mate-fidelity; therefore, extensive loss of habitat within the home range, particularly of the nesting site itself, may cause the pair to abandon that home range, or at least the nesting site (Morrison 2001). Egg laying has been documented as early as September and as late as

June; peak activity occurs from late December through February (Morrison 2001). Clutch size is 2-3 eggs, with an incubation period of 32-33 days. Double brooding can occur if a nest is lost early in the season. Fledging occurs at 8 weeks. Young are dependent on parents for at least 2 months post-fledging, and may remain in the natal territory for up to 10 months. Most young in Florida leave natal territory after 4-6 months and form groups of up to 30 individuals.

The caracara is an opportunistic feeder, taking prey items such as insects, small reptiles and amphibians, and small mammals. Eggs and carrion are also included in the diet of caracaras. Foraging for food takes place in early morning and late afternoon. Caracaras often walk through pastures searching for prey items, particularly after disturbance such as mowing or plowing. Caracaras have also been observed feeding in recently burned areas. Hunting takes place from conspicuous perches or while in flight. Once prey is sighted, the caracara flies to the ground and walks up to prey item (Morrison 1996, Morrison 2001). The caracara is known to occur in the project area and Fisheating Creek (USFWS produced map 2018). Caracara nests and gathering areas around Lake Okeechobee are shown in **Figure 5-1**. The TSP's wetland attenuation feature is outlined in black and the wetland restoration features are outlined in green.

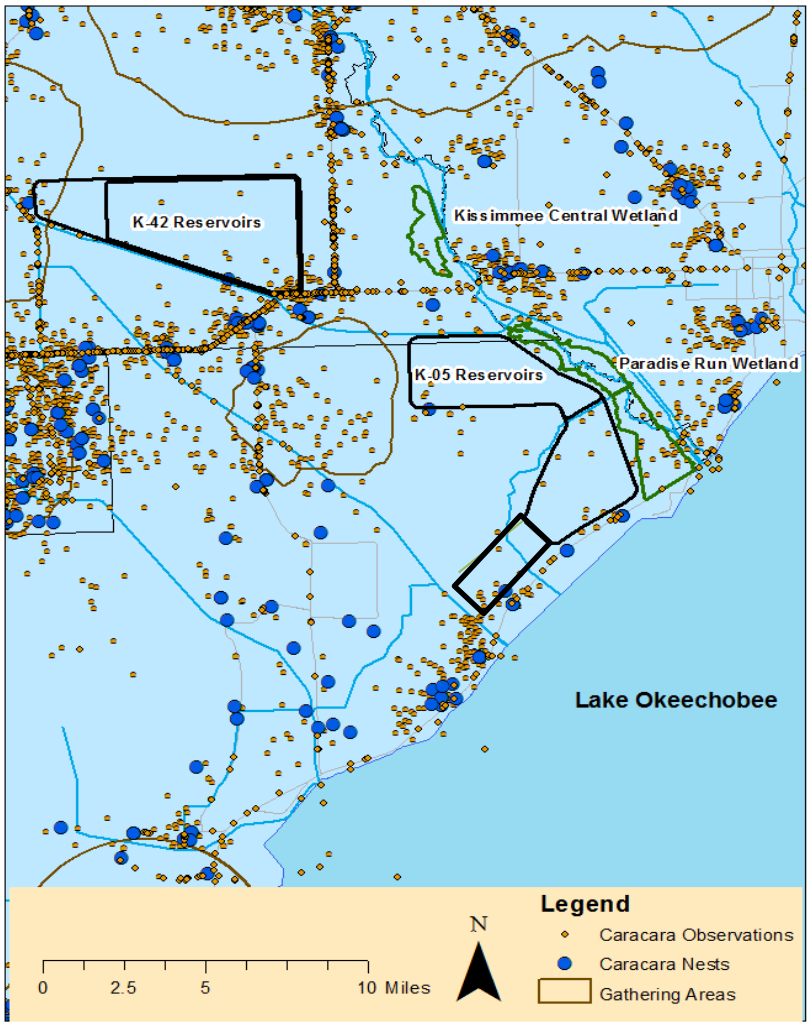


Figure 5-1. Caracara nests, gathering areas, and observations (1994-2017, including eBird database observations from January 2010 to May 2017 around Lake Okeechobee). Source: USFWS 2018

5.3.2.1 Caracara "May Affect" Determination

There are known caracara gathering areas and foraging habitat within the footprint of the TSP. **Figure 5-1** shows the caracara nest locations that have been reported and other caracara observations in the USFWS's database. Due to the relatively small footprint of each cluster of ASRs, it is unlikely that there would be substantial adverse effects to caracara due to ASR construction and operation. A follow-up assessment will be needed once specific ASR sites are selected. The wetland attenuation feature would remove approximately 11,000 acres of improved pastureland, and the wetland restoration features would remove approximately 2,100 acres (**Table 4-1** and **Table 4-2**), for a total of 13,000 acres of prime habitat for caracara. The wetland attenuation feature is expected to be operated between one and four feet, thereby resulting in shallow wetland operations, which may increase the potential prey-base for caracara. For the wetland restoration features, pasture conversion to wetlands greater than 4 feet may displace caracaras, but conversion to short-hydroperiod wetlands may not. Project features would likely need surveys to identify caracara nests and better define the magnitude of adverse and in contrast, potentially beneficial effects. The TSP removal of upland habitat may affect, caracara.

5.3.3 Florida Grasshopper Sparrow

The Florida grasshopper sparrow (*Ammodramus savannarum floridanus*) is a subspecies of grasshopper sparrow that is endemic to the dry prairie of central and southern Florida. This subspecies is extremely habitat specific and relies on fire every two to three years to maintain its habitat. The endangered Florida grasshopper sparrow is restricted to the dry prairie ecosystem of central and south Florida. One of four subspecies of grasshopper sparrows in North America, the Florida grasshopper sparrow does not migrate, living here year round. Florida Grasshopper Sparrows are named for one of their calls, a quiet buzz that sounds much like a grasshopper. Male sparrows sing only a few months of the year during the nesting season, for a few hours each day. Intricately patterned in brown, white, and black, the birds are well camouflaged with the remote grasslands in Florida's interior where they live, making them difficult to locate. Their quiet, cryptic, and remote nature have contributed to their anonymous personality. The Florida Grasshopper Sparrow nests in spring (April-July) on the ground, under palmettos or in grass lumps. The female lays 3-5 eggs, and young fledge within 9 to 10 days. The male sings from a low perch to defend territory—about the only time they are readily visible--and helps raise the young. Diet includes seeds and invertebrates. It is thought that most individuals live their entire lives within a few miles of their place of birth.

The sparrow is so highly endangered due in large part to its exclusive dependence upon Florida dry prairie habitat, of which more than 85% has been destroyed. Most prairie loss has resulted from conversion to domestic pasture grasses, which support more cattle per acre and can support some species of prairie wildlife, but not Florida grasshopper sparrows. This "improved pasture" lacks the structure that these birds need. Research indicates the sparrows need native prairie in prime condition—it should burn every two years, ideally at the end of the dry season (April-June), and as a result have virtually no brush or trees.

Despite much understanding of their habitat requirements, sparrow populations have declined on all three conservation lands where they remain, with 2016 reporting the lowest counts in history. Unfortunately, reasons for the decline are unknown but suspects include suboptimal habitat management, fire ants and other predators destroying nests, diseases, and genetic problems.

The Avon Park Bombing Range sub-population dropped from about 130 singing males in 1999 to only 10 in 2004. In recent years only a few singing males and handful of successful nests have been detected. In a similar fashion, the counts of singing males at Kissimmee Prairie Preserve State Park declined from 150 a decade ago to only a few found on the entire 50,000-acre property. And at Three Lakes Wildlife

Management Area where as many as 140 singing males have been counted, recent counts have been fairly stable at about 60 singing males, but still seem to be sliding downward. The populations at Three Lakes Wildlife Management Area and Kissimmee Prairie Preserve State Park now have fewer birds than were recorded at Avon Park prior to its rapid population rash. At these population levels, genetic problems become a major concern.

Florida grasshopper sparrow habitat consists of large (greater than 50 ha), treeless, relatively poorly-drained grasslands that have a history of frequent fires (FWS 1988, Delany 1996). There is potential Florida grasshopper sparrow habitat within Glades, Highlands, and Okeechobee counties in the project area (**Figure 5-2.)**

Figure 5-2. Draft Florida Grasshopper Sparrow potential Habitat (USFWS 2017).

The Florida grasshopper sparrow occurs in prairies dominated by saw palmetto (*Serenoa repens*) and dwarf oaks (*Quercus minima*) ranging from 30 to 70 cm in height. Bluestem grasses (*Andropogon* spp.), St. John's wort (*Hypericum* spp.), and wiregrasses (*Aristida* spp.) are also components of grasshopper sparrow habitat (Delany et al. 1985, FWS 1988). These dry prairies are relatively flat and are moderately to poorly drained. The soils typically consist of 0.3 to 1.0 m of acidic, nutrient-poor quartz sands overlying a high clay subsoil or organic hardpan (spodic horizon) (FNAI and FDNR 1990, Abrahamson and Hartnett 1990). Both the heavy subsoil and hardpan reduce the movement of water below and above their surfaces (FNAI and FDNR 1990). Thus, dry prairies may become flooded for short periods during the rainy season,

but remain dry for the remainder of the year. The water table in these prairies is normally found between several centimeters and a meter below the soil surface.

The main difference between dry prairies and pine flatwoods is that pines and palms are absent or at a density below one tree per acre. Grasshopper sparrows, however, cannot tolerate tree densities as high as one tree per acre. Some dry prairies may be artifacts of clearcutting, unnaturally frequent burning, livestock grazing, and alteration of hydrology (Abrahamson and Hartnett 1990). Prairie habitat may also have disappeared due to infrequent burn regimes from fireprevention, and from planting of slash pine.

When compared with habitat of other grasshopper sparrows, habitat used by *A.S. floridanus and A.S. pratensis* is characterized by a larger percentage of shrub and bare ground, a smaller percentage of tall vegetation, and less litter (Delany et al. 1985). Because the sparrows are ground-dwelling birds, they usually require at least 20 percent bare ground for unrestricted movement and foraging, but need enough vegetation to provide nesting cover (Whitmore 1979, Vickery 1996). Large areas of prairie habitat between 240-1,348 ha are needed to maintain populations of 50 breeding pairs (Delany et al.1995).

The range of the Florida grasshopper sparrow occurs within the area with the greatest number of thunderstorm-days in the continental United States (Chen and Gerber 1990), and the high frequency of lightning generated by these storms historically resulted in fire every few years on the dry prairie ecosystem (FNAI and FDNR 1990). As a result of these frequent fires, the density of trees and other tall vegetation is low and the percentage of bare ground higher.

Little is known about the Florida grasshopper sparrow's post-breeding activities and habitat preferences; however, ongoing radio telemetry research should yield valuable information on this aspect of the sparrow's life history and habitat associations. Florida grasshopper sparrows are also documented to be reproductively successful in pastures that are overgrown or ungrazed (Vickery et al., 1998). As pastures become heavily grazed, however, sparrow populations have been documented to decrease or disappear (Delany and Linda 1994). Critical habitat has not been designated for this species. Today, this species is the most endangered bird in North America and is represented by less than 100 individuals, with about half of the population in captive breeding.

5.3.3.1 Florida Grasshopper Sparrow "May Affect" Determination

There is no potential grasshopper sparrow habitat within the Paradise Run wetland restoration footprint or the wetland attenuation feature. However, for the Kissimmee River Center wetland restoration site, the entire footprint is located within potential habitat (**Figure 5-3**). Within the Kissimmee River Center wetland site, the majority of the acreage in FLUCCS classification includes improved pastures (796 acres), mixed wetland hardwoods/mixed shrubs (159 acres), and unimproved pastures (64 acres) (**Table 4-2**).

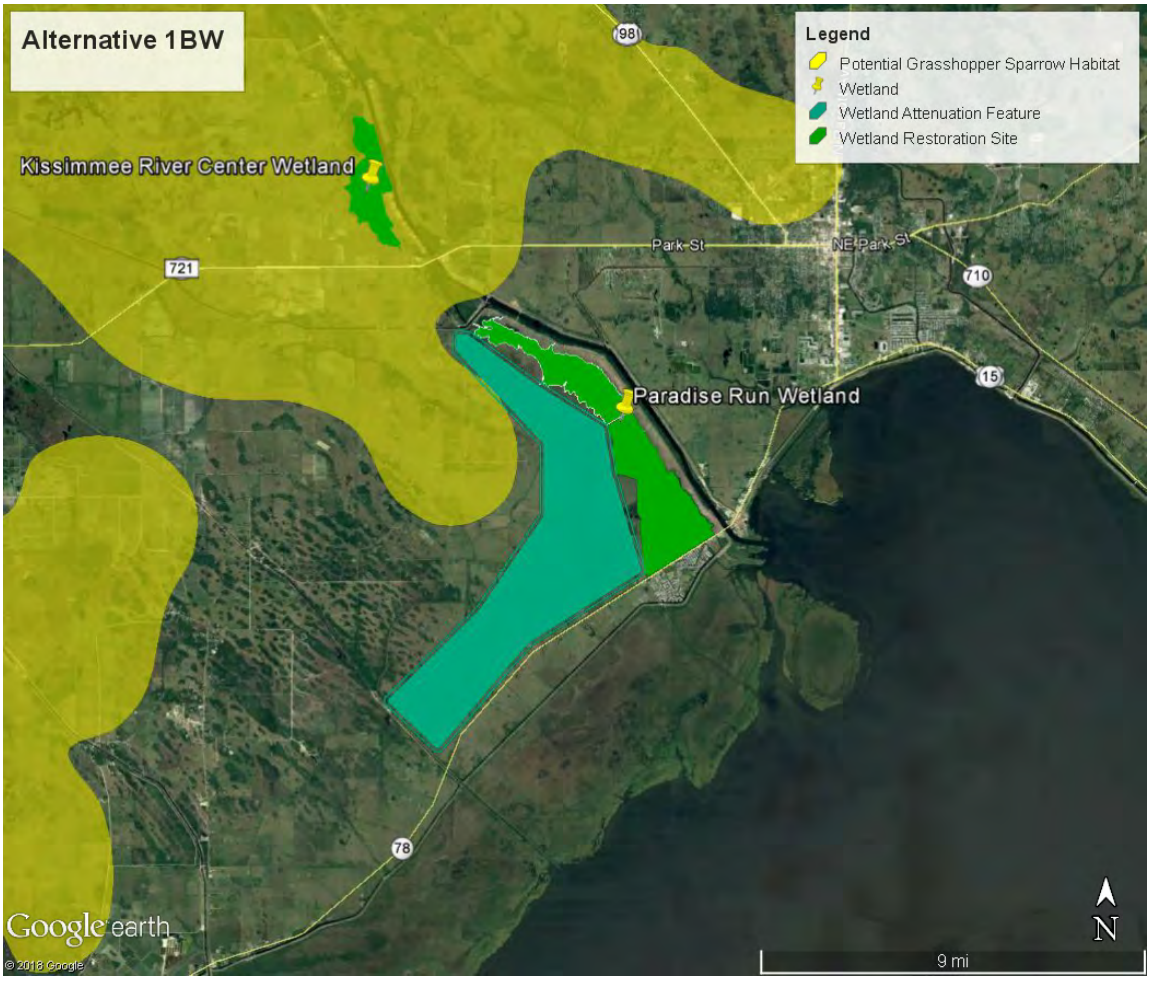


Figure 5-3. Potential grasshopper sparrow habitat within TSP.

Based upon the existing conditions of the wetland restoration sites and lack of suitable sparrow habitat in the wetland attenuation feature, the grasshopper sparrow is not likely to use the current area. Within the proposed footprints of the ASR wells, no potential grasshopper sparrow habitat is present. Construction and use of the ASRs are not expected to affect the grasshopper sparrow. Preconstruction surveys will be conducted prior to building all features to confirm there are no grasshopper sparrows present. If Florida grasshopper sparrow are encountered during the pre-construction surveys, the Corps will work closely with USFWS to identify options to eliminate or minimize any potential effects. The TSP may affect, but is not likely to adversely affect Florida grasshopper sparrow.

5.3.4 Eastern Indigo Snake

The threatened Eastern indigo snake is the largest native non-venomous snake in North America. It is an isolated subspecies occurring in southeastern Georgia and throughout peninsular Florida. The Eastern indigo snake prefers drier habitats, but may be found in a variety of habitats from xeric sandhills, to cabbage palm hammocks, to hydric hardwood hammocks (Schaefer and Junkin 1990). It has also been found in citrus groves and sugar cane. Eastern indigo snakes need relatively large areas of undeveloped land to maintain their population. In warm months, indigo snakes use a variety of natural areas and have large home ranges (Moler 1992; USFWS 1999). Eastern indigo snakes occupy larger home ranges in the summer than the winter. Information on snakes in Florida indicates adult males have home ranges as high as 224 ha in the summer (Moler 1992). Because it is such a wide-ranging species, the Eastern indigo snake

is especially vulnerable to habitat fragmentation that makes travel between suitable habitats difficult. The main reason for its decline is habitat loss due to development. Further, as habitats become fragmented by roads, Eastern indigo snakes become increasingly vulnerable to highway mortality as they travel through their large territories (Schaefer and Junkin 1990).

In south Florida, the Eastern indigo snake is thought to be widely distributed. Given their preference for upland habitats, Eastern indigo snakes are not commonly found in great numbers in wetland complexes, though they have been found in pinelands, tropical hardwood hammocks, and mangrove forests in extreme south Florida (Duellman and Schwartz 1958; Steiner *et al*. 1983). Within the range of the gopher tortoise, tortoise burrows are favorite refugia for indigo snakes. They are known to use burrows made by cotton rats and land crabs, hollows at bases of trees and stumps, ground litter, trash piles and rock piles lining banks of canals and pipes or culverts.

Sexual maturity appears to occur around 3-4 years of age. In North Florida, breeding occurs November to April with females laying 4-12 eggs in May-June (Moler 1992). Most hatching of eggs occurs August-September, with yearling activity peaking in April-May (USFWS 1999).

5.3.4.1 Eastern indigo snake "May Affect" Determination

The TSP includes wetland restoration sites that will convert some uplands to wetlands. The majority of the current land uses in the wetland restoration footprints are improved and unimproved pastures. **Table 5-4** shows the amount of uplands and pasture land that will be converted to wetlands, with a total of 13,913 acres. Eastern indigo snakes have a high probability of occurrence within all proposed wetland restoration footprints based on the acreage of the potential project component and the available potential snake habitat. The TSP is likely to have unavoidable adverse effects on Eastern indigo snakes due to removal of pasturelands and uplands. The Corps will utilize Standard Protection Measures for Eastern Indigo snakes throughout project design and construction in order to minimize any potential adverse effects to the extent practicable. The Corps has determined that the TSP may affect Eastern indigo snake.

Table 5-4. Acres of potential eastern indigo snake habitat within the TSP.

	1BW
Acres of uplands in storage feature footprint	442
Acres of pasture in storage feature footprint	11,199
Acres of pasture in wetland restoration footprint	2,146
Acres of non-pasture uplands in wetland restoration footprint	126
Total acres of uplands and pasture lands lost	**13,913**

5.3.5 Everglade Snail Kite

The Everglade snail kite is listed as an endangered species by both the USFWS and the State of Florida. Although previously located in freshwater marshes over a considerable area of peninsular Florida, the range of the snail kite is now limited to central and southern portions of Florida. Six large freshwater systems are located within the current range of the snail kite: Upper St. Johns marshes, Kissimmee Chain of Lakes (KCOL), Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin. Habitats that have supported snail kites include the East Orlando Wilderness Park, the Blue Cypress Water

Management Area, the St. Johns Reservoir, and the Cloud Lake, Strazzulla, and Indrio impoundments. In the KCOL, snail kites may occur within most of the lakes and adjacent wetlands, with the majority of snail kite nesting occurring within Lake Kissimmee, Lake Tohopekaliga, and East Lake Tohopekaliga, with lower nesting numbers on Lakes Hatchineha and Jackson. Snail kite nesting also has occurred periodically since about 2002 in Lake Istokpoga.

Lake Okeechobee and surrounding wetlands represent significant snail kite nesting and foraging habitats that have historically supported snail kites. Lake Okeechobee is of particular importance since it serves as a critical stopover point as snail kites traverse the network of wetlands within their range. A loss of suitable habitat and refugia, especially during droughts in the lake, may have significant demographic consequences. Lake Okeechobee is critical to the snail kite's long-term population persistence, especially given the susceptibility of juvenile snail kites in the Kissimmee River Valley to an increased frequency of local disturbance events due to cold weather and the treatment of hydrilla. The Everglades snail kite apple snail diet is dependent on the hydrology and water quality of the watersheds. Foraging habitat requires shallow open-area ponds with low marsh areas; nesting/roosting sites are located over water. Foraging conditions have expanded recently due to the increase in exotic apple snail population (since about 2010). As a result, the Everglade snail kite breeding season has lengthened (sometimes into fall) and some previous unsuitable foraging areas now have the more robust exotic apple snail and are being utilized by kites. Snail kites nest in both woody and herbaceous vegetation in the Lake Okeechobee littoral zone. Everglade snail kite nests around Lake Okeechobee from 2010 to 2015 are shown in Figure 5-4.

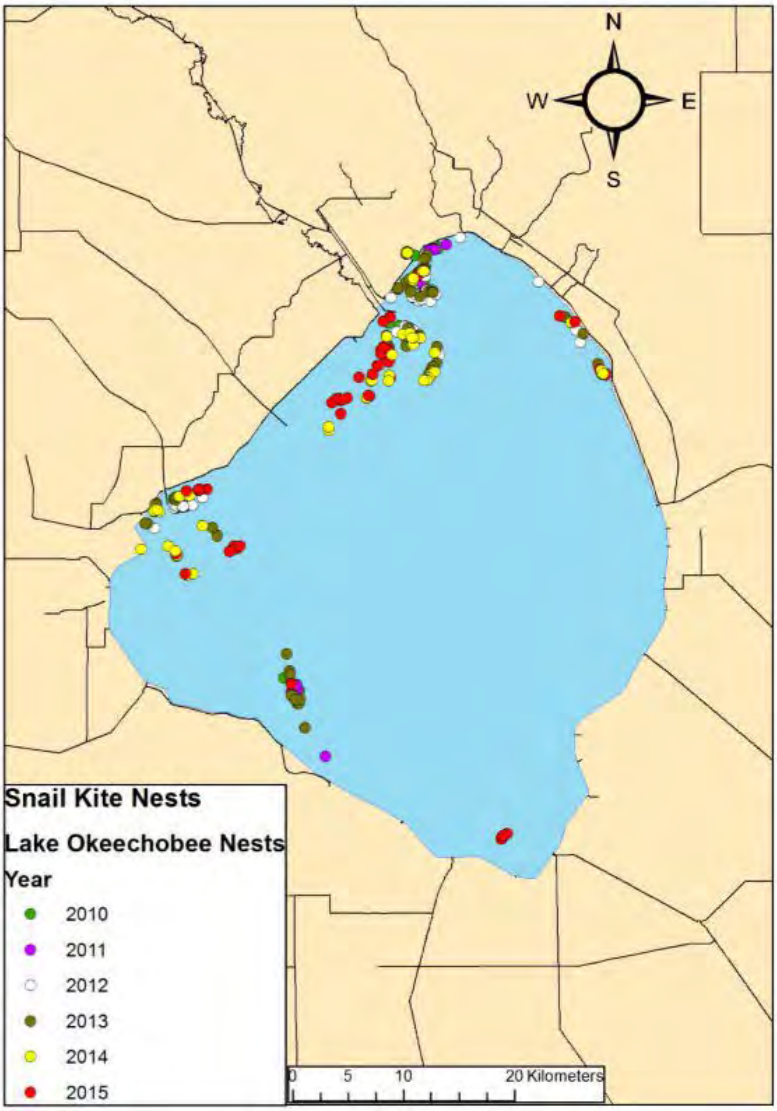


Figure 5-4. Everglade snail kite nest locations from 2010-2015 (*active nests only). Source: obtained from USFWS 2015.

5.3.5.1 Everglade Snail Kite "May Affect" Determination

The creation of storage features has the potential to benefit snail kites if the hydrology allows for creation and maintenance of apple snail populations or if nesting substrate is available. However, there is greater uncertainty that storage features will provide snail kite habitat compared to restored wetlands. The TSP would restore 5,279 acres of wetlands along the Kissimmee River floodplain and would significantly increase the spatial extent of suitable foraging opportunities for snail kites.

Water storage would likely improve the overall lake levels and moderate stage fluctuations, as modeled and discussed at the beginning of this section. This may increase suitable habitat for apple snails, thereby increasing spatial extent of suitable foraging opportunities for snail kites. Minor beneficial effects to vegetation (including vegetation used for snail kite nesting) within Lake Okeechobee's extensive littoral

zone are also anticipated. These ecological benefits are a result of the small increase in amount of time within the beneficial stage envelope and less time in the extremely low stages (<10 ft, NGVD) (**Table 5-1**).

Converse to providing beneficial effects due to a change in lake stages, the TSP modeling also shows a slight increase (1.2%) in the amount of time that the lake stages are within the extremely high range (over 17 feet NGVD). The high water levels could cause short-term minor adverse effects to the littoral zone and nearshore aquatic vegetation that need lower lake stages (between 12 and 15 feet, NGVD) to thrive. This may not result in a difference in vegetation from what is currently happening through natural conditions and current operations. However, if the high lake stages do occur more often, and the vegetation shifts to a different type of community, then this could impact the ability for apple snails to successfully nest, which would affect the foraging habitat for the snail kites.

The TSP includes increasing wetland acreage in the LOW by approximately 18,000 acres, and creating storage with ASR, which will help regulate water levels within the lake and south of the lake. The increase in wetland acreage would significantly increase the spatial extent of suitable foraging habitat and opportunities for snail kites. The change in lake stages does not appear to result in many occurrences of time the lake is above or below the optimal stage envelope for vegetation as compared to the current conditions. The effects of lake stages on snail kites are outlined and discussed in the LORS Biological Opinion, with actions to minimize any potential effects. This project would also follow those guidelines. Rapid recession rates during the dry (breeding) season and associated low water levels can allow nests to become accessible to land-based predators, resulting in decreased nest success (Beissinger 1986; Sykes 1987b). The potential for this effect is greater for snail kites nesting near land (i.e., in lakes or reservoirs) compared to those nesting in expansive marsh systems such as WCA-3A. While recession rates were not analyzed specific to LOWRP effects on Lake Okeechobee stage, LOWRP provides additional capability to moderate Lake Okeechobee stages particularly in the dry season, which may or may not reduce high recession rates (>0.16 ft. per week, Fletcher et al. 2017). The Corps has determined that the TSP may affect, but is not likely to adversely affect Everglade snail kite.

5.3.6 Everglade Snail Kite Critical Habitat

Everglade snail kite critical habitat was designated in 1977. Nine critical habitat units were identified: two small reservoirs, the littoral zone of Lake Okeechobee, and areas of the Everglades' marshes within the WCAs and ENP. Since this designation, the utilization of these units by snail kites as productive nesting areas has varied significantly. In 2012, the KCOL, Lake Tohopekaliga in particular, supported the greatest number of snail kites in Florida. This shift in productive nesting areas was in response to regional droughts as well as habitat degradation in historic breeding locations. While the KCOL is now considered an important habitat for the snail kite, this was not the case when critical habitat was designated in 1977, and the KCOL was not included in the original designation. And while the St John's Reservoir critical habitat in Indian River County does not seem to be used, across the street (SR 60), the St. John's Marsh (not critical habitat) was used in most years (from 1996 to 2016) by nesting snail kites.

Designated critical habitat within the study area includes western portions of Lake Okeechobee. Based on the description in the Federal Register (1977), snail kite critical habitat in Lake Okeechobee is located in the western parts of Glades and Hendry Counties, extending along the western shore to the east of the dike system and the undiked high ground at Fisheating Creek, and from the Hurricane Gate at Clewiston northward to the mouth of the Kissimmee River, including all the spike rush flats of Moonshine Bay, Monkey Box, and Observation Shoal, but excluding the open water north and west of the northern tip of Observation Shoal north of Monkey Box and east of Fisheating Bay (**Figure 5-5**).

Figure 5-5. Snail Kite Critical Habitat located in Lake Okeechobee.

5.3.6.1 Everglade Snail Kite Critical Habitat "May Affect" Determination

The project benefits described above for vegetation within the Lake Okeechobee littoral zone are mostly within the designated snail kite critical habitat. Therefore, snail kite critical habitat in Lake Okeechobee should benefit by implementation of the project, particularly by reducing the frequency of extreme low

lake stages. Due to these anticipated beneficial effects on Lake Okeechobee's littoral vegetation, the Corps has determined that implementation of the TSP may affect, but will not likely adversely affect, Everglade snail kite critical habitat.

5.3.7 West Indian (Florida) Manatee

The West Indian manatee is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers, and springs of Florida. The West Indian (Florida) manatee, *Trichechus manatus*, was listed as endangered throughout its range for both the Florida and Antillean subspecies (*T. manatus latirostris* and *T. manatus manatus*) in 1967 (32 FR 4061) and received Federal protection with the passage of the Endangered Species Act (ESA) in 1973. Because the manatee was designated as an endangered species prior to enactment of ESA, there was no formal listing package identifying threats to the species, as required by section 4(a)(1) of the Act.

Florida manatees can be found throughout the southeastern United States; however, within this region, they are at the northern limit of their range (Lefebvre et al. 2000). Because they are a subtropical species with little tolerance for cold, they remain near warm water sites in peninsular Florida during the winter. During periods of intense cold, Florida manatees will remain at these sites and will tend to congregate in warm springs and outfall canals associated with electric generation facilities (Florida Power and Light 1989). During warm interludes, Florida manatees move throughout the coastal waters, estuaries, bays, and rivers of both coasts of Florida and are usually found in small groups. During warmer months, Florida manatees may disperse great distances. Florida manatees have been sighted as far north as Massachusetts and as far west as Texas and in all states in between (Rathbun et al. 1983; Fertl et al. 2005). Warm weather sightings are most common in Florida and coastal Georgia. They will once again return to warmer waters when the water temperature is too cold (Hartman 1979; Stith et al. 2006). Florida manatees live in freshwater, brackish, and marine habitats, and can move freely between salinity extremes. It can be found in both clear and muddy water. Water depths of at least three to seven feet (one to two meters) are preferred and flats and shallows are avoided unless adjacent to deeper water.

Over the past centuries, the principal sources of Florida manatee mortality have been opportunistic hunting by man and deaths associated with unusually cold winters. As of 2016, the FWC reported 520 Florida manatee deaths that year, which is more than the total number of deaths in reported 2009 (429 deaths), related to the prolonged cold water conditions in the winter of 2009-2010. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. The largest single mortality factor is collision with boats and barges. Florida manatees also are killed in flood gates and canal locks, by entanglement or ingestion of fishing gear, and through loss of habitat and pollution. The manatee is known to inhabit Lake Okeechobee (USFWS, 2001) and at times, the lower Kissimmee River (C-38 Canal), C-43, and C-44 canals. In March of 2017, the manatee was reclassified as threatened due to habitat improvements and population expansion; however, the existing federal protections remain in place.

5.3.7.1 West Indian (Florida) Manatee "May Affect" Determination

The TSP would improve the overall manatee foraging habitat within Lake Okeechobee, local canals, and the northern estuaries; the latter includes designated manatee critical habitat. Within Lake Okeechobee, modeling shows a minor beneficial effect to vegetation within Lake Okeechobee's extensive littoral zone that will improve the foraging habitat in Lake Okeechobee for manatees. The modeling shows performance improvements within the Northern Estuaries as indicated by fewer high volume flow

months, providing a beneficial effect to SAV as discussed in Section 5.2 and Table 5-2Table 5-3. Reduction in high flows and accompanying flow velocities would result in lower suspended solid loading and decreased concentration of colored dissolved organic matter, thereby allowing greater light penetration to promote growth of SAV. In addition, reduction in high volume discharge events from Lake Okeechobee would reduce extreme salinity fluctuations associated with such events. Although some SAV are tolerant of a wide range of salinity levels, a reduction in high volume discharge events would reduce stress to SAV and promote increases in seagrass shoots and have the potential to increase foraging opportunities for manatees in this region and provide a minor beneficial effect.

Florida manatees also depend upon canals as transit from one habitat to another, a source of freshwater, and resting sites. Standard manatee protection guidelines will be used during construction along canals/rivers accessible to manatees to avoid effects. It is highly likely that Florida manatees also depend on the deep canals as a cold-weather refuge. The relatively deep waters of the canals respond more slowly to temperature fluctuations at the air/water interface than the shallow bay waters. Thus, the canal waters remain warmer than open bay waters during the passage of winter cold fronts. **Figure 5-6** illustrates the canals that Florida manatees have access to, some of which are within the LOWRP action area.

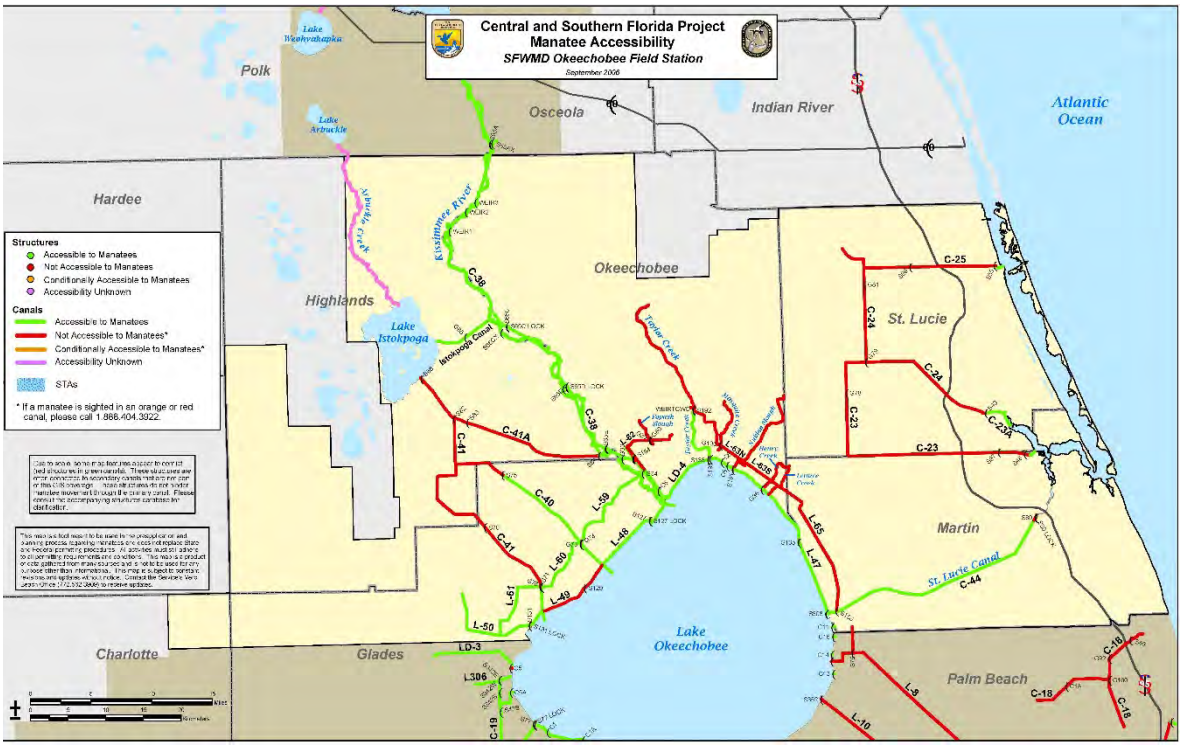


Figure 5-6. Manatee accessibility to and use of canals within LOWRP action area.

The ASRs are not likely to negatively affect manatee with releasing warmer waters (USACE and SFWMD 2015). The typical duration of water releases from ASR wells would likely not be enough water to provide prolonged warm water habitat, as the water is likely to dissipate into the canals without changing the thermal temperature significantly. ASRs that discharge to waters inhabited by manatees will need to maintain the thermal profile in the receiving stream if manatees are present. This will preclude entrapment of manatees in temporary warm water ASR plumes (expected to be 75 °F) when ambient water temperatures are below 60 °F. This concern could be remediated by having alternative ASR

discharge points to areas not inhabited by manatees. With careful planning on timing of releases and placement of ASRs, the Corps has determined that the TSP may affect, but is not likely to adversely affect Florida manatee.

5.3.8 Florida Manatee Designated Critical Habitat

Critical habitat for the Florida manatee was designated in 1976 [50 Code of Federal Regulations [CFR] §17.95(a)]. Critical habitat for the West Indian manatee is shown in **Figure 5-7**.

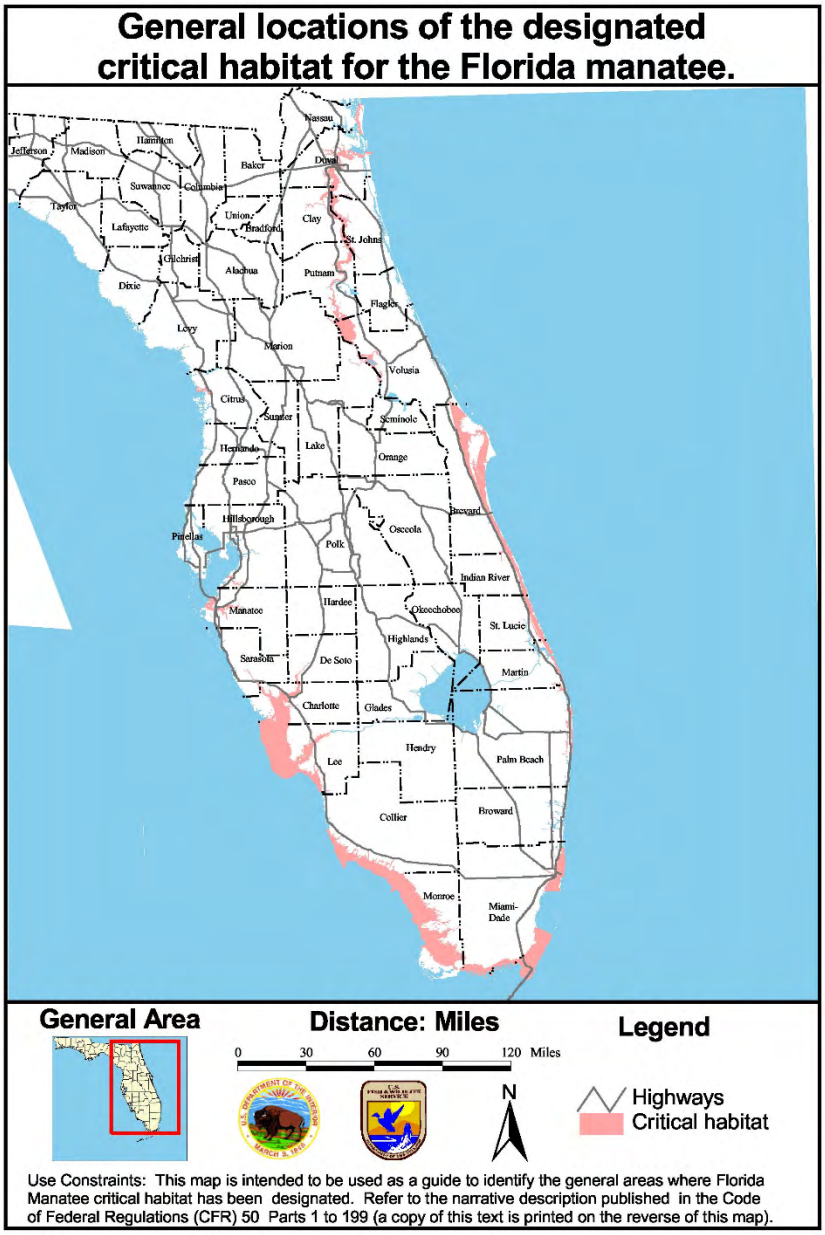


Figure 5-7. Designated critical habitat for the West Indian Manatee.

No specific primary or secondary constituent elements were included in the critical habitat designation. However, experts agree essential habitat features for the manatee include SAV or seagrasses for foraging,

shallow areas for resting and calving, channels for travel and migration, warm-water refuges during cold weather, and fresh water for drinking (Service 2001). Designated critical habitat includes the Caloosahatchee River downstream from the Florida State Highway 31 bridge, Lee County; all U.S. territorial waters adjoining the coast and islands of Lee County; all U.S. territorial waters adjoining the coast and islands and all connected bays, estuaries , and rivers from Gordon's Pass, near Naples, Collier County, southward to and including Whitewater Bay, Martin and West Palm Beach Counties; that section of the intracoastal waterway from the town of Seawalls Point, Martin County to Jupiter Inlet, Palm Beach County; the entire inland section of water known as the Indian River, from its northernmost point immediately south of the intersection of U.S. Highway 1 and Florida State Highway 3, Volusia County, southward to its southernmost point near the town of Sewalls Point, Martin County.

5.3.8.1 West Indian Manatee Designated Critical Habitat "May Affect" Determination

The TSP is not likely to adversely affect the overall manatee foraging habitat within the designated manatee critical habitat. The TSP modeling shows a slight performance improvement within the Northern Estuaries as indicated by fewer high volume flow months, which provides a minor beneficial effect to SAV, as discussed in **Section 5.2**. Reduction in high flows and accompanying flow velocities would result in lower suspended solid loading and decreased concentration of colored dissolved organic matter, thereby allowing greater light penetration to promote growth of SAV. In addition, reduction in high volume discharge events from Lake Okeechobee would reduce extreme salinity fluctuations associated with such events. Although some SAV are tolerant of a wide range of salinity levels, a reduction in high volume discharge events would reduce stress to SAV and promote increases in seagrass shoots and have the potential to increase foraging opportunities for manatees in this region and provide a minor beneficial effect. Therefore, the TSP may affect, but is not likely to adversely affect, Florida manatee designated critical habitat.

5.3.9 Wood Stork

The wood stork is a large, white, long-legged wading bird that relies upon shallow, freshwater wetlands for foraging. Black primary and secondary feathers, a black tail and a blackish, featherless neck distinguish the wood stork from other wading birds species. This species was federally listed as endangered under the ESA on February 28, 1984. No critical habitat has been designated for the wood stork.

In the United States, wood storks were historically known to nest in all coastal states from Texas to South Carolina (Wayne 1910; Bent 1926; Howell 1932; Oberholser 1938). Dahl (1990) estimates these states lost about 38 million acres, or 45.6 percent, of their historic wetlands between the 1780s and the 1980s. However, it is important to note that wetlands and wetland losses are not evenly distributed in the landscape. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres of the wetlands lost in the southeastern United States between the mid-1970s and mid-1980s were located in the Gulf-Atlantic coastal flats. These wetlands were strongly preferred by wood storks as nesting habitat. Currently, wood stork nesting is known to occur in Florida, Georgia, South Carolina, and North Carolina from March to late May. However, in south Florida, wood storks lay eggs as early as October and fledge in February or March. Breeding colonies of wood storks are currently documented in all southern Florida counties except for Okeechobee County. Known nesting colonies are shown in **Figure 5-8**.

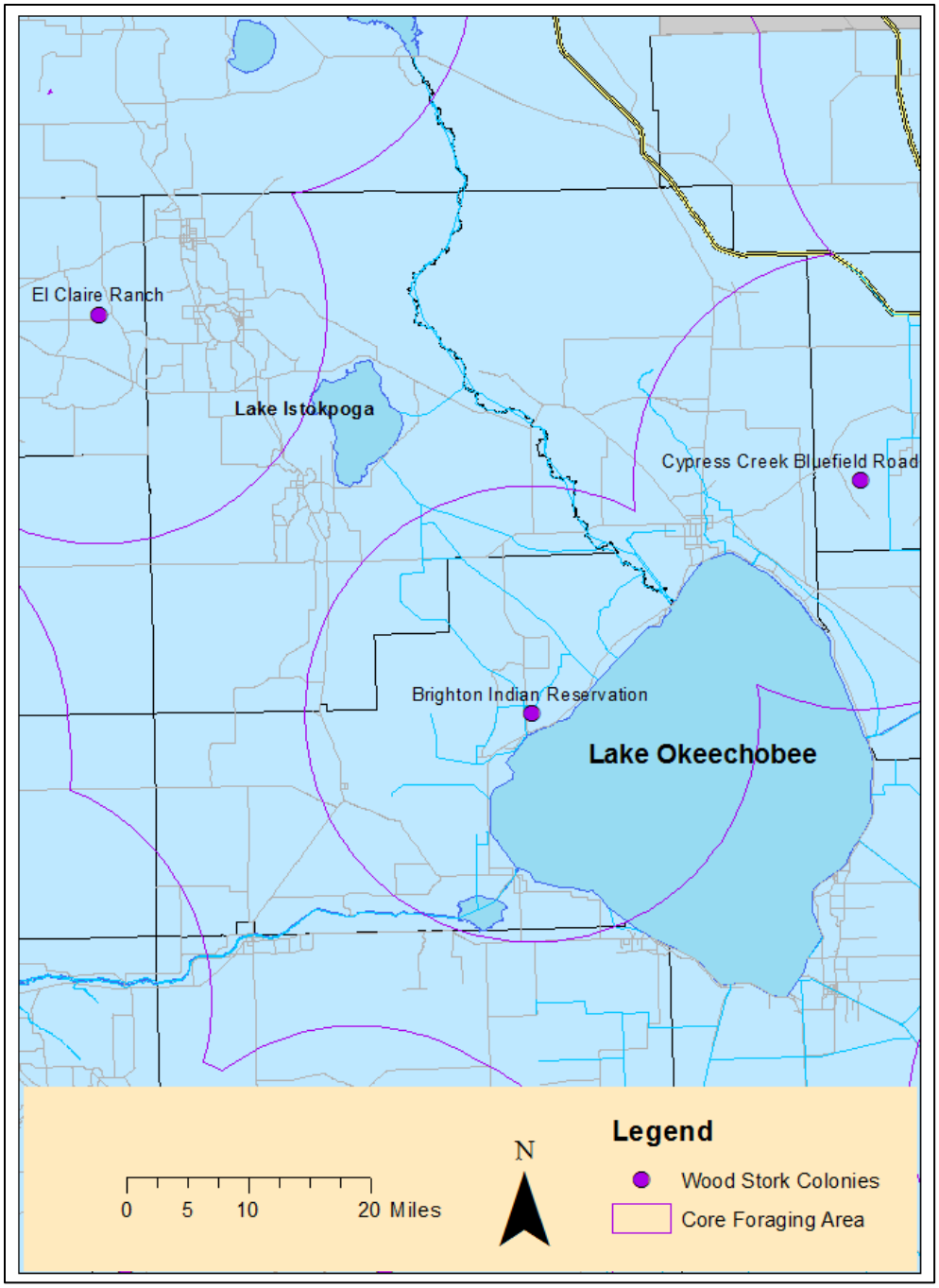


Figure 5-8. Wood stork colonies active in 2016 near Lake Okeechobee. Source: USFWS 2018

The wood stork population in the southeastern United States appears to be increasing. Preliminary population totals indicate that the wood stork population has reached its highest level since it was listed as endangered in 1984. In all, approximately 11,200 wood stork pairs nested within their breeding range in the southeastern United States. Wood stork nesting was first documented in North Carolina in 2005 and wood storks have continued to nest in this state through 2009. This suggests that the northward expansion of wood stork nesting may be continuing.

The primary cause of the wood stork population decline in the United States is loss of wetland habitats or loss of wetland function resulting in reduced prey availability. Almost any shallow wetland depression where fish become concentrated, either through local reproduction or receding water levels, may be used as feeding habitat by the wood stork during some portion of the year; but only a small portion of the available wetlands support foraging conditions (high prey density and favorable vegetation structure) that wood storks need to maintain growing nestlings. Browder et al. (1976) and Browder (1978) documented the distribution and the total acreage of wetland types occurring south of Lake Okeechobee, Florida, for the period 1900 through 1973. They combined their data for habitat types known to be important foraging habitat for wood storks (cypress domes and strands, wet prairies, scrub cypress, freshwater marshes and sloughs, and saw grass marshes) and found these habitat types have been reduced by 35 percent since 1900.

Wood storks forage primarily within freshwater marsh and wet prairie vegetation types, but can be found in a wide variety of wetland types, as long as prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987; Gawlik et al. 2004; Herring and Gawlik 2007). Calm water, about 5 to 25 centimeters in depth, and free of dense aquatic vegetation is ideal, however, wood storks have been observed foraging in ponds up to 40 centimeters in depth (Coulter and Bryan 1993; Gawlik 2002). Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter et al. 1999; Coulter and Bryan 1993; Herring and Gawlik 2007). During nesting, these areas must also be sufficiently close to the colony to allow wood storks to efficiently deliver prey to nestlings.

The principal habitat for the wood stork is within the littoral zone of Lake Okeechobee (USFWS 2001), which is within the study area of this project.

5.3.10 Wood stork "May Affect" Determination

The TSP would be expected to improve conditions for wood storks throughout much of the project area, including the littoral community within Lake Okeechobee due to the increased amount of time the water levels would be within the beneficial stage envelope. This would allow for a greater opportunity for wood stork foraging. Rehydration and vegetation shifts within the LOW (i.e., wetland restoration sites) and lake levels (via additional project storage) are likely to increase the spatial extent of suitable foraging opportunities and nesting habitat for wood storks, which would provide a moderate beneficial effect.

The TSP proposes to restore 5,279 acres of wetlands along the Kissimmee River floodplain (this includes the Paradise Run wetland site) and 13,000 acres of the wetland attenuation feature. This significantly increases the spatial extent of suitable foraging opportunities and nesting habitat for wood storks. These benefits should offset the adverse effects to existing foraging habitat (i.e., wetlands) currently within the potential storage footprints. Therefore, the Corps has determined that the TSP may affect, but is not likely to adversely affect, wood stork.

5.3.11 Florida Panther

The endangered Florida panther, also known as cougar, mountain lion, puma and catamount, was once the most widely distributed mammal (other than humans) in North and South America, but it is now virtually exterminated in the eastern United States. Habitat loss had driven this subspecies south of the Caloosahatchee River. Only recently have adult female panthers been recorded north of the Caloosahatchee River. The Florida panther has been found in almost all Lake Okeechobee watershed ecological communities, including mesic temperate hammocks (Humphrey 1992). The Florida panther

utilizes mesic pine flatwoods in combination with other forested communities. Foraging, breeding, and wildlife corridors are provided for the panther and its prey. Mesic flatwoods are associated with natural drainage patterns defining travel corridors.

One of 30 cougar subspecies, the Florida panther is tawny brown on the back and pale gray underneath, with white flecks on the head, neck and shoulder. Male panthers weigh up to 130 pounds and females reach 70 pounds. Preferred habitat consists of cypress swamps, pine and hardwood hammock forests. The main diet of the Florida panther consists of white-tailed deer, sometimes wild hog, rabbit, raccoon, armadillo and birds. Present population estimations range from 80 to 100 individuals. Florida panthers are solitary, territorial, and often travel at night. Males have a home range of up to 400 square miles and females about 50 to 100 square miles. Florida panther primary, secondary, and dispersal zones are shown in **Figure 5-9,** however, there is no designated critical habitat for the Florida panther.

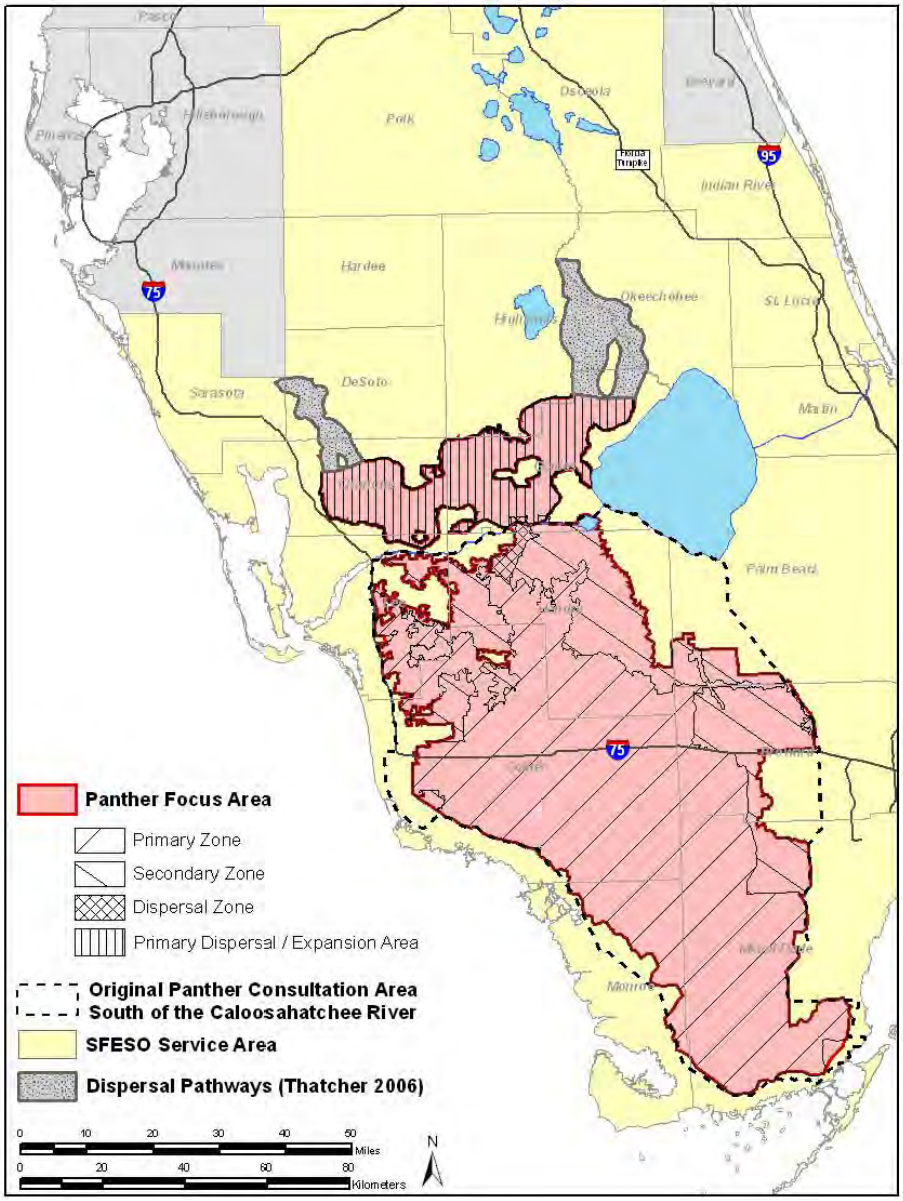


Figure 5-9. Florida panther zones in South Florida.

Female panthers reach sexual maturity at about three years of age. Mating season is December through February. Gestation lasts about 90 days and females bear two to six kittens. Juvenile panthers stay with their mother for about two years. Females do not mate again until their young have dispersed. The main survival threats to the Florida panther include habitat loss due to human development and population growth, collision with vehicles, parasites, feline distemper, feline alicivirus (an upper respiratory infection), and other diseases (USFWS 1999).

The Florida panther has been found in almost all Lake Okeechobee watershed ecological communities, including mesic temperate hammocks (Humphrey 1992). The Florida panther utilizes mesic pine flatwoods in combination with other forested communities. Foraging, breeding, and wildlife corridors are provided for the panther and its prey throughout the project area. Mesic flatwoods are associated with natural drainage patterns defining travel corridors.

5.3.12 Florida Panther "May Affect" Determination

Conversion of approximately 13,000 acres of upland habitat to wetlands may affect the panther's dispersal pathway (as shown in **Figure 5-9**). Construction of the wetland attenuation feature would result in conversion of upland habitat to wetland habitat, however, the lower water depth will not be a geographic barrier as panthers could still traverse the wetland attenuation feature. In addition, lands within LOWRP action area become restored to their more historic natural values, the concomitant improved prey base would result in greater use of these areas by the Florida panther. The Thatcher dispersal pathways were not identified as being used by panthers; rather, they represented a least-cost pathway for panthers to move north based on the available habitat in 2006. Female panthers have only recently been recorded north of the Caloosahatchee River, and the wetland restoration sites would not be expected to be impassable. It has yet to be determined if the panther population will substantially expand beyond the primary expansion area. In the event it does, the restored wetlands would provide permanent panther prey and dispersal pathways. Because panthers are not using these areas now, and the Florida panther is a wide-ranging species with the majority of sightings west of the action area, the TSP may affect, but is not likely to adversely affect, Florida panther.

5.3.13 Florida Bonneted Bat

The endangered Florida bonneted bat is Florida's largest bat, weighing approximately 1.1 to 2.0 ounces, with a 19 to 21 inch wingspan, and a body length of 5.1 to 6.5 inches. The species has dark brown fur and large broad ears that join together and slant forward over the eyes. Relatively little is known regarding the ecology and habitat requirements of this species. In general, bats will forage over ponds, streams and wetlands and require roosting habitat for daytime roosting, protection from predators and rearing of young (FFWCC 2011). Florida bonneted bats roost in tree cavities, rocky outcrops and dead palm fronds. In residential communities, the bats roost in Spanish tile roofs, but have also been found in attics, rock or brick chimneys and fireplaces of old buildings (FFWCC 2011). Colonies are small, with the largest reported as just a few dozen individuals. The bat is a nocturnal insectivore and relies upon echolocation to navigate and detect prey. Females give birth to a single pup from June through September (FFWCC 2011); however limited data suggests that a female may undergo a second birthing season possibly in January or February.

The Florida bonneted bat is Florida's only endemic bat. The range of this species is limited to southern Florida including two locations within the Kissimmee River Wildlife Management Area north of Lake Okeechobee in 2008. Records indicate that it was once common in the 1950s and early 1960s near Coral Gables and Miami (Belwood 1992). The Florida bonneted bat has only been documented in 12 locations within Florida, including areas within Coral Gables, Homestead, Naples, Everglades City and North Fort

Myers. Seven of the locations are under public ownership with the Florida bonneted bat found in discrete and specific areas within BCNP, Fakahatchee Strand Preserve State Park, Kissimmee River Wildlife Management Area, Babcock Ranch and Fred C. Babcock and Cecil M. Webb Wildlife Management Area. Loss of suitable habitat is believed to be the primary cause of population declines. Other perceived threats include pesticide and herbicide use, which decrease populations of insects, the bats primary prey. **Figure 5-10** shows the consultation and focus area of the Florida bonneted bat.

Due to the species' small range, the greatest threats to Florida bonneted bats are loss of habitat, including the destruction of natural roost sites, and natural disasters such as hurricanes, since the impact could occur throughout its entire range. Other perceived threats include pesticide and herbicide use, which decreases the population of insects, the bats' primary prey. Critical habitat has not yet been designated for this species.

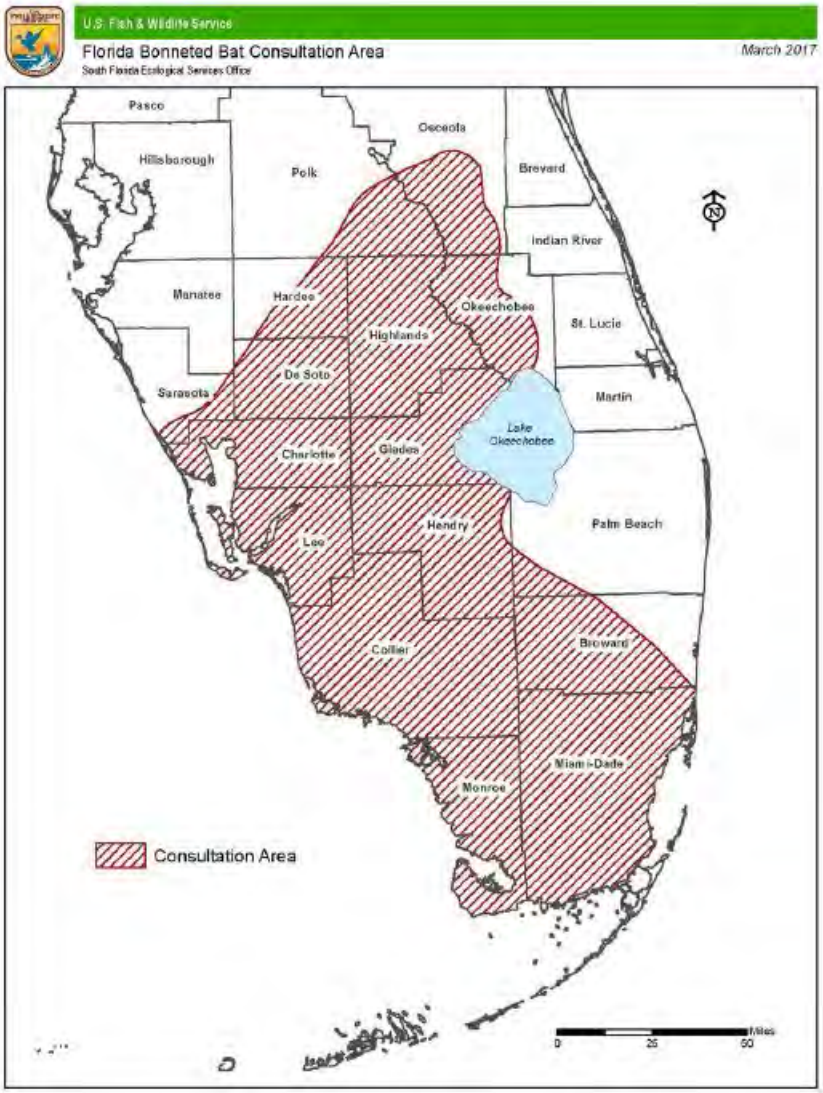


Figure 5-10. 2017 Florida Bonneted Bat Consultation Area.

5.3.14 Florida Bonneted Bat "May Affect" Determination

The Florida bonneted bat consultation area includes all counties that are within the study area (**Figure 5-10).** This species forages for insects at night while flying over water. The TSP would provide benefits to Florida bonneted bat with the creation of wetlands by increasing the wetland acreage available for foraging. However, the wetland restoration sites currently contain approximately 2,900 acres of uplands and the wetland attenuation feature contains approximately 13,000 acres of upland that may contain roosting trees, thus the TSP would likely remove some roosting habitat. Preconstruction surveys would be conducted to identify roosting trees. If bats are encountered, the Corps will coordinate measures with FWS to minimize or avoid potentially adverse effects. The Corps has determined that the TSP may affect, Florida bonneted bat.

6 CUMULATIVE EFFECTS ANALYSIS

Cumulative effects for ESA analysis include only state projects that might affect the area. For a discussion on Federal project cumulative effects, see the Cumulative Effects section of the Draft PIR/EIS, Appendix C.2. A number of projects, such as the Dispersed Water Storage managed by the state and other entities could contribute to the overall effect on Northern caracara, Eastern indigo snake, and Florida bonneted bat. The main driver in effects to these three species includes removal of uplands, which is replaced by the restoration of and creation of wetlands to move towards achieving the CERP goals of Everglades restoration. The South Florida Water Management District's Restoration Strategies is aimed to restore the Everglades in a similar manner as CERP.

7 CONSERVATION MEASURES

The Corps acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within the LOWRP study area. The Corps commits to minimizing effects of the TSP to the greatest extent possible in both the planning and construction phases of the project:

1) Standard protection measures regarding the Eastern indigo snake, West Indian manatee, Florida panther, Everglade snail kite, wood stork, and caracara shall be included in the environmental protection plan when the Corps proceeds to the plans and specifications phase of this project. The Corps proposes specific minimization measures as part of the TSP such as pre-construction acoustical and roost surveys and the use of avoidance buffers around known roosts in order to significantly reduce the potential adverse effects to the Florida bonneted bat as a result of construction activities.

2) Turbidity screening and diversion will be used to control effects to the drainage ditches and connected canals. Runoff from the construction site or storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, and any measures required by area wide plans approved under paragraph 208 of the Clean Water Act. Temporary and permanent erosion and sedimentation control features or screening will be installed.

3) In addition, during construction, the Contractor will be responsible for keeping construction activities, including refueling and maintenance sites, under surveillance, management, and control to avoid pollution of surface, ground waters, and wetlands. The Contractor is responsible for conducting all operations in a manner to minimize turbidity and shall conform to all water quality standards as

prescribed by Chapter 62-302, State of Florida, Florida Department of Environmental Protection (FDEP).

4) Project construction shall not destroy migratory birds, their active nests, their eggs, or their hatchlings. Monitoring for such would be required by the construction contractor. A buffer zone around active nests or nestling activity would be required during the nesting season.

Applicable listed species guidelines and conservation measures will be followed and coordinated with the Service. The Corps would implement construction conservation measures as outlined in the Habitat Management Guidelines for the Wood Stork in the southeast Region (USFWS 2009), Standard Protection Measures for Florida Manatee, and Draft Standard Protection Measures for the Eastern Indigo Snake, and Draft Species Conservation Guidelines for Audubon's (Florida) Crested Caracara (USFWS 2004) to avoid and minimize adverse effects on those species during construction activities. Monitoring for listed species that could occur in or around the project area during construction would be specified in the contract specifications.

8 CONCLUSIONS

The Corps acknowledges the probable existence of 24 federally-listed threatened and/or endangered species within the boundaries of the LOWRP study area. This BA was prepared with the best available scientific and commercial information. Federally threatened or endangered species that are known to exist or potentially exist within close proximity of the project area, but which would not likely be of concern due to the proposed project are discussed in **Section 5.3**.

The conversion of approximately 18,000 acres of upland habitat to wetlands would result in a may affect determination for the Northern caracara, Eastern indigo snake, and Florida bonneted bat due to loss of upland habitat. The Florida bonneted bat habitat would be reduced with removal of some roosting trees in the upland areas, however, the increase in wetland habitat will likely provide for more foraging habitat available to the species.

The project may also affect the Florida panther's dispersal pathway if the Florida panther were to increase its pathway north of the Caloosahatchee River, however, the panther would still be able to traverse over the WAF (1-4 feet of water). The increase in wetland acreage would also provide concomitant prey available for the Florida panther and therefore is not likely to be adversely affected by the project. The existing conditions within the TSP features does not provide the necessary components that characterize grasshopper sparrow habitat, and therefore is not likely to adversely affect grasshopper sparrow.

The increase in 18,000 acres of wetlands through the wetland attenuation feature and wetland restoration sites would likely benefit the wood stork, Everglade snail kite, and caracara by increasing foraging habitat; the Corps has determined that the TSP may affect, but is not likely to adversely affect wood stork, Everglade snail kite or its critical habitat, and manatee or its critical habitat. The slight change in lake levels within Lake Okeechobee would also likely benefit the Everglade snail kite and its critical habitat, wood stork, caracara, and manatee by providing more time within the beneficial lake stages. The seagrasses within the rivers and estuaries will benefit from the expected decrease in high velocity releases from Lake Okeechobee, which therefore benefits Florida manatee and its critical habitat. ASR storage locations would be further coordinated with the USFWS during the design phase of the project, however, based on the ASR Regional Study (USACE and SFWMD, 2015), the warmer water temperatures would

dissipate throughout the water column, which would not create artificial habitat to encourage manatee to inhabit the ASR areas.

Appropriate conservation measures and survey protocol will be followed throughout the design phase and all stages of construction and will also be coordinated with USFWS. Adaptive management will be applied throughout construction, allowing for unforeseen issues to be addressed if they arise.

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A.4 Endangered Species Act Biological Opinion

The NMFS provided the USACE with the Endangered Species Act Programmatic Biological Opinion for the CERP on 17 December 2013 that includes the Lake Okeechobee Watershed Restoration Project. No further consultation with the NMFS is required. The USFWS provided the USACE with the Endangered Species Act Biological Opinion for the LOWRP on 19 December 2019.

A.4.1 National Marine Fisheries Service Comprehensive Everglades Restoration Plan Endangered Species Act Programmatic Biological Opinion

The NMFS provided the USACE with the Endangered Species Act Programmatic Biological Opinion for the CERP on 17 December 2013 that includes the Lake Okeechobee Watershed Restoration Project. No further consultation with the NMFS is required.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

F/SER31: SJA/KD

DEC 17 2013

Mr. Eric Summa
Chief, Environmental Branch
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Re: Comprehensive Everglades Restoration Plan Programmatic Consultation

Dear Mr. Summa:

This responds to your July 2, 2013, Biological Assessment (BA) for the Comprehensive Everglades Restoration Plan (CERP) program received from the U.S. Army Corps of Engineers (USACE) requesting National Marine Fisheries Service (NMFS) concurrence with program and project-effect determinations submitted pursuant to Section 7 of the Endangered Species Act (ESA). You have determined that of the projects reasonably expected to be implemented as part of the CERP, only the following projects may directly affect, but are not likely to adversely affect through construction impacts, listed species and their critical habitats under NMFS's purview: Biscayne Bay Coastal Wetlands (BBCW); Indian River Lagoon South (IRL-S); Caloosahatchee River (C-43) West Basin Storage Reservoir; Picayune Strand Restoration Project; and the Central Everglades Planning Project (CEPP). Further, you determined that all the CERP program components that will change freshwater flow and storage across south Florida and thus affect salinity and aquatic resources in several coastal estuaries and bays inhabited by NMFS's listed species, may affect, but are not likely to adversely affect green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles and their respective critical habitat, smalltooth sawfish and its critical habitat, or Johnson's seagrass and its critical habitat. In addition, you determined that the proposed action would not affect Gulf sturgeon, elkhorn or staghorn corals and their critical habitat, or blue, finback, humpback, sei, or sperm whales. We have also determined that the proposed action may affect, but is not likely to adversely affect seven coral species, and would have no effect on the loggerhead critical habitat currently proposed to be listed as threatened or endangered in the action area of the program. Our findings on the program and each of the project's potential effects are based on the project descriptions in this response. Changes to the proposed actions for any of these projects may negate our findings and may require reinitiating consultation. An acronyms and abbreviation list is provided at the end of this document.

1.0 Consultation History

Between 2002 and 2011, NMFS and USACE consulted informally on several individual project components of the CERP program. In its November 3, 2011, letter concurring with USACE that the BBCW project is not likely to adversely affect any listed species, NMFS recommended that consultation should be conducted on the combined effects of the CERP program (SER-2010-2615). In the BBCW informal concurrence letter, NMFS indicated that 13 CERP projects were

in various stages of construction or planning. Of those 13 projects, seven were determined to potentially affect species and/or critical habitat under NMFS's purview through construction impacts, due to their presence in the action areas of the projects or due to change in water flows. These 13 projects were the BBCW, C-111 Spreader Canal, Site 1 Impoundment, IRL-S, C-43 West Basin Storage Reservoir, Picayune Strand Restoration Project, and Everglades National Park (ENP) Seepage Management. The other six projects have either been constructed or would have no construction effects on listed species or designated critical habitat including the L-31N Seepage Management Pilot Project, C-111 South Dade, Water Conservation Area 3A, Decompartmentalization (Decomp) and Sheet Flow Enhancement, Broward County Water Preserve Area, Lake Okeechobee Watershed, and Everglades Agricultural Area (EAA) Storage Restoration, though all these projects contribute to the overarching restoration objectives of the CERP program and these program-level effects are evaluated in this consultation.

USACE submitted a Programmatic BA on July 2, 2013, which included the seven projects as well as a more recently developed CERP project that may affect listed species and critical habitat, the CEPP, and provided specific evaluations of potential effects to threatened and endangered species and critical habitats within the purview of NMFS. This consultation on the CERP program evaluates the effects of all individual projects reasonably expected to be implemented over the course of the program, including the additive effects of the project components on Florida habitats and resources, and whether listed species or critical habitats under NMFS's purview may be adversely affected.

Because the program components and individual projects included in CERP that may affect NMFS's resources are sufficiently identified and described, including their likely locations, to determine and evaluate potential routes of effects, we are not recommending second tier consultation procedures in the future to validate effects predictions for these projects. Rather, any changes to individual projects covered by this consultation, or additional projects added to CERP, will be evaluated for potential needs to reinitiate consultation.

2.0 Interrelated or Interdependent Activities

As defined in ESA implementing regulations, effects of agency actions, including programs, include the effects of all activities that are either interrelated or interdependent with the action undergoing consultation (i.e. CERP). An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. NMFS recognizes that there are numerous activities being implemented across south Florida by state, local, and conservation entities that share similar goals with CERP, and may augment the benefits of Everglades restoration. Some non-CERP projects were assumed to be completed in the CEPP (system-wide) modeling, acknowledging that full restoration benefits of CEPP would not be achieved without the completion and operation of these projects [C-111 South Dade, Central and South Florida (C&SF) C-51, Kissimmee River Restoration, South Florida Water Management District Restoration Strategies]. These projects are all located inland and would not have direct construction impacts on NMFS species (project locations can be found http://www.evergladesplan.org/pm/projects/landing_projects.aspx). The goals of the non-CERP projects mentioned here have the same restoration goals as CERP, to improve the quality, quantity, timing, and distribution of freshwater flows to the estuaries and south Florida

ecosystem. These projects are not interrelated or interdependent since they each provide restoration benefits on their own.

The most closely associated project we evaluated is the Lake Okeechobee Regulation Schedule (LORS 2008), which regulates the freshwater flows that are released from Lake Okeechobee to the St. Lucie and Caloosahatchee estuaries. This is a legally separate project from CERP, with different National Environmental Policy Act (NEPA) documentation and consultation with NMFS and other agencies (SER-1999-1473; SER-1999-1111; SER-2005-4702; SER-2006-4089; SER-2012-2653; SER-2007-4580). NMFS received a supplemental BA from the USACE in January 2013, due to the need for consultation on sawfish critical habitat and Johnson's seagrass critical habitat (SER-2013-10229). LORS only restricts the water flows that would come from Lake Okeechobee if the water level is too low in the lake (ecological and public water supply purposes) or too high in the lake (flood control purposes). CERP would operate within the operational restrictions of LORS 2008, and if LORS changes there would be a new Environmental Impact Statement (EIS) and thus, new consultation. Therefore, LORS is not interrelated or interdependent since it operates separately from CERP and CERP is designed to add to the benefits of LORS by further improving releases of freshwater flows from Lake Okeechobee.

3.0 Description of CERP (Proposed Action and Action Area)

The purpose of CERP (originally called the Restudy) was to evaluate and determine the feasibility of modifying the C&SF project to provide ecosystem restoration and to provide for other water related needs of the region, such as agriculture. The C&SF project was authorized in 1948 and is a multi-purpose project that provides flood control; water supply for municipal, industrial, and agricultural uses; prevention of saltwater intrusion; water supply for Everglades National Park; and protection of fish and wildlife resources through an extensive system of canals, levees, pumps, and other structures. However, the C&SF project also had significant unintended adverse impacts on environments of south Florida, notably the Everglades. The Restudy investigated structural and operational changes to the C&SF project with the goal of improving the quality of the environment; improving protection of the aquifer; improving the integrity, capability, and conservation of urban and agricultural water supplies; and improving other water-related purposes.

A reconnaissance report for the Restudy was completed in 1994, with the feasibility study beginning in 1995. The Water Resources Development Act (WRDA) 1996 provided specific congressional direction stating that the feasibility report and programmatic EIS would need to be complete by 1999. CERP was authorized under WRDA in 2000. It is a joint South Florida Water Management District and USACE project with the goal of restoring the quality, quantity, timing, and distribution of water throughout the south Florida ecosystem. The CERP program's goal is to help restore the historic freshwater flows as shown in Figure 1.

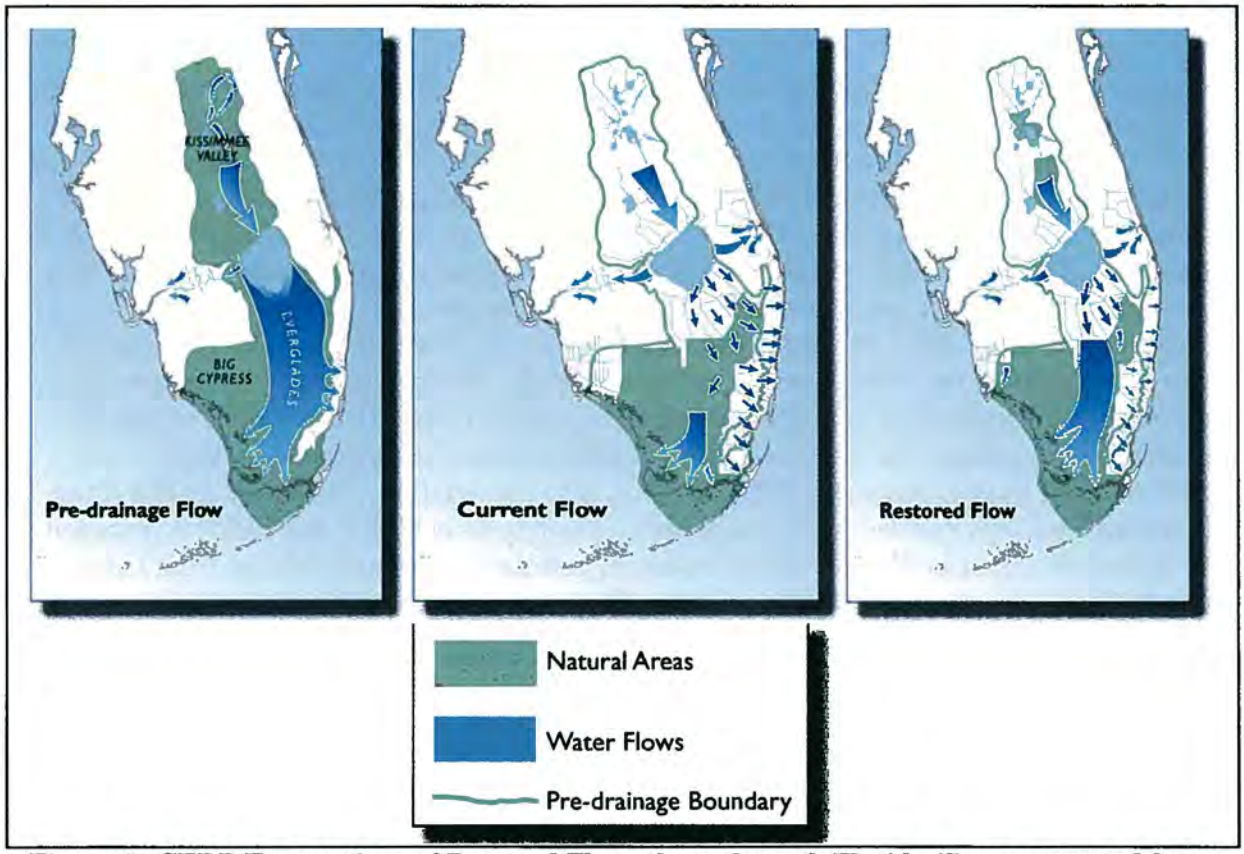

Figure 1. CERP Expectations of Restored Flows through south Florida (figure extracted from CEPP powerpoint presentations)

The CERP study area and thus the action area for this consultation encompasses approximately 18,000 square miles from Orlando to the Florida Reef Tract, within multiple counties including: Monroe, Miami-Dade, Broward, Collier, Palm Beach, Hendry, Martin, St. Lucie, Glades, Lee, Charlotte, Highlands, Okeechobee, Osceola, Orange, and Polk, depicted in Figure 2. The study regions of CERP are described in Table 1 and include Lake Okeechobee, EAA, the Water Conservation Areas (WCA), the majority of ENP, Florida Bay, the majority of Big Cypress National Preserve, coastal estuaries, and urban and agricultural areas along Florida's east coast, south of St. Lucie Canal. Descriptions of the action area and further descriptions in the rest of this section are taken from the CERP Programmatic BA.

Figure 2. CERP Study Area

Table 1. Description of CERP Study Regions

CERP Study Area Region	Description of the Study Area Region
Lake Okeechobee	Lake Okeechobee is a large, shallow lake (surface area approximately 73 square miles) 30 miles west of the Atlantic coast and 60 miles east of the Gulf of Mexico. It is the principal water supply reservoir for south Florida and is used for navigation, flood control, and recreation. It is impounded by a system of levees, with 6 outlets: St. Lucie Canal eastward to the Atlantic Ocean, Caloosahatchee Canal/River westward to the Gulf of Mexico, and four agricultural canals (West Palm Beach, Hillsboro, North New River and Miami).
Northern Estuaries	Lake Okeechobee discharges into the 2 Northern Estuaries. The St. Lucie Canal feeds into the St. Lucie Estuary, which is part of a larger system, the Indian River Lagoon (designated an Estuary of National Significance and is part of the U.S. Environmental Protection Agency - sponsored National Estuary program). The Caloosahatchee Canal/River feeds into the Caloosahatchee Estuary to the west.
EAA (Everglades agricultural area)	The EAA is approximately 700,000 acres in size and is immediately south of Lake Okeechobee. Much of this rich, fertile land is devoted to sugarcane production, and is crossed by a network of canals that are strictly maintained to manage water supply and flood protection.
WCAs (Water conservation areas)	The WCAs, WCA 1 (Loxahatchee National Wildlife Refuge), WCA 2, and, WCA 3 (the largest of the three) are situated southeast of the EAA and are approximately 1,350 square miles (approximately 40 miles wide and 100 miles long) from Lake Okeechobee to Florida Bay. Provides floodwater retention, public water supply, and are the headwaters of Everglades National Park.
ENP (Everglades National Park)	ENP was established in 1947, covering approximately 2,353 square miles (total elevation changes of only 6 feet from its northern boundary of Tamiami Trail south to Florida Bay). Landscape includes sawgrass sloughs, tropical hardwood hammocks, offshore coral reefs, mangrove forest, lakes, ponds, and bays.
Southern Estuaries	Florida Bay comprises a large portion of ENP, and is a shallow estuarine system (average depth less than 3 feet). Florida Bay is the main receiving water of the greater Everglades heavily influenced by changes in timing, distribution, and quantity of freshwater flows into the southern estuaries.
Lower East Coast	The Lower East Coast encompasses Palm Beach, Broward, and Miami-Dade counties, the most densely populated area in Florida. Water levels in this area are highly controlled by the C&SF water management system to prevent overdrainage and manage saltwater intrusion at the shoreline, provides flood control and water supply.

As discussed, the action area covers a large portion of south Florida. Nearly all aspects of south Florida's native vegetation have been affected by development, altered hydrology, nutrient inputs, and spread of non-native species that have resulted directly or indirectly from a century of water management. Habitat types that dominate the southern coastal regions within the project area include submerged aquatic vegetation (SAV) (primarily seagrasses and algae), mangrove

forests, saline emergent wetlands, freshwater wetlands, and non-native dominated wetlands (primarily wetlands dominated by Australian pine, (*Casuarina equisetifolia*), or Brazilian pepper, (*Schinus terebinthifolius*)).

The estuarine communities of south Florida have been affected by upstream changes in freshwater flows through the Everglades as a result of the C&SF project. A reduction in freshwater inflows into Florida Bay and alterations of the normal salinity balance have affected mangrove community composition and may have contributed to a large-scale die-off of seagrass beds (FWS 1999[1]).

Mangrove communities occur within a range of salinities from 0 to 40 practical salinity units (psu). Florida Bay experiences salinities in excess of 40 psu on a seasonal basis. Implementing CEPP will provide increased freshwater flows to Florida Bay and the southwest coast, thereby contributing to lower salinity levels within these areas to better encompass the mangrove salinity tolerance range. In addition, past changes in freshwater flow (from historic conditions) can lead to an invasion by exotic species such as Australian pine and Brazilian pepper.

All CERP projects are expected to improve freshwater flows throughout the south Florida ecosystem. Section 2 (Existing and Future Conditions) in the CEPP Project Implementation Report (PIR)/EIS explains in detail the current conditions of the south Florida ecosystem, including the vegetation, invasive species, threatened and endangered species, etc. Structural features currently in south Florida are depicted in Figure 3.

[1] U.S. Fish and Wildlife Service. 1999. South Florida Multi-Species Recovery Plan. Southeast Region, Atlanta, Georgia, USA.

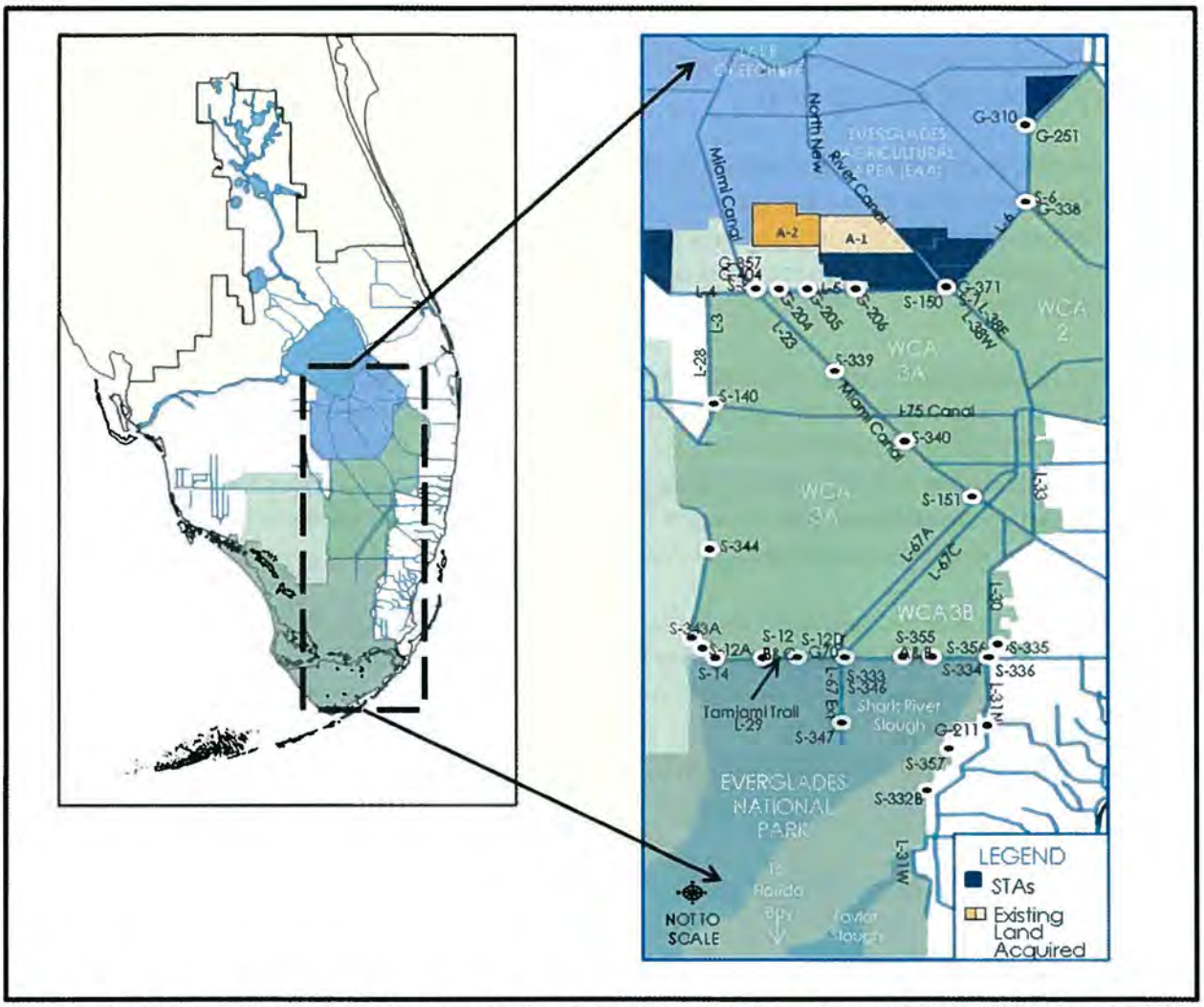

Figure 3. Current Structural Features in South Florida with Locations of EAA, WCAs, and ENP

Overall, freshwater flow improvements from the existing conditions is needed due to current freshwater flow conditions where approximately 1.7 billion gallons of water goes straight to tide through the extensive system of built canals and levees, rather than allowing sheetflow throughout the central part of the state (Figure 3 and Figure 4). More freshwater throughout south Florida will allow for rehydration of wetlands, marl prairies, and ultimately help regulate the salinity regimes in the estuaries by reducing the amount of harmful freshwater pulse releases from Lake Okeechobee and salt water intrusion. These freshwater improvements will then allow for more wading birds, fish, and many other species to thrive throughout south Florida.

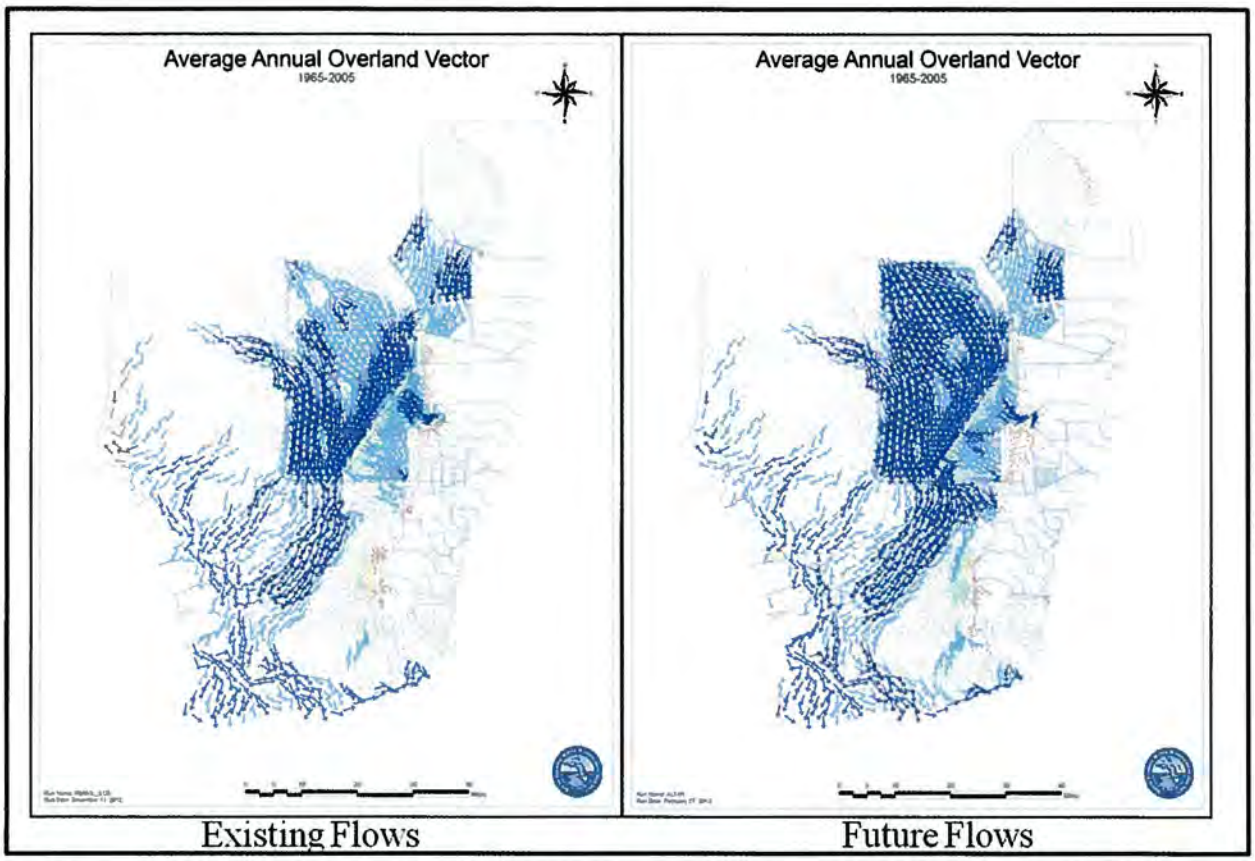

Figure 4. Existing and Future with Project Flows. Blue arrows indicate more water flowing throughout the areas. The box in Figure 2 depicts the same region shown in this figure. (Figure extracted from CEPP PIR/EIS Appendix G – Benefits Analysis)

Below is a detailed decription of all of the proposed actions covered under CERP, an explanation of the major components of CERP, and and an evaluation of the effects anticipated from the completion of CERP.

3.1 Major Components of CERP

CERP consists of structural and operational changes to the C&SF Project and defines components as conceptual project features (or options) intended to achieve a particular planning objective or set of planning objectives. They include both structural measures, such as reservoirs, pump stations, and canals, and nonstructural measures, such as reservoir operating schedules. One or more components are combined as features of specific projects to be implemented.

Components were developed by sub-regions and were optimized at the sub-regional level and then grouped with other components to form alternative Comprehensive Plans. The Restudy Team formulated and evaluated 10 alternative comprehensive plans. Alternative D-13R was selected as the Initial Draft Plan. Alternative D-13R, which is comprised of forty-nine operational and structural features or components, along with the series of Other Project Elements, Critical Projects, water quality treatment facilities, and other modifications that further improve performance of the plan, comprise the recommended Comprehensive Everglades

Restoration Plan. The following subsections (3.1.1 through 3.1.14) describe the structural and operational changes to the existing C&SF Project as part of the CERP.

3.1.1 Surface Water Storage Reservoirs

A number of water storage facilities are planned north of Lake Okeechobee, in the Caloosahatchee and St. Lucie basins, in the EAA, and in the Water Preserve Areas of Palm Beach, Broward, and Miami-Dade counties. These areas will encompass approximately 181,300 acres and will have the capacity to store 1.5 million acre-feet of water.

3.1.2 Water Preserve Areas

Multipurpose water management areas are planned in Palm Beach, Broward, and Miami-Dade counties between the urban areas and the eastern Everglades. The WCAs will have the ability to treat urban runoff, store water, reduce seepage, and improve existing wetland areas.

3.1.3 Manage Lake Okeechobee as an Ecological Resource

Lake Okeechobee is currently managed for many, often conflicting uses. The lake's regulation schedule will be modified and plan features constructed to reduce the extreme high and low levels that damage the lake and its shoreline. Management of intermediate water levels will be improved, while allowing the lake to continue to serve as an important source for water supply. Several plan components and Other Project Elements are included to improve water quality conditions in the lake. A study is recommended to evaluate in detail the dredging of nutrient-enriched lake sediments to help achieve water quality restoration targets, important not only for the lake, but also for downstream receiving bodies.

3.1.4 Improve Water Deliveries to Estuaries

Excess stormwater that is discharged to the ocean and the gulf through the Caloosahatchee and St. Lucie Rivers is very damaging to their respective estuaries. The CERP will greatly reduce these discharges by storing excess runoff in surface and underground water storage areas. During times of low rainfall, the stored water can be used to augment flow to the estuaries. Damaging high flows will also be reduced to the Lake Worth Lagoon.

3.1.5 Underground Water Storage

Wells and associated infrastructure will be built to store water in the upper Floridian aquifer. As much as 1.6 billion gallons a day may be pumped down the wells into underground storage zones. The injected fresh water, which does not mix with the saline aquifer water, is stored in a "bubble" and can be pumped out during dry periods. This approach, known as aquifer storage and recovery, has been used for years on a smaller scale to augment municipal water supplies. Since water does not evaporate when stored underground and less land is required for storage, aquifer storage and recovery has some advantages over surface storage. CERP includes aquifer storage and recovery wells around Lake Okeechobee, in the WCAs, and the Caloosahatchee Basin.

3.1.6 Treatment Wetlands

Approximately 35,600 acres of man-made wetlands, known as stormwater treatment areas, will be built to treat urban and agricultural runoff water before it is discharged to the natural areas throughout the system. Stormwater treatment areas are included in CERP for basins draining to Lake Okeechobee, the Caloosahatchee River Basin, the St. Lucie Estuary Basin, the Everglades, and the Lower East Coast. These are in addition to the over 44,000 acres of stormwater treatment areas already being constructed pursuant to the Everglades Forever Act to treat water discharged from the EAA.

3.1.7 Improve Water Deliveries to the Everglades

The volume, timing, and quality of water delivered to the south Florida ecosystem will be greatly improved. CERP will deliver an average of 26 percent more water into Northeast Shark River Slough over current conditions. This translates into nearly a half million acre-feet of additional water reaching the slough, and is especially critical in the dry season. More natural refinements will be made to the rainfall-driven operational plan to enhance the timing of water sent to the WCAs, ENP, Holey Land, and Rotenberger Wildlife Management Areas.

3.1.8 Remove Barriers to Sheetflow

More than 240 miles of project canals and internal levees within the Everglades will be removed to reestablish the natural sheetflow of water through the Everglades. Most of the Miami Canal in WCA 3 will be removed and 20 miles of the Tamiami Trail (U.S. Route 41) will be rebuilt with bridges and culverts, allowing water to flow more naturally into ENP, as it once did. In the Big Cypress National Preserve, a north-south levee will be removed to restore more natural overland water flow.

3.1.9 Store Water in Existing Quarries

Two limestone quarries in northern Miami-Dade county will be converted to water storage reservoirs to supply Florida Bay, the Everglades, Biscayne Bay, and Miami-Dade county residents with water. The 11,000-acre area will be ringed with seepage barriers to ensure that stored water does not leak or adjacent groundwater does not seep into the area. A similar facility will be constructed in northern Palm Beach county.

3.1.10 Reuse Wastewater

CERP includes two advanced wastewater treatment plants in Miami-Dade county capable of making more than 220 million gallons a day of the county's treated wastewater clean enough to discharge into wetlands along Biscayne Bay and for recharging the Biscayne Aquifer. This reuse of water will improve water supplies to south Miami-Dade county as well as reducing seepage from the Northeast Shark River Slough area of the Everglades. Given the high cost associated with using reuse to meet the ecological goals and objectives for Biscayne Bay, other potential sources of water to provide freshwater flows to the central and southern bay will be investigated before pursuing reuse.

3.1.11 Pilot Projects

A number of technologies proposed in CERP have uncertainties associated with them - either in the technology itself, its application, or in the scale of implementation. While none of the proposed technologies are untested, what is not known is whether actual performance will measure up to that anticipated in CERP. The pilot projects, which include wastewater reuse, seepage management, Lake Belt technology, and three aquifer storage and recovery projects are recommended to address uncertainties prior to full implementation of these components.

3.1.12 Improve Fresh Water Flows to Florida Bay

Improved water deliveries to Shark River Slough, Taylor Slough, and wetlands to the east of ENP will in turn provide improved deliveries of fresh water flows to Florida Bay. A feasibility study is also recommended to evaluate additional environmental restoration needs in Florida Bay and the Florida Keys.

3.1.13 Southwest Florida

There are additional water resource problems and opportunities in southwest Florida requiring studies beyond the scope of the CERP. In this regard, a feasibility study for Southwest Florida is being recommended to investigate the region's hydrologic and ecological restoration needs.

3.1.14 Comprehensive Integrated Water Quality Plan

The CERP includes a follow-on feasibility study to develop a comprehensive water quality plan to ensure that CERP leads to ecosystem restoration throughout south Florida. The water quality feasibility study would include evaluating water quality standards and criteria from an ecosystem restoration perspective and recommendations for integrating existing and future water quality restoration targets for south Florida water bodies into future planning, design, and construction activities to facilitate implementation of CERP. Further, water quality in the Keys is critical to ecosystem restoration. The Florida Keys Water Quality Protection Plan includes measures for improving wastewater and stormwater treatment within the Keys. Implementation of the Keys Water Quality Protection Plan is critical for restoration of the south Florida ecosystem.

The CERP program's projects will remove over 240 miles of internal levees in the Everglades to help the recovery of natural volumes of water to rehydrate preexisting wetlands. Water storage and water quality treatment are part of the overall project design to improve ecosystem and urban water supply needs within south Florida. Providing adequate flows throughout the system will help recharge the surficial aquifer, protecting it from saltwater intrusion and also providing for public water supply and other users in the lower east coast. All CERP projects have the same goal of improving the quality, quantity, timing, and distribution of freshwater flows throughout south Florida for the purpose of restoring the Everglades ecosystem. It will take more than 30 years to construct all of the elements and projects of CERP.

CERP plans to provide benefits to the estuaries by reducing harmful freshwater releases from Lake Okeechobee into the Caloosahatchee and St. Lucie River estuaries. The benefits would include improved seagrass beds as well as other SAV, thereby also improving species conditions that depend upon those resources (i.e. manatee, oysters, etc.). Increased freshwater flowing into the southern coastal systems (i.e. Florida and Biscayne Bays) would also improve habitat for listed species in the area.

4.0 CERP Evaluation and Reporting

Throughout the project implementation process, system-wide analyses will continue. A feedback loop will be established so that each PIR is evaluated for its contribution to the overall system and that the Comprehensive Plan is revised as necessary to reflect new information developed during the project development process. As part of this effort, the REstoration COordination VERification (RECOVER) team is responsible for linking science and the tools of science to a set of system-wide planning, evaluation, and assessment tasks. Their objectives are to evaluate and assess CERP's performance periodically, refine, and improve the plan during implementation, and ensure that a system-wide perspective is maintained throughout the restoration program.

The CERP program includes an adaptive management plan as well as an extensive monitoring and assessment plan (MAP). Monitoring results are reported to the RECOVER team of scientists who put together a system status report every four to five years. The MAP program provides documentation of the status and trends of the key indicator species of the south Florida

ecosystem, as well as addresses the key questions and uncertainties about achieving ecosystem restoration goals. A comprehensive understanding of the system enables the successful use of adaptive management principles to track and guide restoration activities to ultimately achieve restoration success (CERP reports are available on www.evergladesplan.org). These reports are distributed to all agencies and provide indicators such as salinity changes and changes in SAV as results that can be extrapolated to determine whether conditions for NMFS species have improved.

Performance measures were used in the CEPP modeling which includes other CERP projects within its modeling assumptions. These performance measures are described in detail in the CEPP PIR/EIS Appendix G – Benefits Model. The performance measures were split up by Northern Estuaries, Greater Everglades, and the Southern Coastal Systems. The RECOVER system-wide evaluation (CEPP PIR/EIS Annex E) analyzes the modeling results from CEPP in the same format, allowing for an evaluation of the estuaries, central Florida, and the southern estuaries. These effects are described in the Section 6.0 (Program Effects to Species) of this consultation.

5.0 CERP Projects Included in this Consultation

The projects included in the final recommended CERP are described in detail at http://evergladesplan.org/pm/projects/project_list.aspx. WRDA 2000 approved CERP as a framework for modifications to the C&SF project needed to restore the south Florida ecosystem and to provide for the other water-related needs of the region. WRDA 2000 also authorized construction of four pilot projects from CERP and implementation of ten initial projects needed to provide, in the short term, system-wide water quality and flow distribution benefits as well as an adaptive assessment and monitoring program subject to conditions. Authorization for the remaining components of the CERP occurs through subsequent WRDA legislation, after completion of PIRs.

In addition, Acceler8, a major initiative for Everglades restoration, was launched in 2005 to accelerate the pace of funding, design, and construction for eight environmental restoration projects. Seven of the ten congressionally authorized CERP projects are included in this initiative. These projects were recommended to Congress for initial authorization because the scientists and engineers engaged in the C&SF Restudy considered that they would provide immediate and significant restoration benefits.

The following CERP projects are either authorized by Congress and/or will be constructed entirely or in part by Acceler8 are the:

- C-44 Basin Storage Reservoir
- EAA Storage Reservoir – Phase 1
- Site 1 Impoundment (to be dedicated as the Fran Reich Preserve)
- WCA-3A/3B Levee Seepage Management
- C-9 Impoundment and Stormwater Treamtment Area (STA) – recently added to the Long-Term Plan
- C-11 Impoundment and STA – recently added to the Long-Term Plan
- C-111 N Spreader Canal
- Taylor Creek/Nubbin Slough STAs Project

- Raise and Bridge East Portion of Tamiami Trail and Fill Miami Canal
- North New River Improvement

In addition, the Acceler8 initiative will advance restoration benefits by constructing the following projects:

- Acme Basin B Discharge Project – programmatic authorization in WRDA 2000 and recently added to the Long-Term Plan
- Biscayne Bay Coastal Wetlands Project - Phase I
- Picayune Strand Restoration Project (formerly Southern Golden Gate Estates)
- C-43 West Reservoir Project
- Three STA expansions in the EAA as part of the Long-Term Plan

The CEPP project is a new project (2013) and is awaiting Congressional approval to begin detailed planning, construction, and implementation. Completed consultation is needed for CEPP approval, and this project is described in detail below. Because this project is more recent, modeling results encompass other CERP projects, presenting a programmatic view of CERP plus CEPP project effects.

5.1 Consultation Overview

Table 2 lists proposed and listed threatened (T) and endangered (E) species, along with designated or proposed critical habitat under the jurisdiction of NMFS that we believe may occur in or near the action area and may be affected by the project.

Table 2. Status of Species and Their Critical Habitat (CH) in the Project and Action Area

Species Name	Scientific Name	Status
Turtles		
Green sea turtle	*Chelonia mydas*[2]	T
Hawksbill sea turtle	*Eretmochelys imbricata*	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E
Leatherback sea turtle	*Dermochelys coriacea*	E
Loggerhead sea turtle	*Caretta caretta*[3]	T
Fish		
Smalltooth sawfish	*Pristis pectinata*[4]	E, CH
Gulf Sturgeon	*Acipenser oxyrinchus desotoi*	E, CH
Seagrass		
Johnson's seagrass	*Halophila johnsonii*	T, CH
Invertebrates		
Elkhorn coral	*Acropora palmata*[5]	T, CH
Staghorn coral	*Acropora cervicornis*[6]	T, CH
Elliptical star coral	*Dichocoenia stokesii*	Proposed T[7]

[2] Green turtles are listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are listed as endangered

[3] Northwest Atlantic Ocean distinct population segment (DPS).

[4] U.S. DPS

[5] Proposed listing change from threatened to endangered on December 7, 2012

[6] Proposed listing change from threatened to endangered on December 7, 2012

[7] Corals proposed to be listed as threatened on December 7, 2012 (77 Fed. Reg. 73220)

Species Name	Scientific Name	Status
Lamarck's sheet coral	*Agaricia lamarcki*	Proposed T
Star coral	*Montastraea franksi*	Proposed E[8]
Mountainous star coral	*Montastraea faveolata*	Proposed E
Pillar coral	*Dendrogyra cylindrus*	Proposed E
Rough cactus coral	*Mycetophyllia ferox*	Proposed E
Boulder star coral	*Montastraea annularis*	Proposed E

Proposed critical habitat for the loggerhead sea turtle is within the action area, however, there are no routes of adverse effects to this habitat. No projects will be constructed in these habitats. The proposed units closest to the action area of the project are units 21-29, consisting of nearshore reproductive critical habitat defined as nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open- water environment as well as by nesting females to transit between beach and open water during the nesting season (see http://www.nmfs.noaa.gov/pr/species/criticalhabitat_loggerhead.htm). The increased freshwater flows would likely not extend out into the ocean to effect this habitat, and even if it did, it would have no effect on the essential features of these units, which consist of lack of structures or conditions that would inhibit use of the habitat and ingress and egress to and from the beaches. Thus, loggerhead critical habitat will not be considered further in this consultation.

We reviewed all the projects included in the recommended CERP and authorized as a restoration framework by Congress in WRDA 2000 (Table 3). The level of specificity of project description, location, and objectives allowed us to make ESA effects determinations for all projects, including those not yet authorized. In many cases, we were able to conclude that projects would not have any direct effects on listed species or critical habitats, for example through construction interactions or noise, because the projects will be built outside of the ranges of NMFS's listed species and critical habitats. Those projects and reasoning are discussed below. We also evaluated the projects' potential effects individually and additively (programmatically) on habitats and aquatic resources used by NMFS species, primarily through the alteration of freshwater flow regimes across south Florida and into coastal habitats, which is one of the main goals of the CERP program.

CERP projects that may overlap with species or critical habitats under NMFS purview, and may affect these resources through construction activity include: IRL-S, Picayune Strand Restoration Project, BBCW Project, C-43 West Basin Storage Reservoir, C-111 Spreader Canal Western Project, and CEPP (the ENP Seepage Management Project has been incorporated into CEPP). The Florida Keys Tidal Restoration project is a project that may affect NMFS's listed species and would need separate NMFS consultation because no known plans exist for the project at this time or are expected in the foreseeable future.

Table 3 summarizes CERP projects in terms of their capacity to have potential direct effects through construction activities on NMFS species or critical habitats. Some projects were consulted on individually in the past and for most, construction is already complete. Potential impacts to sawfish critical habitat, which was designated after the project was already built or

[8] Corals proposed to be listed as endangered on December 7, 2012 (77 Fed. Reg. 73220)

consulted on, are evaluated here. Similarly, whether any of the past projects consulted on and/or completed may affect the seven species of corals proposed to be listed, was also evaluated. Below we describe the previous consultations, including any new information about the projects and anticipated effects. Program effects to species are evaluated in Section 6.0 (Program Effects to Species) and the project effects are equal to or less than determinations made on the program (meaning that each project has a may affect, not likely to adversely affect determination or less).

Table 3. CERP projects from Evergladesplan.org and determination of capacity for direct (construction) effects on NMFS species or their Critical Habitat (CH) http://evergladesplan.org/pm/projects/project_list.aspx

Project Name and PCTS # if Applicable	Potential to Affect NMFS species or CH
Acme Basin B Discharge	No Effect
Aquifer Storage and Recovery Regional Study	No Effect
Big Cypress – L-28 Interceptor Modifications	No Effect
Biscayne Bay Coastal Wetlands (SER-2010-2615)	Johnson's seagrass, elkhorn & staghorn coral, sea turtles, smalltooth sawfish
Broward Co. Secondary Canal System	No Effect
Broward County Water Preserve Areas	No Effect
C-111 Spreader Canal (SER-2009-3680)	No Effect
C-4 Control Structures	No Effect
C-43 Aquifer Storage and Recovery Pilot (SER-2004-1548)	No Effect
C-43 West Basin Storage Reservoir Project (SER-2007-2630)	Gulf sturgeon, sea turtles, smalltooth sawfish & CH
Caloosahatchee Back Pumping with Stormwater Treatment	No Effect
Caloosahatchee River West Basin Storage Reservoir Project	No Effect
Central Everglades Planning Project	Smalltooth sawfish & CH, sea turtles & CH, elkhorn & staghorn coral CH, Johnson's seagrass & CH, marine mammals
Central Lake Belt Storage Area	No Effect
Everglades Agricultural Area Storage Reservoirs	No Effect
Everglades National Park Seepage Management (now part of CEPP)	No Effect
Florida Keys Tidal Restoration	Smalltooth sawfish & CH, sea turtles & CH, elkhorn & staghorn coral CH, Johnson's seagrass & CH
Flows to Northwest and Central Water Conservation Area 3A	No Effect
Henderson Creek – Belle Meade Restoration	No Effect
Hillsboro Aquifer Storage and Recovery and Pilot	No Effect
Indian River Lagoon South	Sea turtles, Johnson's seagrass & CH
L-31N (L-30) Seepage Management Pilot	No Effect
Lake Belt In ground Reservoir Technology Pilot	No Effect
Lake Okeechobee Aquifer Storage and Recovery and Pilot	No Effect
Lake Okeechobee Watershed	No Effect
Lakes Park Restoration	No Effect
Loxahatchee National Wildlife Refuge Internal Canal Structures	No Effect

Project Name and PCTS # if Applicable	Potential to Affect NMFS species or CH
Loxahatchee River Watershed Restoration Project	No Effect
Loxahatchee River Watershed Restoration Aquifer Storage and Recovery	No Effect
Melaleuca Eradication and Other Exotic Plants	No Effect
Miccosukee Tribe Water Management Plan	No Effect
Modify Holey Land Wildlife Management Area Operation Plan	No Effect
Modify Rotenberger Wildlife Management Area Operation Plan	No Effect
North Lake Belt Storage Area	No Effect
Palm Beach County Agriculture Reserve Reservoir	No Effect
Picayune Strand Restoration Project	Smalltooth sawfish & CH, sea turtles
Restoration of Pineland and Hardwood Hammocks in C-111 Basin	No Effect
Site 1 Impoundment (SER-2005-7112)	No Effect
South Miami-Dade Reuse	No Effect
Strazzulla Wetlands	No Effect
Wastewater Reuse Technology Pilot	No Effect
Water Conservation Area 3 Decompartmentalization & Sheetflow Enhancement – Part 1 (Decomp)	No Effect
Water Conservation Area 2B Flows to ENP	No Effect
West Miami-Dade Reuse	No Effect
Winsberg Farm Wetlands Restoration	No Effect
Water Ppreserve Area Conveyance	No Effect

5.2 CERP Projects with No Potential to Directly Affect Listed Species or Critical Habitats

Projects listed as No Effect in Table 3 are not expected to have any effects on NMFS species due to construction activities. A review of the documentation for these projects on evergladesplan.org reveals that they are inland projects that do not consist of any construction or dredging in or near the estuaries or the coastline of Florida (all construction will be on or from the uplands), or in any designated critical habitat, and therefore would not directly impact NMFS species or their critical habitat. However, they all have and contribute additively to the overarching program objectives of CERP, to improve the quality, quantity, timing, and distribution of water flows throughout the south Florida ecosystem for restoration purposes.

5.3 CERP Projects that Have Prior Individual Consultations: Project Descriptions, Summary of Prior Consultation Conclusions, and Evaluation of New Information

As discussed above, between 2002 and 2011, NMFS and USACE consulted informally on several individual projects of the CERP program. In a November 3, 2011, letter of concurrence, NMFS summarized that at time 13 CERP projects were in various stages of construction or planning. Of those 13 projects, seven were determined to potentially affect species and/or critical habitat under NFMS's purview through construction impacts, due to their presence in the action areas of the projects. None of the projects were found likely to have adverse effects on NMFS listed species or critical habitats. These previous individual consultations and their effects conclusions are summarized below. Any new information or new species and critical habitat evaluations relevant to construction impacts of these projects is discussed below. Direct

construction would not take place in coral reef or hard bottom communities, thus elkhorn and staghorn corals, and the seven coral species proposed to be listed, will not be affected by construction activities. The program-level impacts of all CERP projects from changes in freshwater flow and hydrology, including the projects in this section that have had previous section 7 consultations, are evaluated in section 6.0. The previous section 7 concurrence letters for these projects are included as attachments to this programmatic consultation.

5.3.1 C-111 Spreader Canal

The C-111 Spreader Canal Western Project is an enhancement to the 1994 C-111 General Reevaluation Report. Its goal is to improve ENP conditions by establishing more natural water flows in Taylor Slough. This, in turn, will improve the timing, distribution, and quantity of water in Florida Bay. The western project also has features that will jumpstart environmental restoration in the Southern Glades and Model Lands. These areas form a contiguous habitat corridor with ENP, Biscayne National Park, Crocodile Lakes National Wildlife Refuge, the north Key Largo Conservation and Recreational Lands purchases, John Pennekamp State Park, and the National Marine Sanctuary. It is estimated that about 252,000 acres of wetlands and coastal habitat may be affected by the proposed project (Figure 5).

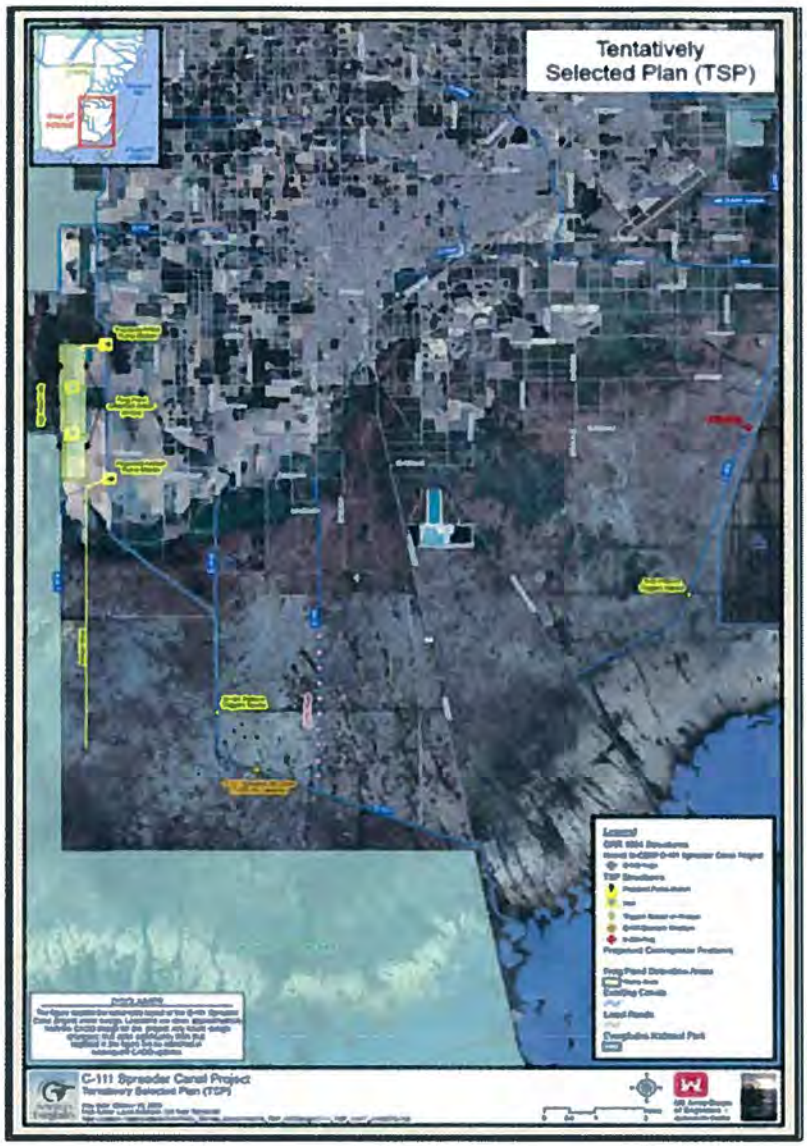

Figure 5. C-111 Spreader Canal Project Area

The C-111 Spreader Canal Western Project will create a nine-mile hydraulic ridge adjacent to ENP that will keep more of the natural rainfall and water flows within Taylor Slough. The hydraulic ridge will be created by constructing a 590-acre above-ground detention area in the Frog Pond area by installing two 225 cubic feet per second pump stations, and integrating other project features. The project will also begin restoration of the Southern Glades and Model Lands with an operable structure in the lower C-111 canal, incremental operational changes at the S-18C structure, a plug at S-20A, operational changes at the S-20 structure, and construction of earthen plugs at the C-110 canal (http://www.evergladesplan.org/docs/fs_c111_july_2013_508.pdf).

On May 7, 2009, the USACE requested concurrence with NMFS on its determination of may affect, but is not likely to adversely affect smalltooth sawfish and sea turtles. In addition, the USACE determined that the project would not modify critical habitat for elkhorn or staghorn

coral. Critical habitat for the smalltooth sawfish had not been designated until after publication of the final PIR/EIS. After further discussion with NMFS, and as described in their BA, the USACE changed their determinations to no effect for all species currently listed, including elkhorn and staghorn corals, and their designated critical habitat. Consultation on this individual project was concluded in 2009 with a no effect determination on all listed species under NMFS purview. Construction on this project is complete. We have no new information that requires revisiting the previous consultation conclusions.

5.3.2 Site 1 Impoundment

The Site 1 Impoundment (Figure 6) is designed to capture and store local runoff during wet periods and then use the water to supplement water deliveries to the Hillsborough Canal during dry periods, thus reducing demands for releases from Lake Okeechobee and the Arthur R. Marshall Loxahatchee National Wildlife Refuge (LNWR). Constructing and operating the impoundment will reduce the need for releases from LNWR during the dry season to meet local water demands and will facilitate the maintenance of more natural, desirable, and consistent water levels within the LNWR. The impoundment will also reduce groundwater seepage from LNWR. The ability to achieve and maintain more natural hydroperiods and hydropatterns within LNWR by retaining more rainfall and inflows from upstream will enhance habitat function and quality, also improving native plant and animal species abundance and diversity. In addition, there will be benefits to the downstream estuaries as a result of reducing peak freshwater flows from local stormwater runoff and large pulse releases from Lake Okeechobee.

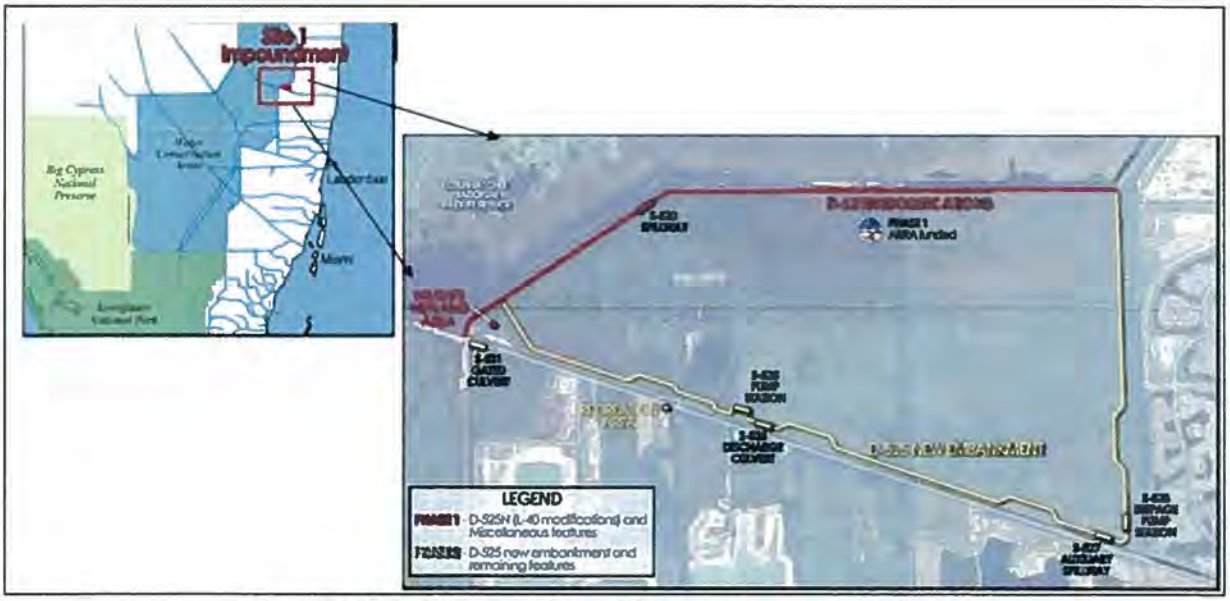

Figure 6. Site 1 Impoundment Project Area and Features

Consultation on this individual project was completed in 2005 with a no effect determination on smalltooth sawfish. Construction is currently ongoing for this project. This project is not located within smalltooth sawfish critical habitat and will not have any effect on other listed species or critical habitats, given its location, other than its contribution to the program effects on freshwater flows and hydrology, discussed in Section 6.0 below.

5.3.3 Caloosahatchee River (C-43) West Basin Storage Reservoir

The C-43 project purpose is to improve the timing, quantity, and quality of freshwater flows to the Caloosahatchee River estuary. The project provides approximately 170,000 acre-feet of above-ground storage volume in a two-cell reservoir. Major features of the project include external and internal embankments, and environmentally responsible design features to provide fish and wildlife habitat such as littoral areas in the perimeter canal and deep water refugia within the reservoir. The project contributes toward the restoration of ecosystem function in the Caloosahatchee estuary by reducing the number and severity of events where harmful amounts of freshwater from basin runoff and Lake Okeechobee releases are discharged into the estuary system. The project also helps to maintain a desirable minimum flow of freshwater to the estuary during dry periods. These two primary functions help to moderate unnatural changes in salinity that are detrimental to estuarine communities (Figure 7).

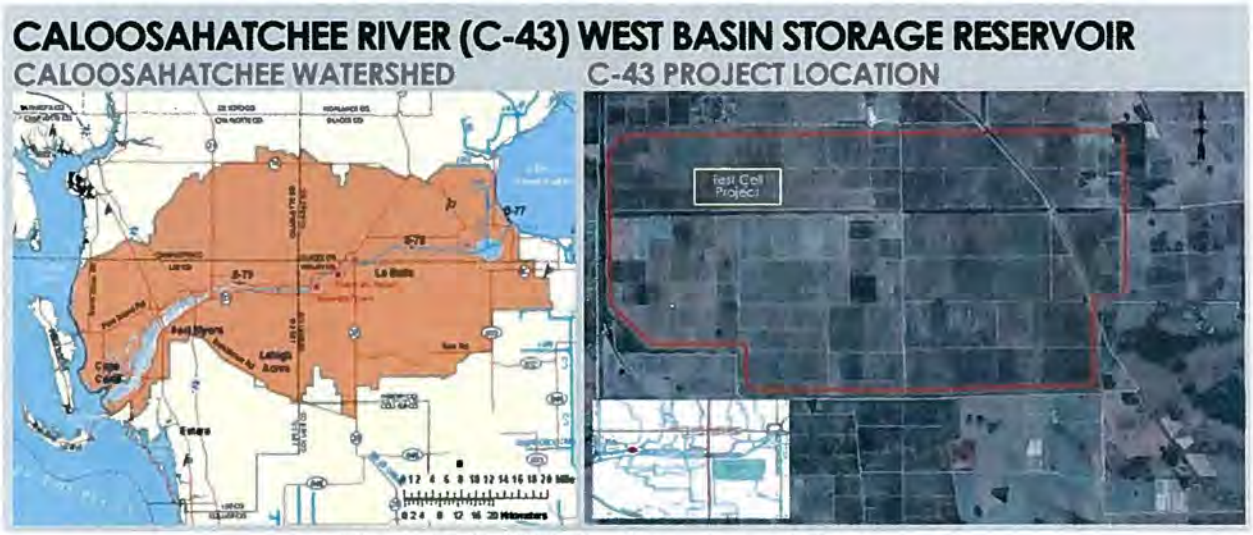

Figure 7. C-43 Project Location and Features

Consultation on this project was completed in 2007 with the conclusion of may affect, not likely to adversely affect sea turtles and smalltooth sawfish. We have no new information requiring that the previous consultation conclusions be revisited. However, critical habitat for the smalltooth sawfish was designated in 2009. This project is located upstream from critical habitat and therefore needs to be considered in the evaluation of program level effects below.

5.3.4 Biscayne Bay Coastal Wetlands

The BBCW project is located in coastal wetlands adjacent to Biscayne Bay in Miami-Dade county (Figure 8).

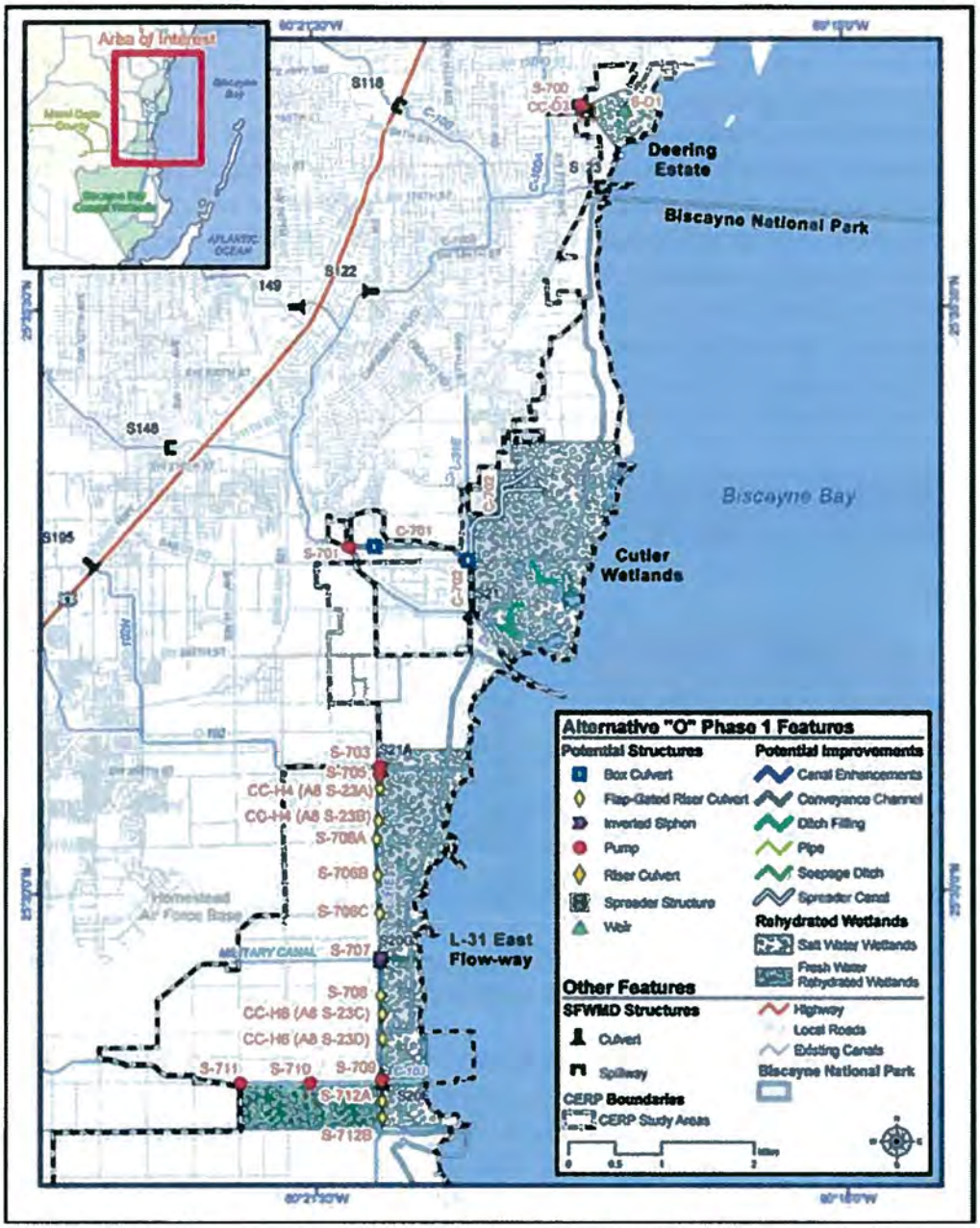

Figure 8. Biscayne Bay Coastal Wetlands Project Location and Features

The primary project purpose is to redistribute freshwater runoff from the watershed adjoining Biscayne Bay to provide a more natural and historic overland flow through existing coastal wetlands. CERP identified a need to replace lost overland flow, rehydrate coastal wetlands, and reduce point source freshwater discharges to Biscayne Bay using a system of pumps and interconnections between coastal canals and operational changes to coastal structures.

Consultation on this specific project was completed November 3, 2011, with a may affect, not likely to adversely affect determination for smalltooth sawfish and other listed species under NMFS purview. NMFS concurred with the USACE's determination that the BBCW project is not likely to adversely affect any listed species pending completion of a recommended

programmatic consultation for any remaining individual CERP projects. We have no new information that requires revisiting the prior effects determinations on listed species from construction activities.

5.3.5 Indian River Lagoon South

The IRL-S project is located in Martin and St. Lucie counties. The purpose is to improve surface-water management in the C-23/C-24, C-25, and C-44 basins for habitat improvement in the St. Lucie River Estuary and southern portions of the Indian River Lagoon. Project features include (1) the construction and operation of four above-ground reservoirs to capture water from the C-44, C-23, and C-25 canals for increased storage (130,000 acre-feet), (2) the construction and operation of four stormwater treatment areas to reduce the introduction of sediment, phosphorus, and nitrogen into the estuary and lagoon, (3) the restoration of upland and wetland habitat, (4) the redirection of water from the C-23/24 basin to the north fork of the St. Lucie River to attenuate freshwater flows to the estuary,(5) muck removal from the north and south forks of the St. Lucie River and middle estuary, and (6) the creation of oyster shell, reef balls, and artificial submerged habitat near muck removal sites for added habitat improvement. The project is expected to provide significant water quality improvement benefits to both the St. Lucie River and estuary and Indian River Lagoon by reducing the load of nutrients, pesticides, and suspended materials from basin runoff (Figure 9).

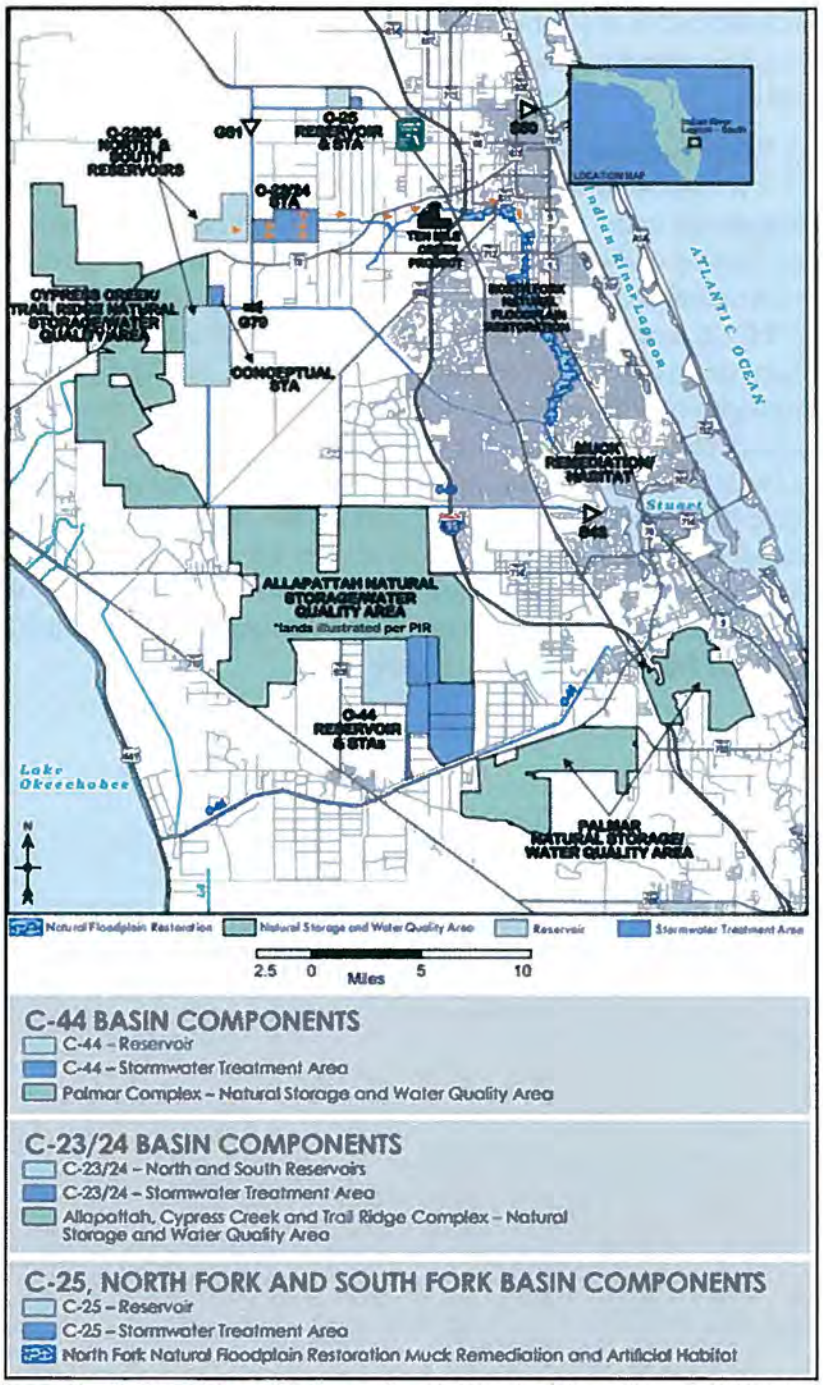

Figure 9. Indian River Lagoon South Project Location and Features

Consultation was complete in 2002, determining that the project may affect, but is not likely to adversely affect sea turtles, Johnson's seagrass, and Johnson's seagrass critical habitat. The smalltooth sawfish was listed after this project's consultation and needs to be considered in this consultation. The project is not located in sawfish critical habitat. Project features include building pumps, levees, canals, and other structures. These features are required in order to operate and interconnect project features, provide a mechanism for re-directing freshwater

discharges to the north fork of the St. Lucie River, and facilitate muck removal and habitat restoration actions inside the estuaries.

Smalltooth sawfish may be adversely affected by being temporarily unable to use the site for foraging and shelter due to avoidance of construction activities, related noise, and physical exclusion from areas blocked by turbidity curtains. Muck removal has not yet been completely designed for this project, therefore we are including measures to reduce any risk to NMFS's species. Construction will include minor dredging of muck by a mechanical dredge along with upland construction projects. All construction will be limited to daylight hours only to help construction workers spot sea turtles near the project areas and avoid interactions with these species. These effects will be insignificant, given the small area anticipated to be dredged and the short, daylight-only construction time limited likely needed to complete the task. The USACE will be required to follow NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, which require work to stop if a protected species is seen within 50 feet of operating construction equipment. Additionally, turbidity controls will enclose the project site and be removed after construction which will not appreciably block use of the area by ESA-listed species, but will help prevent these species from getting close to the active construction site. The construction activies have not changed from previous consultation conclusions and will not impact foraging or refuge habitat for smalltooth sawfish. Thus we believe that effects to this species from construction activity are discountable. Once a muck removal plan is developed, USACE will provide this to NMFS in order to assure that the above measures are followed.

5.3.6 Picayune Strand Restoration

The Picayune Strand project involves restoration of natural water flow across 85 square miles in western Collier county that were drained in the early 1960s in anticipation of extensive residential development. The subsequent development dramatically altered the natural landscape, changing a healthy wetland ecosystem into a distressed environment. The goal is to restore wetlands in Picayune Strand and in adjacent public lands by reducing over-drainage while restoring a natural and beneficial sheetflow of water to the Ten Thousand Islands National Wildlife Refuge. Project features include 83 miles of canal plugs, 227 miles of road removal, and the addition of pump stations and spreader swales to aid in rehydration of the wetlands. Restoration benefits include wetland restoration and subsequent reemergence of foraging wading birds and native flora. In addition to restoring freshwater wetlands, the project will improve estuarine water quality by increasing groundwater recharge and reducing large and unnatural freshwater inflows.

On October 20, 2004, the USACE requested concurrence from NMFS on its no effect determination on smalltooth sawfish, green sea turtle, Kemp's ridley sea turtle, and loggerhead sea turtle. Re-initiation of consultation is needed since smalltooth sawfish critical habitat was designated after the original consultation was completed.

A recent potential project feature would remove up to two acres of mangrove habitat approximately one-half mile north of the smalltooth sawfish critical habitat along the Faka Union Canal (Figure 10). These effects will be discountable because the mangroves are likely located above the Mean High Water Line and inaccessible to sawfish because they are only hydrated during extreme storm events.

The mangroves are located west of the Faka Union Canal and all construction would take place from upland areas.

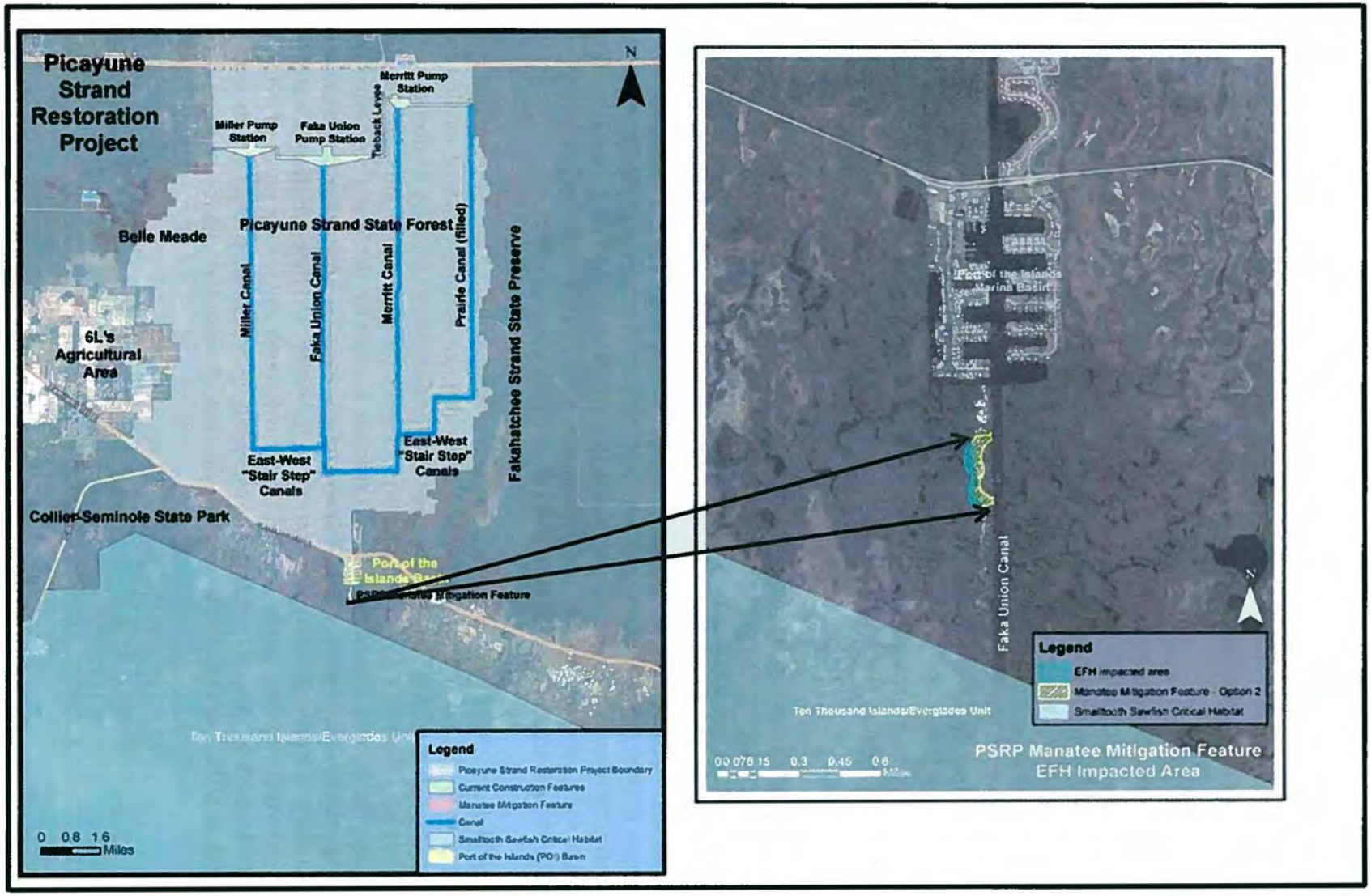

Figure 10. Picayune Strand Project Area and Potential Manatee Mitigation Feature with Smalltooth Sawfish Critical Habitat

5.4 Central Everglades Planning Project (CEPP)

CEPP is being described in detail in this document because the USACE is currently seeking authorization to construct new projects to achieve CEPP's goals, and authorization is contingent upon completion of consultation. As discussed below, CEPP assumes that some CERP projects are already completed, including some that have previous consultation histories, and some projects to be constructed in the future.

The purpose of CEPP is to propose implementation of a new set of components of CERP. Since the CERP framework and initial projects were approved through WRDA 2000, three projects were authorized in the 2007 WRDA and proceeded into construction (IRL-South, Picayune Strand, and Site 1 Impoundment) and a fourth project, Melaleuca and Other Exotic Plants Biological Controls, was implemented under the programmatic authority in WRDA 2000. Despite this progress, ecological conditions and functions within the central portion of the Everglades ridge and slough community continue to decline due to lack of sufficient quantities of freshwater flow into the central Everglades and timing and distribution problems. To respond to this concern, the USACE and the South Florida Water Management District initiated CEPP in November of 2011 to evaluate alternatives for restoring ecosystem conditions in the central portion of the Everglades and opportunities for providing for other water-related needs in the region.

This project incorporates restoration components primarily intended to benefit freshwater wetlands and estuarine resources by distributing freshwater flows through WCA 3A, 3B, and ENP. The CEPP project assumes that the following CERP projects are complete: (1) IRL-S, (2) Picayune Strand Restoration Project, (3) Site 1 Impoundment Project, (4) BBCW Project, (5) C-43 West Basin Storage Reservoir, and (6) C-111 Spreader Canal Western Project. CEPP encompasses ENP Seepage Management within its project, therefore combining the two. Because all CERP projects expected to potentially affect NMFS species or their critical habitat are assumed to be complete prior to implementation of CEPP, the modeling analysis for CEPP is inclusive of the programmatic effects of individual CERP projects effects.

CEPP would decrease the large freshwater pulse releases from Lake Okeechobee that currently are sent east to the St. Lucie and west to the Caloosahatchee estuaries, instead sending the water southward through the EAA canals to flowage equalization basins (similar to stormwater treatment areas). The reduction of existing high flows to the estuaries would help restore them by regulating the salinity regimes in a more favorable manner for listed and non-listed species. The flowage equalization basins would deliver water to existing stormwater treatment areas, which would reduce phosphorus concentrations in the water, and then the treated water would be released at the northwestern end of WCA 3A to flow through and restore much of WCA 3A, 3B, ENP, and Florida Bay. Several existing levees, canals, culverts, and pump stations would be constructed, modified, or removed to improve the flow of water through the system (Figure 11).

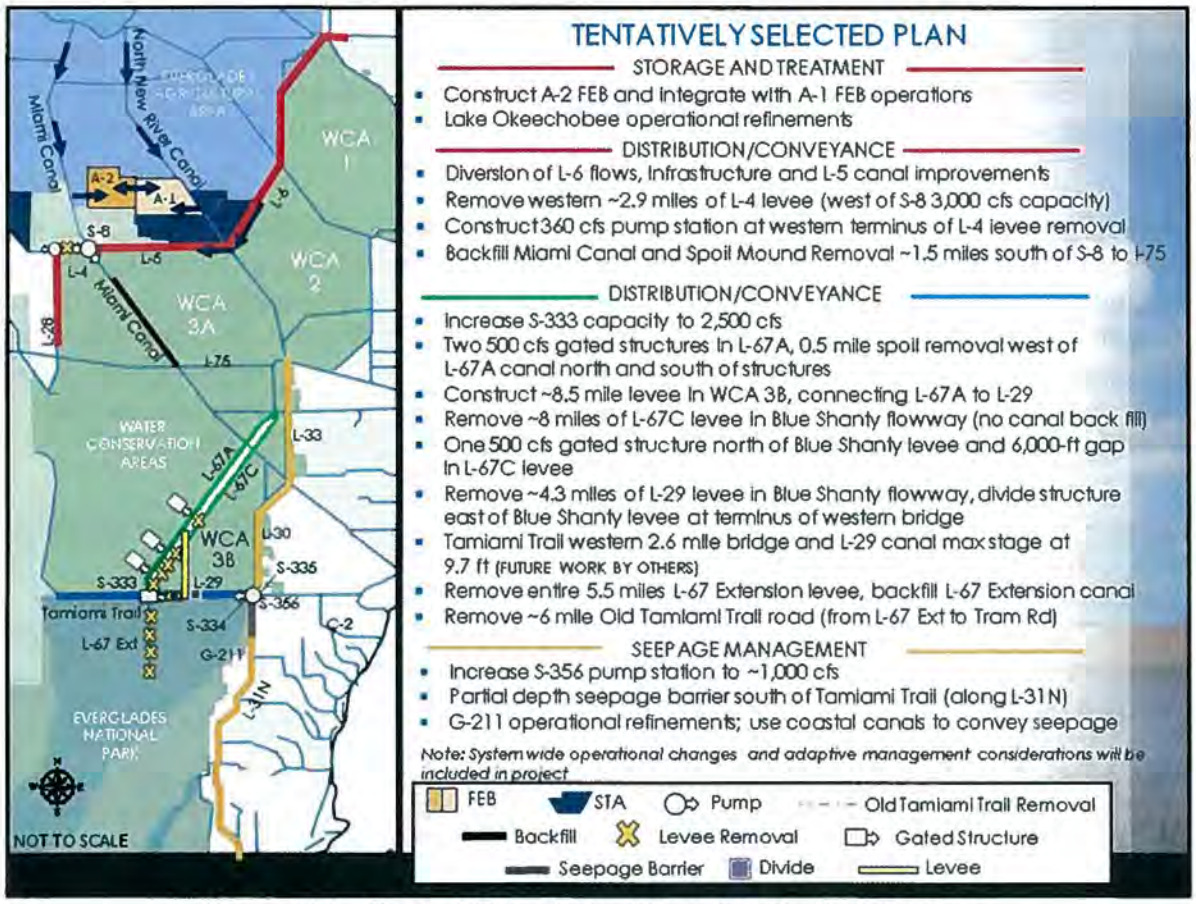

Figure 11. Central Everglades Planning Project Features

Consultation for six of these CERP projects were previously conducted. In its BA, the USACE determined CEPP would have no effect on corals or listed whales, due to these species' habitats outside of the expected extent of impacts of this project. The USACE determined, and NMFS concurs, that CEPP's construction activities may affect, but are not likely to adversely affect, green, hawksbill, leatherback, Kemp's ridley, and loggerhead sea turtles, and smalltooth sawfish. If they would be in the inland action areas of these projects, which is unlikely, these species would be expected to be foraging or migrating through project construction areas, but their mobility, and implementation of NMFS' sea turtle and sawfish construction conditions, will allow them to avoid any adverse effects from construction.

The program-level effects of CEPP through changes in freshwater flow and hydrology are discussed in Section 6.0.

6.0 CERP Program Effects on Listed Species or their Critical Habitat

NMFS has considered all routes of effects that CERP could have on listed species and critical habitat and determined that species and critical habitats may be affected through either impacts of construction activities or through changes to freshwater hydrologic flows. As described above, NMFS has previously consulted on all potential projects that may have construction impacts, with the exception of the Florida Keys Tidal Restoration Project which is not covered by this consultation and some components of CEPP, which are evaluated above. NMFS has determined that effects from construction, both individually and additively, would be

discountable or insignificant. All construction projects in the ranges of listed species or critical habitats will use floating turbidity curtains around all in-water construction areas and will follow NMFS's 2006 *Sea Turtle and Smalltooth Sawfish Construction Conditions*. The mobility of species that may be in the action area of construction activities allows them to avoid construction impacts.

As discussed below, CERP's program effects to freshwater hydrologic flows, individually and additively, would have solely beneficial effects to NMFS listed species and critical habitats. Potential effects would result from change in freshwater flows and alteration of salinity through the south Florida ecosystem. The Recovery Plans for some NMFS species indicate that restoring more natural freshwater flows would be a conservation measure for the species. CERP program effects are meant to be beneficial in nature to help restore the historic/more natural quality, quantity, timing, and distribution of freshwater flows throughout south Florida.

6.1 CEPP Modeling Evaluations and Key Findings

Modeling that was completed for CEPP includes the existing (current in 2010 when the project began) conditions, the Future Without Project (FWO), and CEPP. The FWO project assumptions contains all CERP projects listed in this consultation with the exception of the Florida Keys Tidal Restoration Project. CERP projects are also included in the CEPP Preferred Alternative modeling which provides an additive evaluation of program effects. Therefore, all discussion of CEPP modeling is an evaluation of the CERP program.

Evaluations of CEPP were performed using performance measures, independent analysis of the RECOVER system-wide evaluation (CEPP PIR/EIS Annex E), and a benefits model analysis (CEPP PIR/EIS Appendix G), as well as best professional judgment. This consultation is reiterating the key findings, however, a more detailed analysis of CEPP performance measures and modeling can be found in the CERP Programmatic BA or is located in the CEPP PIR/EIS located on www.evergladesplan.org. Modeling assumptions are explained in more detail in Section 2, Table 2-2 in the CEPP PIR/EIS.

The RECOVER system-wide evaluation was completed on Alternatives 1-4 of CEPP and not on the preferred Alternative (Alt 4R2). RECOVER recommendations were incorporated into Alternative 4R to improve performance in the St. Lucie Estuary, Water Conservation Area 2, and Biscayne Bay. Because most of the changes to CEPP Alternative 4R2 (preferred alternative) were limited to the southern end of the system, RECOVER scientist models were only rerun to determine Florida Bay benefits and to understand potential effects on Biscayne Bay. RECOVER scientists agree that Alternative 4R2 results to Biscayne Bay improved over Alternatives 1-4 for increased freshwater flows.

6.1.1 Northern Estuary Modeling

The northern estuary restoration goals include re-establishment of a salinity range favorable to juvenile marine fish, shellfish, oysters, and SAV, re-establishment of seasonally appropriate freshwater flows of favorable quality that maintain low salinities in the upper estuary and re-establishment of more stable salinities and ranges in the lower estuary.

In the Caloosahatchee, targets were based on freshwater discharges from C-43 canal at the S-79 structure where the mean monthly inflow should be maintained between 450 and 2,800 cubic feet per second (cfs). Targets were developed to reduce minimum discharge and mediate high flow events to the estuary to improve estuarine water quality and protect and enhance estuarine

habitat and biota. Ultimately, the low flow target is no months during October to July when the mean monthly inflow from the Caloosahatchee watershed, as measured at S-79, falls below a low-flow limit of 450 cfs (C-43 basin runoff and Lake Okeechobee regulatory releases). Ultimately, the high flow target is no months with mean monthly flows greater than 2,800 cfs, as measured at the S-79, from Lake Okeechobee regulatory releases in combination with flows from the Caloosahatchee River (C-43) basin.

The St. Lucie Estuary restoration requires addressing high volume, long duration discharge events from Lake Okeechobee, the C-44, C-23, and C-24 watersheds. The flow targets are designed to result in a favorable salinity envelop in the mid estuary of 8 to 25 psu salinity. Only discharges from Lake Okeechobee were included in the St. Lucie Estuary flow targets. This is due to the fact that the watershed flow targets are being addressed in the IRL-S Project which is included in the 2050 base conditions. Full restoration targets are estimated to be 31 months where mean flow is less than 350 cfs and 0 Lake Okeechobee regulatory discharge events (14 day moving averages > 2000 cfs).

Performance measures within the northern estuaries were used to measure the suitability for oyster and SAV habitat based on target flows from structures S-79 and S-80. CEPP will improve conditions for estuarine and marine resources throughout the northern estuaries by restoring more natural timing, volume, and duration of freshwater flows to the Caloosahatchee and St. Lucie estuaries with the potential to provide a more appropriate range of salinity conditions by reducing extreme salinity fluctuations. Performance measure scores within the northern estuaries were generated from the model at S-79 and S-80. Calculation of habitat benefits achieved by each of the project alternatives is restricted to portions of the estuary where changes in salinity in relation to freshwater flows at S-79 and S-80 can be reasonably predicted.

Modeling results indicate that CEPP would reduce the number of high flow events in both estuaries, thereby improving habitat for oyster and SAV. The low flow reductions were minimal, however, the RECOVER scientists state that the results provide indication that CEPP is moving restoration in the right direction.

6.1.2 Southern Coastal Systems Modeling

A desired result of restored hydroperiods through CEPP is to increase densities of small fishes and macroinvertebrates throughout the Everglades, especially in the southern Everglades. Because small fishes are the most abundant vertebrates in the Everglades and are consumed by large predators, the Trophic Hypothesis predicts that an increase in density of small fish will benefit higher trophic-level predators such as wading birds, reptiles, and larger fish that depend on them as a food source. This CEPP model (Cantano and Trexler, 2013[9]) compares freshwater fish densities in the WCA 3A and 3B, Shark River Slough, and Taylor Slough of existing conditions against FWO and CEPP.

Results of these model comparisons agree that abundance of both small fishes and largemouth bass would increase under the CEPP hydrologic model scenarios compared to the Existing

[9] Catano, C. and J. Trexler. 2013. CEPP Model Comparison of Predicted Freshwater Fish Densities, Draft 3.0. Comprehensive Everglades Restoration Plan, Restoration Coordination and Verification (RECOVER). U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, Florida, USA and South Florida Water Management District, West Palm Beach, Florida, USA.

Conditions hydrology or the FWO. The increased fish productivity under CEPP is linked to longer hydroperiods and reduced severity of drying events in regions south of the L-5 canal (WCA 3A, WCA 3B, Shark River Slough, Southern Marl Prairies, Taylor Slough). CEPP Alternative 4 yielded the greatest benefits for fish production. There were relatively small differences between these two scenarios in the predicted benefits on small fish density and largemouth bass.

RECOVER evaluations determined that the model-predicted salinity improvements in Florida and Biscayne Bays translated to a noticeable increase in abundance of juvenile spotted trout, pink shrimp, juvenile crocodiles, and SAV. Salinity improvements from CEPP over the existing conditions and FWO include a more stable salinity regime for marine species in the estuaries due to a reduction in large freshwater pulse releases from Lake Okeechobee with CERP features such as more water storage, decreased acreage of levees acting as barriers to sheetflow, and increased overland freshwater flows throughout south Florida (CEPP PIR/EIS Annex E – RECOVER System-wide Evaluation).

6.2 Sea Turtles

There are five species of sea turtles (green, hawksbill, Kemp's ridley, leatherback, and loggerhead) that may be affected within the action area due to habitat alteration. Although these species may be present in the action area, adverse effects would not be expected to occur to them or their habitat due to the alteration of freshwater flows. On the contrary, increased freshwater flows to the estuaries would potentially benefit the species by better regulating the frequency of high volume freshwater discharges as well as regulating low flow events from Lake Okeechobee to the Caloosahatchee and St. Lucie River estuaries. Increased freshwater flows to the estuaries due to CERP are expected to regulate the salinity regime within the estuaries, thereby beneficially affecting seagrass foraging habitat. This beneficial regulation of salinity regimes is documented in the RECOVER system-wide evaluation, as well as the Habitat Modeling for CEPP (CEPP PIR/EIS Annex E and G). CERP expects to increase freshwater flows to Florida Bay; however, this would not alter the foraging base for the leatherback and is therefore unlikely to be impacted by activities in the proposed action. Based on the above discussion, we consider the potential for impacts to sea turtles to be discountable and they are not likely to be adversely affected by the program.

6.3 Smalltooth Sawfish and its Critical Habitat

Smalltooth sawfish and its critical habitat are within the action area that may be affected by the programmatic effects of CERP on freshwater flow and hydrology. The critical habitat consists of two units: the Charlotte Harbor Estuary Unit (CHEU) located in Charlotte and Lee Counties, which comprises approximately 221,459 acres (346 mi^2) of coastal habitat; and the Ten Thousand Islands/Everglades Unit, located in Collier, Monroe, and Miami-Dade Counties, which comprises approximately 619,013 acres (967 mi^2) of coastal habitat. The essential features of critical habitat are red mangroves and shallow, euryhaline waters less than 3 feet mean lower low water (MLLW). The only essential feature of critical habitat that would be affected by the proposed action is mangroves. NMFS has identified the following potential effects to smalltooth sawfish and its critical habitat, and concluded they will not likely be adversely affected by the program.

The goal and expectation of CERP is to decrease large freshwater pulse releases from Lake Okeechobee to the estuaries, and specific to the sawfish, the Caloosahatchee estuary which

contains critical habitat. The change in freshwater flows throughout central and south Florida would benefit the sawfish with more stable salinity regimes in the estuaries as well as providing more historic overland flows to Ten Thousand Islands and Florida Bay, thereby improving mangrove wetland habitat[10].

The ideal salinity range for sawfish is 18- 30 parts per thousand (ppt) (Poulakis et al 2011[11]). CEPP used salinity envelopes in their model by range of tolerability for tape grass (*Vallisneria Americana*) and oysters, which have a similar range to sawfish at 16-28 psu, with this range considered beneficial and less harmful to estuarine flora and fauna (USACE 2013 Appendix E[12]).

CEPP modeling results indicate that at Shell Point (Figure 12), which is within sawfish critical habitat, salinity is increased within the ideal range for oysters (16-28) from existing conditions at 8,569 psu to 9,870 psu with CEPP due to the reduction of freshwater pulse releases from Lake Okeechobee. Since the sawfish range is similar to the oyster, this increase in salinity at Shell Point (lower estuary) would benefit the smalltooth sawfish and its critical habitat as the salinity is better than current conditions.

The salinity regimes also improved at Cape Coral (middle estuary) from existing conditions to the FWO, and then improved more with CEPP (Table 4).

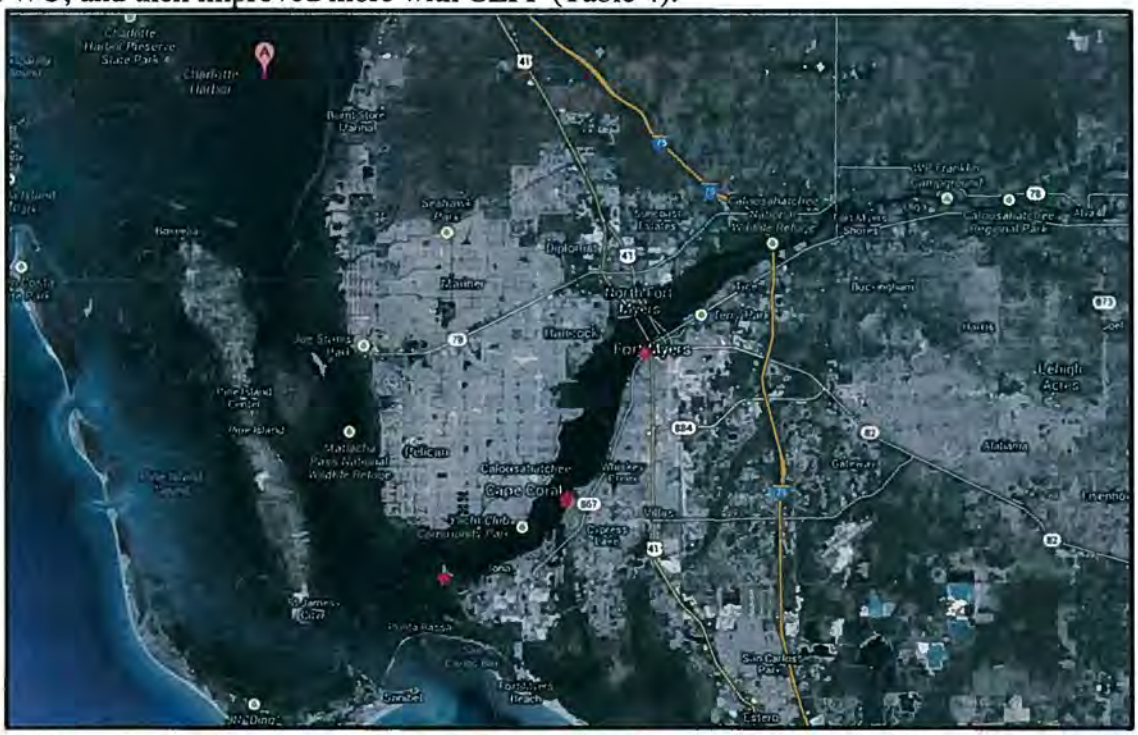

Figure 12. Salinity collection points in the Caloosahatchee Estuary used in CEPP Analysis. The red dots indicate where information was collected.

[10] http://www.evergladesplan.org/pm/recover/recover_docs/et/ne_pm_salinityenvelopes.pdf pg 9

[11] Poulakis, G.R., Stevens, P.W., Timmers, A.A., Wiley, T.R., and Simpfendorfer, C.A. (2011). Abiotic affinities and spatiotemporal distribution of the endangered smalltooth sawfish, *Pristis pectinata*, in a south-western Florida nursery. Marine and Freshwater Research. Available online (www.publish.csiro.au/journal/mfr)

[12] USACE 2013. Draft Project Implementation Report and Environmental Impact Statement for the Central Everglades Planning Project. Appendix E – RECOVER System-wide Evaluation. Jacksonville, FL.

Table 4. Distribution of daily average salinity modeled at Cape Coral Bridge. Table extracted from Annex E, RECOVER system-wide evaluation of CEPP.

Salinity ranges	Existing Conditions	FWO	CEPP
<16 psu	8596	8461	8025
16-28 psu	5640	6404	6772
>28	733	110	178

Implementation of CERP could benefit the smalltooth sawfish and its critical habitat with more stable salinity regimes in the estuaries as described above, and is consistent with the objectives of the Sawfish Recovery Plan[13], which states that one of the causes of sawfish decline was the diversion of freshwater runoff to the coast and throughout Ten Thousand Islands. CERP goals are in line with conservation aspects in the recovery plan to minimize or eliminate the disruption of natural and historic freshwater flow regimes (including timing, distribution, quality, and quantity) and maintain or restore water quality to ensure long term viability of sawfish. The potential restored hydrology provided by CERP would increase the periodic inundation of the downstream mangrove wetlands, which depend on this periodic inundation; the lack of freshwater from upstream sources contributes to their degradation. Based on the above discussion, we consider the potential programmatic effects to smalltooth sawfish and its critical habitat from freshwater flow to be beneficial and are therefore not likely to be adversely affected.

6.4 Johnson's Seagrass

Johnson's seagrass and its critical habitat have the potential to be affected within the action area in the St. Lucie estuary as well as the southern estuaries. The essential features of Johnson's seagrass critical habitat are: (1) adequate water quality; (2) adequate salinity levels; (3) adequate water transparency; and (4) stable, unconsolidated sediments that are free from physical disturbance. All four essential features must be present in an area for it to function as critical habitat for Johnson's seagrass.

Based on a study by Virnstein (1997[14]) in the Indian River Lagoon area (CERP project), the reduced high volume discharge to the northern estuaries due to implementation of CERP would benefit seagrass due to decreased siltation, increased water clarity, and more stable salinity envelopes, thus also beneficially affecting the features of Johnson's critical habitat. In the RECOVER annual report (2009[15]), the Interim Goals on Seagrass section suggest that Johnson's seagrass is expected to expand with improved salinity conditions. Analysis performed by the RECOVER team in 2013 for CEPP revealed that salinity envelopes for seagrasses improved with CEPP in the northern estuaries, Florida Bay, and Biscayne Bay. Based on the above discussion, we consider the potential for impacts to Johnson's seagrass and its critical habitat to be beneficial and this species is not likely to be adversely affected.

6.5 Corals

Elkhorn and staghorn coral and their critical habitat occur on the Atlantic side of Florida and have the potential to be affected by CERP. For elkhorn and staghorn coral, the physical feature

[13] NMFS. 2009. Recovery Plan for Smalltooth Sawfish (*Pristis pectinata*).

[14] Virnstein, R.W., L.J. Morris, J.D. Miller, and R. Miller-Myers. 1997. Distribution and abundance of Halophila johnsonii in the Indian River Lagoon. St. Johns River Water Management District Technical Memorandum #24. November 1997. 14 pp.

[15] USACE, 2009. RECOVER: 2009 System Status Report. http://www.evergladesplan.org/pm/ssr_2009/ssr_main.aspx

of critical habitat essential to the conservation of the species is substrate of suitable quality and availability, in water depths from the mean high water line to 30 meters, to support successful larval settlement, recruitment, and reattachment of fragments. Substrate of suitable quality and availability means consolidated hardbottom or dead coral skeletons free from fleshy macroalgae and sediment cover.

Proposed listed species of corals include the elliptical star coral, Lamarck's sheet coral, star coral, mountainous star coral, pillar coral, rough cactus coral, and boulder star coral that are located on the Atlantic and Caribbean side of Florida could also have the potential to be affected by CERP. Program effects include alteration of habitat due to changes in freshwater distribution throughout south Florida. Habitat suitability and quality are factors impacting recovery of the two listed species (http://sero.nmfs.noaa.gov/pr/esa/acropora.htm). Although the action area of CERP encompasses the shoreline, effects from freshwater flow alterations are not expected to reach the proximity of corals and their critical habitat. However, the southern estuaries are expected to receive more overland freshwater flows, thereby providing more stable salinity regimes within the southern coastal systems (see Section 6.1.2, Annex E of the CEPP PIR/EIS or Appendix G – Benefits Model of the CEPP PIR/EIS). Based on the above discussions, we consider the potential for impacts to corals and their critical habitat to be beneficial and are not likely to be adversely affected.

7.0 Conclusion and Next Steps

Based on our analysis, we concur with the USACE's determination that CERP is not likely to adversely affect any listed species or their designated critical habitat under our purview. CERP system-wide evaluation reports are provided to all agencies every four to five years and will be reviewed by NMFS. All reports are posted to the web: http://www.evergladesplan.org/pm/recover/assess_team.aspx. Because this is an ongoing action and involves assumptions about future individual projects, USACE has a continuing duty to ensure the program and its effects are not modified in a way that requires reinitiation of consultation, or that reinitiation is required due to new species listings or critical habitat designations in the future. As part of this responsibility, USACE will review all projects covered by this consultation as authorization to construct them is sought, to ensure that their locations and construction activities are not different than as evaluated in this consultation to the extent it requires additional consultation with NMFS.

This concludes the USACE's consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action.

Additional relevant information is enclosed for your review. We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat.

If you have any questions on this consultation, please contact Kay Davy, consultation biologist, at (727) 415-9271, or by e-mail at kay.davy@noaa.gov.

Sincerely,

Miles M. Croom

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: 1. *Sea Turtle and Smalltooth Sawfish Construction Conditions* (Revised March 23, 2006)
2. *PCTS Access and Additional Considerations for ESA Section 7 Consultations* (Revised June 11, 2013)
3. Prior NMFS Concurrence Documentation for CERP Projects

cc: F/SER4 – Kay Davy

File: 1514-22.F.4

ACRONYMS AND ABBREVIATIONS

BA	Biological Assessment
C-43	Caloosahatchee River Project(C-43)
C&SF	Central and South Florida
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
CH	Critical Habitat
cfs	Cubic Feet per Second
EAA	Everglades Agricultural Area
EIS	Environmental Impact Statement
ENP	Everglades National Park
ESA	Endangered Species Act
FWO	Future Without Project
IRL-S	Indian River Lagoon South Feasibility Study
LNWR	Loxahatchee National Wildlife Refuge
LORS	Lake Okeechobee Regulation Schedule
MAP	Monitoring and Assessment Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
PIR	Project Implementation Reports
Psu	Pratical Salinity Units
RECOVER	REstoration COordination VErification
SAV	Submerged Aquatic Vegetation
STA	Stormwater Treatment Area
USACE	U.S. Army Corps of Engineers
WCA	Water Conservation Areas
WRDA	Water Resources Development Act

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS
(REVISED MARCH 23, 2006)

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

PCTS ACCESS AND ADDITIONAL CONSIDERATIONS FOR ESA SECTION 7 CONSULTATIONS (REVISED JUNE 11, 2013)

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 7-15-2009)

Public Consultation Tracking System (PCTS) Guidance: PCTS is an online query system at **https://pcts.nmfs.noaa.gov/** that allows federal agencies and U.S. Army Corps of Engineers' (COE) permit applicants and their consultants to ascertain the status of NMFS' Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations, conducted pursuant to ESA section 7, and Magnuson-Stevens Fishery Conservation and Management Act's (MSA) sections 305(b)2 and 305(b)(4), respectively. Federal agencies are required to enter an agency-specific username and password to query the Federal Agency Site. The COE "Permit Site" (no password needed) allows COE permit applicants and consultants to check on the current status of Clean Water Act section 404 permit actions for which NMFS has conducted, or is in the process of conducting, an ESA or EFH consultation with the COE.

For COE-permitted projects, click on "Enter Corps Permit Site." From the "Choose Agency Subdivision (Required)" list, pick the appropriate COE district. At "Enter Agency Permit Number" type in the COE district identifier, hyphen, year, hyphen, number. The COE is in the processing of converting its permit application database to PCTS-compatible "ORM." An example permit number is: SAJ-2005-000001234-IPS-1. For the Jacksonville District, which has already converted to ORM, permit application numbers should be entered as SAJ (hyphen), followed by 4-digit year (hyphen), followed by permit application numeric identifier with no preceding zeros. For example: SAJ-2005-123; SAJ-2005-1234; SAJ-2005-12345.

For inquiries regarding applications processed by COE districts that have not yet made the conversion to ORM (e.g., Mobile District), enter the 9-digit numeric identifier, or convert the existing COE-assigned application number to 9 numeric digits by deleting all letters, hyphens, and commas; converting the year to 4-digit format (e.g., -04 to 2004); and adding additional zeros in front of the numeric identifier to make a total of 9 numeric digits. For example: AL05-982-F converts to 200500982; MS05-04401-A converts to 200504401. PCTS questions should be directed to Eric Hawk at Eric.Hawk@noaa.gov. Requests for username and password should be directed to PCTS.Usersupport@noaa.gov.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA section 101 (a)(5) is necessary. Please contact NMFS' Permits, Conservation, and Education Division at (301) 713-2322 for more information regarding MMPA permitting procedures.

NMFS's PRIOR CONCURRENCE

Biscayne Bay Coastal Wetlands

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701-5505
(727) 824-5312, FAX (727) 824-5309
http://sero.nmfs.noaa.gov

F/SER31:AL

NOV 03 2011

Ms. Rebecca S. Griffith
Environmental Branch
Planning Division
Jacksonville District Corps of Engineers
P.O. Box 4970
Jacksonville, FL 32232-0019

Re: Biscayne Bay Coastal Wetlands (BBCW) Project and Recommendation for Programmatic Consultation on the Comprehensive Everglades Restoration Plan and Implementation

Dear Ms. Griffith:

This responds to your June 16, 2010, letter and October 2008 biological assessment (BA) regarding the subject Corps of Engineers' (COE) project located in coastal wetlands adjacent to Biscayne Bay in Miami-Dade County, Florida. The BBCW project is a component of the larger Comprehensive Everglades Restoration Plan (CERP). The primary purpose of the BBCW project is to redistribute freshwater runoff from the watershed away from the existing canal discharges and into the coastal wetlands adjoining Biscayne Bay to provide a more natural and historic overland flow of freshwater through existing coastal wetlands (BA, page A4-5). The proposed BBCW project will include pumps, a spreader canal, canal staging, and several culvert structures to manage freshwater flows for optimal restoration opportunities to adjacent freshwater and saltwater wetlands. You determined that the proposed activity may affect, but is not likely to adversely affect smalltooth sawfish and five species of sea turtles (loggerhead, leatherback, green, hawksbill, and Kemp's ridley), and requested the National Marine Fisheries Service's (NMFS) concurrence, pursuant to Section 7 of the Endangered Species Act (ESA). In addition, you determined that the proposed activity would not affect Johnson's seagrass, elkhorn coral, or staghorn coral.

Consultation History

By letter dated June 18, 2007, the COE submitted a BA and request for ESA Section 7 consultation with NMFS on the BBCW Acceler8 project. By letter dated August 30, 2007, NMFS concurred with the COE's determination that implementation of the BBCW Acceler8 project may affect, but is not likely to adversely affect, smalltooth sawfish. The Project Implementation Report (PIR), Environmental Impact Statement (EIS), and BA are written for this project only. However, the BBCW is part of the larger CERP program evaluated in a programmatic EIS, and as such, NMFS requested additional information from the COE (via phone and e-mail on 10/3/11, 10/17/11, and 10/20/11) which was received via e-mail on

10/17/11, 10/19/11, 10/20/11, and 10/26/11. The purpose of our request was to assess the need for a programmatic ESA Section 7 consultation that would evaluate the potential effects of the CERP program on listed species and designated critical habitat under NMFS' purview. A summary of the CERP projects is provided below under Conclusion and Next Steps. The Project Description and the Effects Analysis below pertain only to the BBCW project.

To evaluate potential effects of the CERP program on listed species and critical habitat under our purview, NMFS sought additional information on the CERP program and individual projects on the CERP website (http://www.evergladesplan.org/pm/projects/landing_projects.aspx). Based on our review, there are 13 CERP projects in various stages of planning and/or construction. Of these, NMFS determined that seven of the projects may affect listed species and/or designated critical habitat under our purview; one of those projects is the subject of this consultation. The other six projects have either been constructed or would have no effect on listed species or designated critical habitat under our purview. The status of these projects is summarized below:

- C-111 Spreader Canal: On 7 May 2009, the COE requested concurrence with NMFS on its determination of may affect, but is not likely to adversely affect smalltooth sawfish and sea turtles. In addition, the COE determined that the project would not modify critical habitat for elkhorn or staghorn coral. Critical habitat for the smalltooth sawfish had not been designated until after publication of the final PIR/EIS. After further discussion with NMFS, the COE changed their determinations to no effect for each species and their designated critical habitat, and NMFS concurred by email on 6 August 2009. Per COE, construction is complete for this project; therefore, reinitiation is not required.

- Site 1 Impoundment: On 16 February 2005, the COE requested concurrence with NMFS on its determination of no effect on the smalltooth sawfish and opossum pipefish downstream of the project area. By letter dated 18 February 2005, NMFS concurred with the COE's no effect determination. Per COE, construction is complete for this project.

- Indian River Lagoon South Feasibility Study: On 18 March 2002, NMFS concurred with the COE's determination of may affect, but is not likely to adversely affect sea turtles, Johnson's seagrass, and Johnson's seagrass designated critical habitat. The COE stated that construction is not complete and reinitiation of ESA Section 7 consultation with NMFS is needed to evaluate potential effects on smalltooth sawfish (e-mail from Bradley Tarr, COE, 10-20-11). The project is not located in designated critical habitat for smalltooth sawfish.

- Caloosahatchee River (C-43) West Basin Storage Reservoir: By letter dated 18 March 2002, NMFS stated that only the Gulf sturgeon could potentially be affected by the proposed action, but concluded that the project would not adversely affect the species. On 10 January 2007, the COE submitted a revised BA to the FWS and NMFS. NMFS concurred with the COE's determination of "may affect, but is not likely to adversely affect" sea turtles and smalltooth sawfish by letter dated 20 July 2007. NMFS designated critical habitat for smalltooth sawfish on September 2, 2009. Although the project site is not located within critical habitat, it is located upstream from smalltooth sawfish critical

habitat. If construction has not been completed for this project, NMFS recommends that the COE reinitiate Section 7 consultation and address its effects in a programmatic consultation as we believe the project may affect downstream designated critical habitat for smalltooth sawfish.

- Picayune Strand Restoration Project: On 20 October 2004, the COE requested concurrence with NMFS on its determination of may affect, but is not likely to adversely affect the smalltooth sawfish, the green sea turtle, Kemp's ridley sea turtle and the loggerhead sea turtle. As stated in the Biological Assessment published in the final PIR/EIS, NMFS concurred with the COE's effect determination for those species. This project intends to re-establish sheetflow to the Ten Thousand Islands, which has been designated as critical habitat for the smalltooth sawfish; therefore, re-initiation of consultation with NMFS is required and effects should be evaluated programmatically along with the other projects that have the potential to affect critical habitat.

- Everglades National Park (ENP) Seepage Management Project: As envisioned, this project is comprised of three components: L-31N Improvements for Seepage Management, S-356 Structures, and Bird Drive Recharge Area. These three components would work to improve freshwater deliveries to Northeast Shark River Slough and restore wetland hydroperiods and hydropatterns in ENP via seepage management. Planning efforts proceeded up to the formulation of an initial array of alternatives; however, the project is on hold until related projects can develop the best possible solutions for seepage management out of ENP. Therefore, ESA consultation on this project should be included in the proposed programmatic consultation no later than when the project planning resumes.

Based on the preceding, it is evident that some of the projects listed above (e.g., Indian River Lagoon South, C-43, Picayune Strand, and ENP) may affect one or more listed species or critical habitats under NMFS jurisdiction, and may have additive effects. Therefore, we recommend that the COE request a programmatic consultation with NMFS in order to assess potential effects of the CERP program on listed species and designated critical habitat under our purview. In the interim, we concur with the COE's determination that implementation of the BBCW project may affect, but is not likely to adversely affect smalltooth sawfish and sea turtles and that proceeding with this project pending completion of the programmatic consultation will not violate ESA sections 7(a)(2) or 7(d). Our project specific effects analysis on the BBCW project in support of that conclusion is included below.

BBCW Project Description and Effects Analysis

Based on discussions with the SFWMD, we understand that the Deering Estate and Cutler Flow Way components of the BBCW Acceler8 project are near completion (John Shaffer, SFWMD Project Manager, pers. comm. by telephone to Audra Livergood, NMFS, August 5, 2010). In addition, four culverts have been installed within the L-31E component of the Acceler8 project. No mangrove impacts are proposed for the Deering Estate component of Acceler8 or BBCW Phase 1. However, filling of mosquito ditches in the Cutler Flow Way will entail several acres of mangrove impacts. Mangrove impacts are also proposed under the L-31E component of the

BBCW Phase 1 project. Both of these components (including mangrove impacts) are discussed in greater detail below.

As described in the BA, the BBCW project objectives are to:

- Re-establish productive nursery habitat along the shoreline;
- Redistribute freshwater flow to minimize point source discharges to improve freshwater and estuarine habitat;
- Enhance and improve quantity, quality, timing, and distribution of freshwater to Biscayne Bay, including Biscayne National Park;
- Preserve and restore spatial extent of natural coastal glades habitat;
- Re-establish connectivity between the BBCW, C-111 Basin, Model Lands, and adjacent basins; and
- Restore nearshore and tidal wetland salinity regimes.

The goal of the project is to rehydrate coastal wetlands and reduce point source freshwater discharges into Biscayne Bay by replacing lost overland flow and partially compensating for the reduction in groundwater seepage by redistributing, through a spreader system, available surface water entering the area from regional canals. The proposed redistribution of freshwater across a broad front is expected to restore or enhance tidal wetlands and nearshore bay habitat. Diversion of canal discharges into coastal wetlands, as opposed to their direct discharge into Biscayne Bay, is expected to re-establish productive nursery habitat along the shoreline and reduce abrupt freshwater discharges that are physiologically stressful to fish and benthic invertebrates in Biscayne Bay near the canal discharge points (BA, page A4-8).

The project area is approximately 11,000 acres and is located in southeast Miami-Dade County, Florida (figures attached). It is comprised of three components: (1) the Deering Estate, (2) the Cutler Wetlands C-1 Flow Way, and (3) the L-31E Culverts. The Deering Estate includes the Power's Addition Parcel, also known as the Cutler Glade Rehydration Area. Features of this component include an extension of the C-100A Spur Canal, construction of a freshwater wetland on the Power's Addition Parcel, and delivery of freshwater under Old Cutler Road to the Cutler Drain and to the coastal wetlands along Biscayne Bay. The Spur Canal extension and freshwater wetland would run approximately 500 feet through the Power's Addition Parcel. The pump station required to move the water is located on the Power's Addition Parcel and has 100 cubic feet per second total capacity. The pump would discharge to a surcharge chamber and then to a 60-inch-diameter discharge pipe running under Old Cutler Road and to the outlet structure on the east side of Old Cutler Road. No other structures are proposed downstream of the outlet structure as the Cutler Drain is found immediately east of the roadway. Based on Table A4-2 in the BA, no mangrove impacts are anticipated from this component of the project.

The second component of the project is the Cutler Wetlands C-1 Flow Way. Features of this component include a pump station, a conveyance canal, culverts for roadway and canal crossings, and a spreader canal. This component also includes plugging and filling of mosquito ditches found in the saltwater wetlands east of the L-31E Levee and Canal. According to the BA, the intent is to discourage the channelization of freshwater delivered to the area by the spreader canals. Currently, the mangrove wetlands that have been impacted by mosquito ditches

are not receiving adequate amounts of freshwater, especially during times of drought. The plugging and filling of the ditches should help alleviate the channelization of freshwater and should restore a more natural flow of freshwater to rehydrate these wetlands. Based on Table A4-2 in the BA, the COE estimates 2.1 acres of mangroves would be impacted by filling/plugging approximately 2,500 linear feet of mosquito ditches. In addition to filling/plugging of mosquito ditches and rehydrating the wetlands, this component also includes removal of exotic vegetation.

The third component of the project is the L-31E Culverts. This component is divided into the L-31 North area (described in the BA as the portion of the project between the C-1 Canal to the north and the Military Canal to the south) and the L-31 South area (described in the BA as the portion of the project between the Military Canal to the north and the North Canal to the south). Features of this component include installing structures that would isolate the L-31E Canal from the major discharge canals (C-102 Canal and the Military Canal) as well as gated riser culverts (L-31E Culverts) that would deliver water from the L-31E Canal, through the L-31E Levee, and discharge freshwater into the saltwater wetlands to the east. In addition, a pump station would be constructed to mimic the intent of the L-31E Culverts by pumping water over the L-31E Levee and delivering it to the saltwater wetlands. The L-31E component involves the installation of ten culverts (five in the L-31 North area and five in the L-31 South area). The culverts would gravity discharge to the east at the edge of the wetlands. Flap gates would be installed on the culverts to prevent saltwater intrusion during periods of high tide when the tailwater elevation could exceed the headwater elevation. The purpose of the culverts is to rehydrate the adjacent saltwater wetlands and restore a more natural flow of freshwater into Biscayne Bay. Based on Table A4-2 in the BA, the COE proposes approximately 3 acres of mangrove impacts from the L-31E component (via installation of pumps, culverts, and the spreader canal). In addition to installing culverts to benefit saltwater wetlands (i.e., mangrove-dominated wetlands), L-31E includes a freshwater wetland component. The freshwater wetland component includes two pump stations, a spreader canal, a small berm, and a seepage collector ditch. Once filled, the spreader canal would deliver overland freshwater flows to the freshwater wetland. To help alleviate flooding concerns to the west of the spreader canal, a small berm and seepage collector ditch would be constructed immediately to the west of the spreader canal.

In summary, the proposed action may involve construction impacts to approximately 5.1 acres of mangrove habitat (2.1 acres in the Cutler C-1 Flow Way and 3 acres in the L-31E component). The BA states the project will adhere to the NMFS' March 23, 2006, Sea Turtle and Smalltooth Sawfish Construction Conditions (enclosed).

The project is located south of the known range of Johnson's seagrass; therefore, NMFS believes the project would have no effect on Johnson's seagrass. Two listed species of coral, elkhorn coral (*Acropora palmata)* and staghorn coral (*Acropora cervicornis),* are known to occur within the waters of Biscayne Bay and Biscayne National Park. However, NMFS believes there would be no effect on these species because they are not found within or near the project area. There is no designated critical habitat under NMFS' purview within the project area.

Five species of sea turtles (loggerhead, green, Kemp's ridley, hawksbill, and leatherback) and smalltooth sawfish, protected by the ESA and under NMFS' purview, are known to occur within

or near the project area (in Biscayne Bay). NMFS believes smalltooth sawfish and sea turtles may be affected by the proposed work. Potential direct effects from the proposed action include adverse effects resulting from construction activities in red mangroves and nearshore waters. Potential indirect effects include habitat loss and/or alteration.

NMFS believes that direct effects from the proposed action are extremely unlikely to occur and therefore discountable. Smalltooth sawfish and sea turtles are highly mobile and likely to move away from the work area during construction. In addition, the applicant has agreed to follow the enclosed construction conditions.

NMFS believes smalltooth sawfish may be indirectly affected by habitat loss and/or alteration. The Cutler Flow Way segment of the project proposes approximately 2.1 acres of mangrove impacts via backfilling and plugging of mosquito ditches. In addition, the L-31E component of the project proposes approximately 3 acres of construction-related mangrove impacts associated with the installation of pumps, culverts, and the spreader canal. Combined, these two components propose approximately 5.1 acres of construction-related mangrove impacts. NMFS believes the 2.1 acres of mangroves within the Cutler Flow Way segment are inaccessible to sawfish because these mangroves are impounded (i.e., they are not tidally connected to Biscayne Bay). Therefore, we believe the proposed action would only affect 3 acres of red mangrove habitat that is potentially utilized by sawfish. While NMFS acknowledges that approximately 3 acres of red mangroves may be adversely affected during construction, we believe that the overall project purpose (i.e., rehydrating coastal wetlands and restoring a more natural flow of freshwater into Biscayne Bay) may benefit smalltooth sawfish. The mangroves in this area exist within a hypersaline regime. Most juvenile smalltooth sawfish have an affinity for salinity between 18 and 30 psu.[1] The proposed action would not permanently alter the salinity regime such that it would fall outside of this range; however, during extremely wet periods, salinity in the nearshore environment may fall below 18 psu for a short duration until the freshwater from land mixes with the nearshore waters of the bay (personal communication, Bradley Tarr, COE, October 28, 2011). NMFS believes juvenile smalltooth sawfish that potentially utilize red mangroves in the project area would be able to physiologically tolerate salinities below 18 psu for a short duration. In a recent study, juvenile smalltooth sawfish were captured at the mouth of the Caloosahatchee River during a period of low salinity (between 3.1-9.0 psu) caused by increased freshwater flow. These individuals remained in the study area for as long as 473 days.[2] Based on these findings, Poulakis *et al.* 2011 conclude "the water conditions observed during the capture of these sawfish probably does not reflect an affinity for low salinity, but rather a tolerance, because they remained in the river rather than egressing to the open bay to find higher salinities." Based on the preceding, NMFS believes juvenile sawfish that may be found in the project area are likely to tolerate a temporary reduction in salinity (below 18 psu) for a short duration and are not likely to be adversely affected.

---

[1] Poulakis, G.R., Stevens, P.W., Timmers, A.A., Wiley, T.R., and Simpendorfer, C.A. (2011). Abiotic affinities and spatiotemporal distribution of the endangered smalltooth sawfish, *Pristis pectinata*, in a south-western Florida nursery. Marine and Freshwater Research. Available online (www.publish.csiro.au/journal/mfr) [published online 12 August 2011].

[2] Simpendorfer, C.A., Yeiser, B.G., Wiley, T.R., Poulakis, G.R., Stevens, P.W., and Heupel, M.R. (2011). Environmental influences on the spatial ecology of juvenile smalltooth sawfish (*Pristis pectinata*): results from acoustic monitoring. *PLoS ONE* 6, e16918. Doi:10.1371/JOURNAL.PONE.0016918.

The proposed installation of culverts would rehydrate mangrove wetlands by restoring a more natural flow of freshwater to these wetlands and Biscayne Bay. NMFS believes the restoration of more natural freshwater flows to the mangroves and the bay may provide an ecological benefit to Biscayne Bay and smalltooth sawfish that potentially utilize red mangrove habitat in this area. In addition, the Cutler Flow Way component also proposes the removal of exotic vegetation, which may indirectly benefit coastal wetlands. NMFS believes the project may have a net benefit on smalltooth sawfish by rehydrating mangrove wetlands, enhancing coastal wetland function, and reducing harmful point source discharges from the major conveyance canals. We believe indirect effects due to habitat loss/alteration from the project are insignificant.

In addition to smalltooth sawfish, NMFS believes the project may affect sea turtles by habitat alteration. Foraging habitat for several sea turtle species (e.g., loggerhead, green, and Kemp's ridley) is present in the project area. NMFS believes there is the potential for changes in the species composition of seagrasses in the project area due to an increase in the amount of freshwater delivery to the coastal wetlands and nearshore waters of the project area. However, we concur with the FWS (November 18, 2009, concurrence letter from FWS to the COE for the BBCW project) that lowering salinities in the nearshore waters of the project area is not anticipated to reduce seagrass abundance in the project area; therefore, we believe the project is not likely to adversely affect sea turtles due to potential changes in their foraging habitat. Moreover, the proposed action may indirectly benefit sea turtles by minimizing harmful freshwater pulse releases and point-source discharges from the major conveyance canals, which may improve nearshore water quality and nearshore foraging habitat.

Conclusion and Next Steps

Based on our analysis, we concur with the COE's determination that the BBCW project is not likely to adversely affect any listed species under our purview and we concur with COE's determination that proceeding with the project will not violate sections 7(a)(2) and 7(d) pending completion of the recommended programmatic consultation. Be advised that the consultation on this particular project must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action.

We have enclosed additional information on other statutory requirements that may apply to this action, as well as information on NMFS' Public Consultation Tracking System (PCTS) that allows you to track the status of ESA consultations. We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation or PCTS, please contact Audra Livergood at (954) 356-7100, or by e-mail at Audra.Livergood@noaa.gov.

Sincerely,

Miles M. Croom

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosures (2)

File: 1514-22.F.4
Ref: I/SER/2010/02615

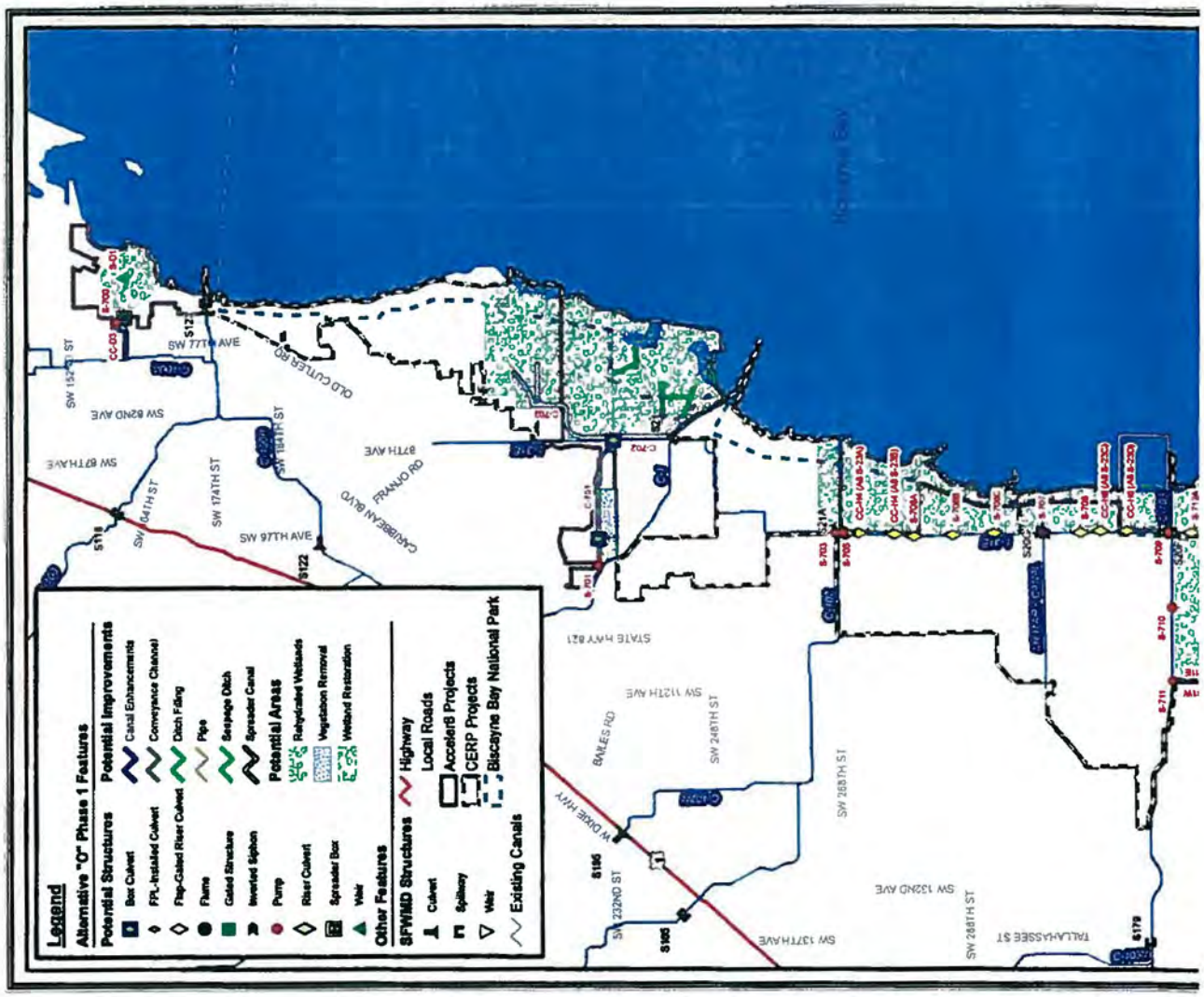
Legend
Alternative "O" Phase 1 Features
Potential Structures
Box Culvert
FPL-Installed Culvert
Flap-Gated Riser Culvert
Flume
Gated Structure
Inverted Siphon
Pump
Riser Culvert
Spreader Box
Weir
Other Features
SFWMD Structures
Culvert
Spillway
Weir
Existing Canals
Potential Improvements
Canal Enhancements
Conveyance Channel
Ditch Filling
Pipe
Seepage Ditch
Spreader Canal
Potential Areas
Rehydrated Wetlands
Vegetation Removal
Wetland Restoration
Highway
Local Roads
Accelerated Projects
CERP Projects
Biscayne Bay National Park
Biscayne Bay
SW 152ND ST
SW 82ND AVE
SW 87TH AVE
SW 77TH AVE
OLD CUTLER RD
SW 184TH ST
SW 174TH ST
SW 104TH ST
SW 97TH AVE
CARIBBEAN BLVD
FRANJO RD
87TH AVE
STATE HWY 821
SW 112TH AVE
BAILES RD
SW 248TH ST
SW 288TH ST
SW 232ND ST
SW 137TH AVE
SW 122ND AVE
SW 288TH ST
TALLAHASSEE ST
S-700
CC-03
S-712
S-711
S-122
C-702
C-701
S-701
S-703
S-700A
S-710
S-711
S-170
S-105
S-106

FIGURE A4-2: BISCAYNE BAY COASTAL WETLANDS DEERING ESTATE

FIGURE A4-3: BISCAYNE BAY COASTAL WETLANDS C-1 FLOW WAY

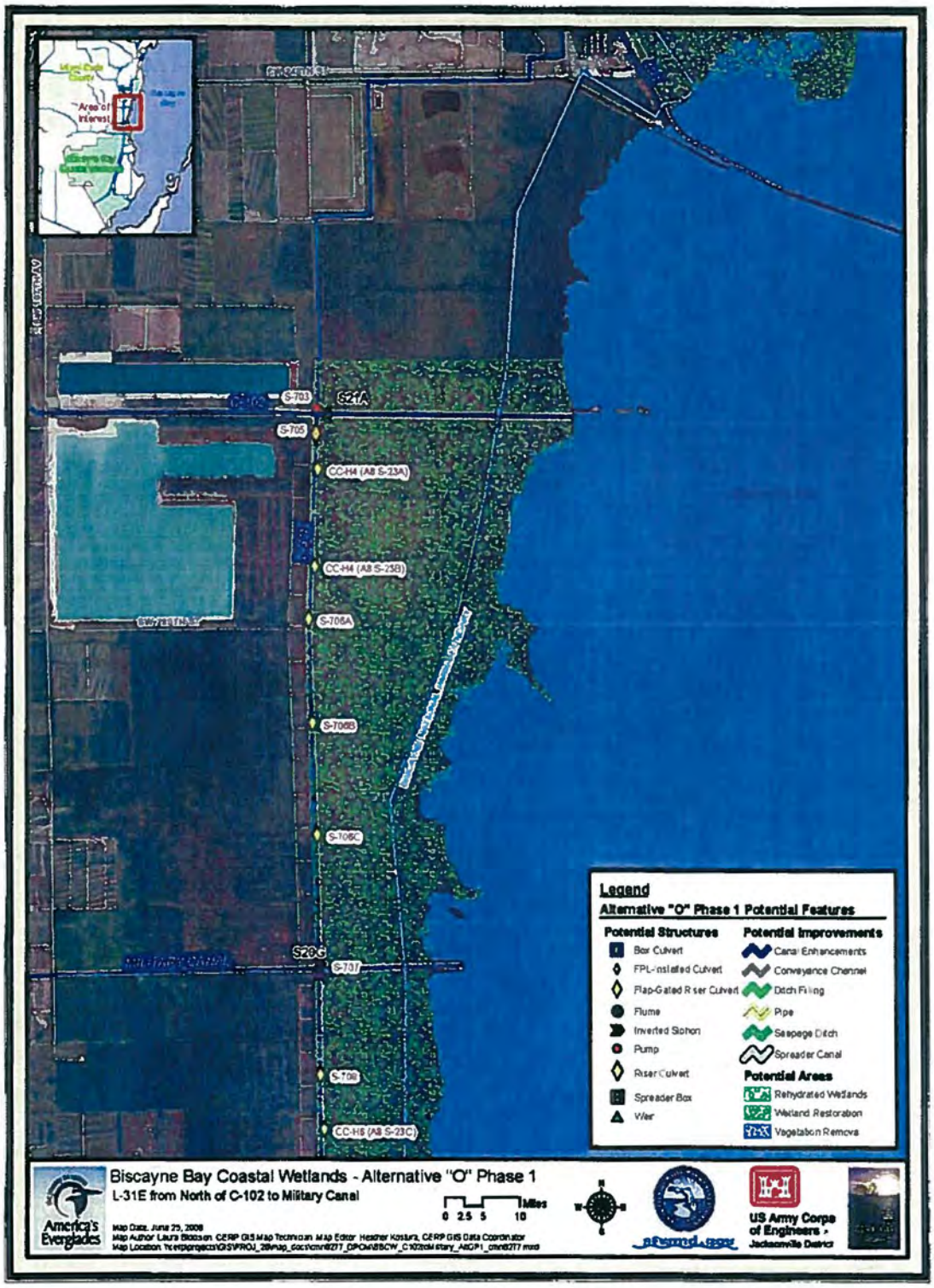

FIGURE A4-4: BISCAYNE BAY COASTAL WETLANDS L-31 FROM NORTH OF C-102 TO MILITARY CANAL

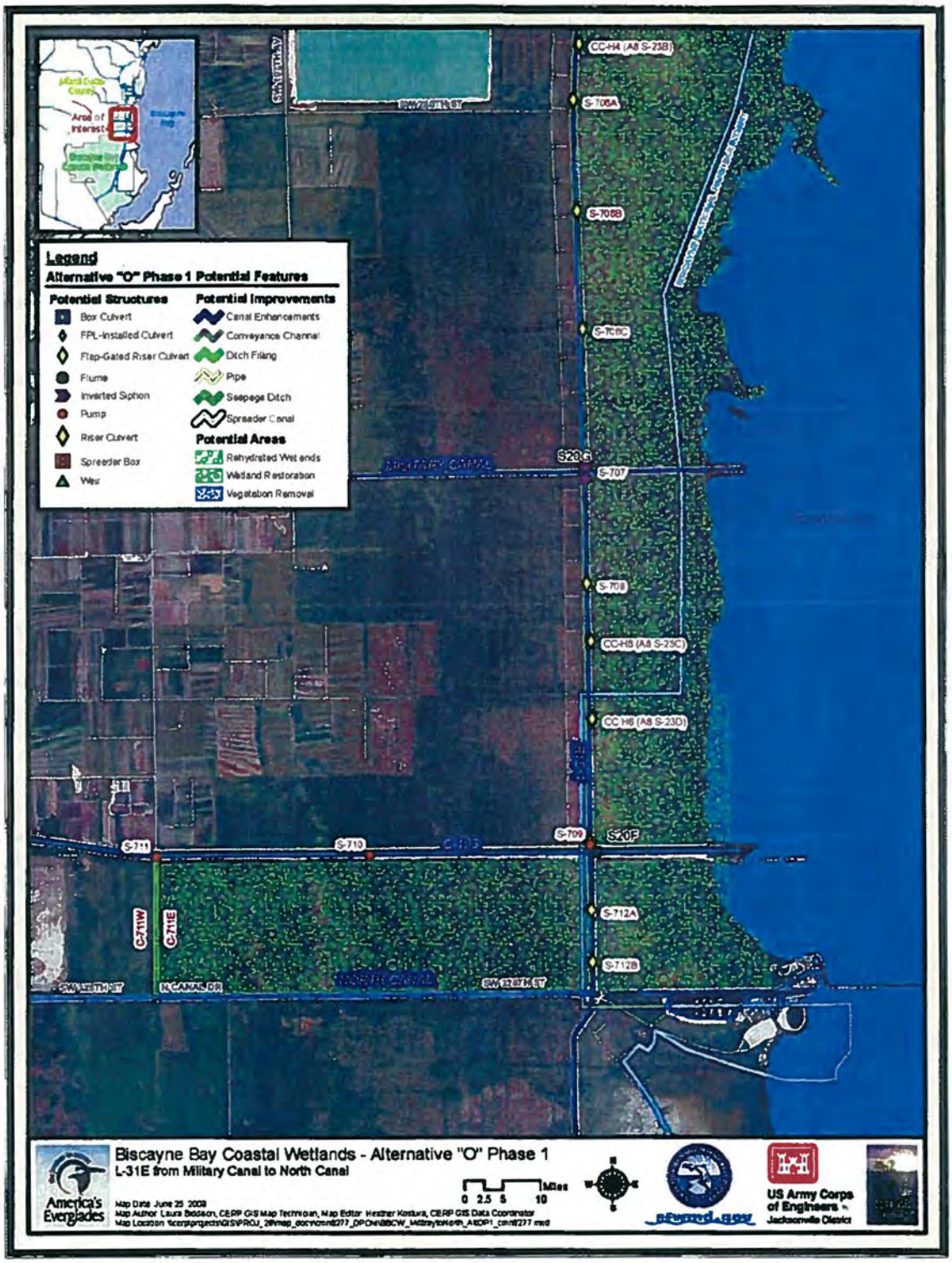

FIGURE A4-5: BISCAYNE BAY COASTAL WETLANDS L-31E FROM MILITARY CANAL TO NORTH CANAL

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

d. All vessels associated with the construction project shall operate at "no wake/idle" speeds at all times while in the construction area and while in water depths where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 7-15-2009)

Public Consultation Tracking System (PCTS) Guidance: PCTS is an online query system at **https://pcts.nmfs.noaa.gov/** that allows federal agencies and U.S. Army Corps of Engineers' (COE) permit applicants and their consultants to ascertain the status of NMFS' Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations, conducted pursuant to ESA section 7, and Magnuson-Stevens Fishery Conservation and Management Act's (MSA) sections 305(b)2 and 305(b)(4), respectively. Federal agencies are required to enter an agency-specific username and password to query the Federal Agency Site. The COE "Permit Site" (no password needed) allows COE permit applicants and consultants to check on the current status of Clean Water Act section 404 permit actions for which NMFS has conducted, or is in the process of conducting, an ESA or EFH consultation with the COE.

For COE-permitted projects, click on "Enter Corps Permit Site." From the "Choose Agency Subdivision (Required)" list, pick the appropriate COE district. At "Enter Agency Permit Number" type in the COE district identifier, hyphen, year, hyphen, number. The COE is in the processing of converting its permit application database to PCTS-compatible "ORM." An example permit number is: SAJ-2005-000001234-IPS-1. For the Jacksonville District, which has already converted to ORM, permit application numbers should be entered as SAJ (hyphen), followed by 4-digit year (hyphen), followed by permit application numeric identifier with no preceding zeros. For example: SAJ-2005-123; SAJ-2005-1234; SAJ-2005-12345.

For inquiries regarding applications processed by COE districts that have not yet made the conversion to ORM (e.g., Mobile District), enter the 9-digit numeric identifier, or convert the existing COE-assigned application number to 9 numeric digits by deleting all letters, hyphens, and commas; converting the year to 4-digit format (e.g., -04 to 2004); and adding additional zeros in front of the numeric identifier to make a total of 9 numeric digits. For example: AL05-982-F converts to 200500982; MS05-04401-A converts to 200504401. PCTS questions should be directed to Eric Hawk at Eric.Hawk@noaa.gov. Requests for username and password should be directed to PCTS.Usersupport@noaa.gov.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA section 101 (a)(5) is necessary. Please contact NMFS' Permits, Conservation, and Education Division at (301) 713-2322 for more information regarding MMPA permitting procedures.

Picayune Strand Restoration Project

Everglade snail kite, eastern indigo snake, American crocodile and West Indian manatee critical habitat. The proposed project would have "no effect" on everglade snail kite critical habitat and American crocodile critical habitat. Corps and Service biologists have agreed that there is insufficient information at this project phase to make a determination regarding effects on wood stork, West Indian manatee and Florida Panther. By letter dated October 20, 2004, the Service concurred with these determinations. A copy of the Biological Assessment for listed species found on proposed project lands is included in Appendix D. Coordination has concluded for the planning (feasibility-stage) of the project in 2004, but will continue, if the project is approved and funds are provided to continue through detailed design and construction, throughout the project life. No construction will begin until determinations of effects are coordinated with the Service for the three species of ongoing concern and concurrence is reached. It is the expectation of Corps and Service biologists that with detailed analysis, availability of pre-construction surveys, and final coordination of listed species conservation measures, concurrence may be reached early in the detailed design phase.

Initial informal consultation on marine species with the National Marine Fisheries Service (NMFS) began on May 25, 2001. Informal consultation was updated in an email exchange and a February 10, 2004 phone conversation. NOAA fisheries indicated its concurrence with a Corps information determination of no effect on listed marine species.

Section 9.6 of this report has additional information on both marine and upland listed species. With receipt of Service concurrence with current effect determinations, the Project is in compliance with the ESA for feasibility phase activities. Full compliance will be achieved when determinations on the manatee, Florida panther and wood stork are re-coordinated with the Service in a new BA, and Service concurrence is received.

11.3 FISH AND WILDLIFE COORDINATION ACT OF 1958, AS AMENDED

Consultation was initiated with FWS on February 26, 1999 in a Scope of Work (SOW) requesting a Planning Aid Letter (PAL) for the SGGE project. Several planning aid letters (PALs) have been received by the Corps (ref. Appendix D) Further coordination with the U.S. Fish and Wildlife Service resulted in the submission to the Corps of a draft Coordination Act Report (dCAR) dated February 2, 2004 and a Final report (FCAR) on September 22, 2004. The FCAR included 16 recommendations to assure that the objectives of the project would be achieved. The FWS stated that the proposed project, as described, should provide significant hydrologic improvements and enhancement of wetland

Kremer, John G SAJ

From: David Bernhart [David.Bernhart@noaa.gov]
Sent: Friday, August 10, 2001 9:04 AM
To: David Dale
Cc: Kremer John G SAJ; Eric Hawk; Jennifer Lee
Subject: Re: Southern Golden Gate Estates (SGGE) project

08-10-01 ESA phone consultation with David Bernhart of NMFS:
At approximately 1015 hrs on the above date I talked to David to explain the SGGE project. David stated that he was not aware of any listed marine species able to move up the Fahka Union Canal over the existing weir to the SGGE construction sites. Also since the project intent is to eliminate fresh water point source surges and restore the pre-alteraton overland flows which will emulate a natural hydrology he could see no negative indirect effects to listed species. He agreed that a no effects call in the EA would be justfied.

Good morning, John,

David's points on EFH consultation are directly applicable to ESA consultation as well. The adverse effect vs. net benefit is especially important. If there will be any adverse effect to a listed species, you need to consult, even if the outcome of that consultation is that the action will produce a net benefit. If the project will only produce beneficial results for ESA-listed species, then no consultation is required, but you should note in your NEPA documents that you've made these determinations.

I can send you a species list if you like. It sounds like there are none of our listed species present near the construction site. The 10,000 Islands (is this the affected downstream area?) are a very important habitat for endangered Kemp's ridley sea turtles, the proposed to be listed as endangered smalltooth sawfish, and several candidate species of fish. Please consider possible direct and indirect effects to these critters. If you need additional assistance, please call at 727-570-5312.

-DB

David Dale wrote:

> John, a couple points you may want to consider for this project and others in the future:
>
> 1. Even if an EFH or ESA Consultation is not required, you may want to note that finding in the NEPA document.
>
> 2. NMFS has a division of labor regarding habitat issues and T&E issues. EFH Consultations and NEPA or FWCA coordination's are handled by the Habitat Conservation Division (which I am in). ESA Consultations are handled by the Protected Resources Division. I'm copying David Bernhart of that Division with this response, you will want to get a response from them regarding your need to Consult.
>
> 3. Regarding EFH: Even projects that have a net positive effect on EFH still require EFH Consultation if they may adversely impact designated

EFH to implement them. For example, filling mud bottoms to an elevation to create saltmarsh results in a negative effect on mud bottoms but a positive effect on emergent wetlands and would generally be considered a net positive effect.

In this case I think all the implementing features of the project are well upstream of any designated EFH (depending where the canal is plugged) thus all the effects on EFH would be positive and consultation would not be required.

4. We've been asked to prepare EFH Assessments for FWCA Reports but it is our policy that we will not prepare EFH Assessments on behalf of another agency because it is our responsibility to review the Assessment and provide Conservation Recommendations. In essence, it would create a case where we are reviewing our own work and would create a conflict of interest. Also, EFH Assessments include the views of the Federal action agency which would not be appropriate for NMFS to provide. Bottom line is that the Magnuson-Stevens Act clearly puts that responsibility on the Federal action agency.

If this did nothing but confuse you give me a call!

David
727.570.5311

"Kremer, John G SAJ" wrote:

>
>
> David,
> Kim Dryden gave me your name as the NOAA biologist to contact about
> Essential Fish Habitat and any potential listed species for the SGGE
> project. Essentially what this project will do is reduce the Fahka
> Union Canal fresh water flows and storm surges to almost nothing.
> Instead broad slow moving sheetflow will be reestablished to the SGGE
> landscape. These waters will flow through culverts under US 41 and
> reach tide along a broad front which mimics the natural system that
> existed prior to this 1960 's real estate development debacle.
>
> At this time I have come across no information indicating that
> returning the SGGE landscape to a more natural system would have
> adverse effects on any EFH or listed aquatic species. If you have any
> information to the contrary please let me know.
>
> This project is on a very tight schedule to make the WRDA 2002
> congressional funding cycle. There is a lot of federal, state, and
> local political pressure to meet this deadline. I will be attending a
> meeting of the Interagency Team on 15 Aug 01 at the SFWMD Naples
> office. You are welcome to attend and present any information you
> have. If you are unable to attend please send your comments to me
> before 14 Aug 01 and I will present them.

> Should I not hear from you in the next week I will assume you have no
> input and the Corps will proceed with a "no effects" determination
> for this project.
>
> Thanks,
> John Kremer
> (904)232-3551
>
>

8/10/01

08-10-01 ESA phone consultation with David Bernhart of NMFS:
At approximately 1015 hrs on the above date I talked to David to explain the SGGE project. David stated that he was not aware of any listed marine species able to move up the Fahka Union Canal over the existing weir to the SGGE construction sites. Also since the project intent is to eliminate fresh water point source surges and restore the pre-alteraton overland flows which will emulate a natural hydrology he could see no negative indirect effects to listed species. He agreed that a no effects call in the EA would be justfied.

Email communication:

Good morning, John,
David's points on EFH consultation are directly applicable to ESA consultation as well. The adverse effect vs. net benefit is especially important. If there will be any adverse effect to a listed species, you need to consult, even if the outcome of that consultation is that the action will produce a net benefit. If the project will only produce beneficial results for ESA-listed species, then no consultation is required, but you should note in your NEPA documents that you've made these determinations.
I can send you a species list if you like. It sounds like there are none of our listed species present near the construction site. The 10,000 Islands (is this the affected downstream area?) are a very important habitat for endangered Kemp's ridley sea turtles, the proposed to be listed as endangered smalltooth sawfish, and several candidate species of fish. Please consider possible direct and indirect effects to these critters. If you need additional assistance, please call at 727-570-5312.
-DB
David Dale wrote:

> John, a couple points you may want to consider for this project and others in the future:
>
> 1. Even if an EFH or ESA Consultation is not required, you may want to note that finding in the NEPA document.
>
> 2. NMFS has a division of labor regarding habitat issues and T&E issues. EFH Consultations and NEPA or FWCA coordination's are handled by the Habitat Conservation Division (which I am in). ESA Consultations are handled by the Protected Resources Division. I'm copying David Bernhart of that Division with this response, you will want to get a response from them regarding your need to Consult.
>
> 3. Regarding EFH: Even projects that have a net positive effect on EFH still require EFH Consultation if they may adversely impact designated EFH to implement them. For example, filling mud bottoms to an elevation to create saltmarsh results in a negative effect on mud bottoms but a positive effect on emergent wetlands and would generally be considered a net positive effect.
>
> In this case I think all the implementing features of the project are well upstream of any designated EFH (depending where the canal is

plugged) thus all the effects on EFH would be positive and consultation would not be required.

4. We've been asked to prepare EFH Assessments for FWCA Reports but it is our policy that we will not prepare EFH Assessments on behalf of another agency because it is our responsibility to review the Assessment and provide Conservation Recommendations. In essence, it would create a case where we are reviewing our own work and would create a conflict of interest. Also, EFH Assessments include the views of the Federal action agency which would not be appropriate for NMFS to provide. Bottom line is that the Magnuson-Stevens Act clearly puts that responsibility on the Federal action agency.

If this did nothing but confuse you give me a call!

David
727.570.5311

"Kremer, John G SAJ" wrote:

>
>
> David,
> Kim Dryden gave me your name as the NOAA biologist to contact about
> Essential Fish Habitat and any potential listed species for the SGGE
> project. Essentially what this project will do is reduce the Fahka
> Union Canal fresh water flows and storm surges to almost nothing.
> Instead broad slow moving sheetflow will be reestablished to the SGGE
> landscape. These waters will flow through culverts under US 41 and
> reach tide along a broad front which mimics the natural system that
> existed prior to this 1960 's real estate development debacle.
>
> At this time I have come across no information indicating that
> returning the SGGE landscape to a more natural system would have
> adverse effects on any EFH or listed aquatic species. If you have any
> information to the contrary please let me know.
>
> This project is on a very tight schedule to make the WRDA 2002
> congressional funding cycle. There is a lot of federal, state, and
> local political pressure to meet this deadline. I will be attending a
> meeting of the Interagency Team on 15 Aug 01 at the SFWMD Naples
> office. You are welcome to attend and present any information you
> have. If you are unable to attend please send your comments to me
> before 14 Aug 01 and I will present them.
>
> Should I not hear from you in the next week I will assume you have no
> input and the Corps will proceed with a "no effects" determination
> for this project.

>
> Thanks,
> John Kremer
> (904)232-3551

Estuary selections by estuary:

Estuary	State	Common	Species	Lifestage	PDF
Ten Thousand Islands	Florida	Brown shrimp	Penaeus aztecus	Adult	Florida\TenThous\TenKbsa.PDF
Ten Thousand Islands	Florida	Brown shrimp	Penaeus aztecus	Juvenile	Florida\TenThous\TenKbsj.PDF
Ten Thousand Islands	Florida	Gray snapper	Lutjanus griseus	Adult	Florida\TenThous\TenKgsa.PDF
Ten Thousand Islands	Florida	Gray snapper	Lutjanus griseus	Juvenile	Florida\TenThous\TenKgsj.PDF
Ten Thousand Islands	Florida	Gulf stone crab	Menippe adina	Adult	Florida\TenThous\TenKgsca.PDF
Ten Thousand Islands	Florida	Gulf stone crab	Menippe adina	Juvenile	Florida\TenThous\TenKgscj.PDF
Ten Thousand Islands	Florida	Pink shrimp	Penaeus duorarum	Adult	Florida\TenThous\TenKpsa.PDF
Ten Thousand Islands	Florida	Pink shrimp	Penaeus duorarum	Juvenile	Florida\TenThous\TenKpsj.PDF
Ten Thousand Islands	Florida	Red drum	Sciaenops ocellatus	Adult	Florida\TenThous\TenKrda.PDF
Ten Thousand Islands	Florida	Red drum	Sciaenops ocellatus	Juvenile	Florida\TenThous\TenKrdj.PDF
Ten Thousand Islands	Florida	Spanish mackerel	Scomberomorus maculatus	Adult	Florida\TenThous\TenKsma.PDF
Ten Thousand Islands	Florida	Spanish mackerel	Scomberomorus maculatus	Juvenile	Florida\TenThous\TenKsmj.PDF
Ten Thousand Islands	Florida	Spiny lobster	Panulirus argus	Adult	Florida\TenThous\TenKsla.PDF
Ten Thousand Islands	Florida	Spiny lobster	Panulirus argus	Juvenile	Florida\TenThous\TenKslj.PDF
Ten Thousand Islands	Florida	Stone crab	Menippe mercenaria	Adult	Florida\TenThous\TenKsca.PDF
Ten Thousand Islands	Florida	Stone crab	Menippe mercenaria	Juvenile	Florida\TenThous\TenKscj.PDF
Ten Thousand Islands	Florida	White shrimp	Penaeus setiferus	Adult	Florida\TenThous\TenKwsa.PDF
Ten Thousand Islands	Florida	White shrimp	Penaeus setiferus	Juvenile	Florida\TenThous\TenKwsj.PDF

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southeast Fisheries Science Center
Galveston Laboratory
4700 Avenue U
Galveston, TX 77551-5997
(409) 766-3500

1 = SUBMIT

LCWRP/PBL-EIS Appendix E-A-288 February 2002

Indian River Lagoon South

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312; FAX 570-5517
http://caldera.sero.nmfs.gov

FILE #

JAN 3 2002

F/SER3:BH:mdh

Mr. John R. Hall
Stuart Regulatory Office
Jacksonville District Corps of Engineers
218 Atlanta Ave.
Stuart, Florida 34994

Dear Mr. Hall:

This is in reference to the Army Corps of Engineers' (COE) permit application number 200101177 (IP-TA). The proposed project consists of the restoration of aquatic habitat at Spoil Island, SL-15, in the Indian River Lagoon, St. Lucie County, Florida. This project includes the construction of a temporary work platform, the dredging of 0.61 acres of mangroves to create flushing channels, the removal of exotic vegetation, and the regrading of the island to create approximately 3.28 acres of submerged aquatic vegetation and 4.74 acres of mangroves. The National Marine Fisheries Service (NMFS) consultation number for this project is I/SER/2001/01161; please refer to this number in future correspondence on this project.

Five species of sea turtles (loggerhead, green, Kemp's ridley, hawksbill, and leatherback), Johnson's seagrass, and designated Johnson's seagrass critical habitat protected by the Endangered Species Act (ESA) can be found in or near the action area. Construction methods used for docks (*e.g.*, pile driving or jetting-in and construction barge anchoring) and small scale dredging have not been shown to adversely affect sea turtles, which are highly mobile and may be frightened away from the project area by construction activity and noise; therefore, the chances of the proposed action affecting sea turtles is discountable.

Seagrass surveys of the area indicate that Johnson's seagrass can be found in the action area. NMFS believes that the only parts of this project likely to affect Johnson's seagrass are the construction of the temporary work platform and the construction of the flushing channels. However, the applicant has stated that they will site the platform and flushing channels in areas devoid of Johnson's seagrass. Therefore, NMFS believes that any effects that the proposed action will have on Johnson's seagrass will be insignificant. In conclusion, NMFS believes that the proposed action is not likely to adversely affect species protected by the ESA under its purview.

This concludes the COE's consultation responsibilities under section 7 of the ESA for the proposed project. Be advised that 50 CFR 402.16 requires that consultation be

reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action.

We are copying our Habitat Conservation Division (HCD) with this letter, in case HCD has any habitat concerns pursuant to the section 305 essential fish habitat consultation requirements of the Magnuson-Stevens Fishery Conservation and Management Act (50 CFR 600.905-600.930, subpart k). HCD may be reached at (904) 232-2580, extension 121.

If you have any questions, please contact Mr. Robert Hoffman, fishery biologist, at the number listed above.

Sincerely yours,

for, Joseph E. Powers, Ph.D.
Acting Regional Administrator

cc: F/PR3
F/SER45 - George Getsinger

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1514.22f.1

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
9721 Executive Center Drive North
St. Petersburg, FL 33702
(727) 570-5312; FAX (727) 570-5517
http://caldera.sero.nmfs.gov

FILE #

MAR 18 2002 F/SER3:EGH

Mr. James C. Duck
Chief, Planning Division
Army Corps of Engineers, Jacksonville District
P.O. Box 4970
Jacksonville, FL 32232-0019

Dear Mr. Duck:

This responds to Mr. Stephen Traxler's February 12, 2002, telephone request to Mr. Eric Hawk of my staff for a written response from the National Marine Fisheries Service (NMFS) to your May 25, 2001, letter requesting informal consultation, pursuant to section 7 of the Endangered Species Act (ESA), on the potential effects of the Indian River Lagoon Restoration Integrated Feasibility Study. On June 12, 2001, Mr. Hawk advised Mr. Traxler of NMFS' concurrence with the Corps' determination that the study would not likely adversely affect listed species under NMFS' purview. We assigned consultation number I/SER/2001/00697 to this action. Additional details on the project were submitted by Mr. Traxler on February 17, 2002, and are incorporated herein by reference (Draft IRL-South Feasibility Report and Supplemental EIS, October 2001: Recommended Plan [Section 8: Construction Features]).

NMFS Protected Resources Division (PRD) has reviewed the proposed action, a restoration project whose primary goal is reestablishing a stable salinity regime in the St. Lucie Estuary. The recommended plan is a combination of components and operational rules that will help lead to a healthy, sustainable estuarine and watershed ecosystem. The components in the preferred plan include construction of reservoirs and stormwater treatment areas, and rehydration of impacted agricultural lands. These components will attenuate and treat the high freshwater flows to the St. Lucie Estuary. In addition, the preferred plan has proposed muck management, artificial habitats, and floodplain restoration in the north fork of the St. Lucie Estuary.

PRD has reviewed the construction features of the various components of the preferred plan, including: C-44 West Reservoir and Stormwater Treatment Areas, C-44 East Stormwater Treatment Area, Palmar Complex - Natural Storage and Treatment Area, C-23 North Reservoir, C-23 South Reservoir, C-23/C-24 Stormwater Treatment Area, Allapattah Complex - Natural Storage and Treatment Area, Cypress Creek Complex - Natural Storage and Treatment Area, C-23/C-44 Stormwater Treatment Area and Diversion Canal, C-25 Reservoir and Stormwater Treatment Area, Muck Remediation and Artificial Habitat (Creation), and North Fork Floodplain Restoration. The planned removal of approximately 5.5 million cubic yards of fine-grained

material ("muck") from the bottom of the St. Lucie River will create an additional 2,650 acres of substrate suitable for colonization by benthic organisms. In addition, six sites in the middle estuary, each approximately 15 acres in area, have been identified for creation of oyster habitat. Oysters are a desirable species because they are excellent at filtering fine sediments and nutrients in the water column. A total of 90 acres of artificial habitat will be created: 60 acres of oyster shell hash, 24 acres of prefabricated reef balls, and 6 acres of artificial submerged aquatic vegetation.

Sea turtles and Johnson's seagrass may occur within the Indian River Lagoon system. PRD concurs with the Corps' determination that implementation of the preferred plan will not adversely affect listed species nor designated critical habitat under NMFS' purview. PRD believes that implementation of the plan will lead to improvement of foraging and developmental habitat for federally listed species and candidate species under NMFS' purview by reducing the loads of nutrients, pesticides, phosphorous levels, and other pollutants entering the Indian River Lagoon system. Improved water quality will benefit existing submerged aquatic vegetation within the Indian River Lagoon system, including Johnson's seagrass. PRD believes that neither of the methods being considered for remediating or removing the muck - capping or dredging - will adversely impact listed species under NMFS' purview, since dredge equipment will necessarily be limited (because of the shallowness of the site) to a non-hopper type dredge. Reservoirs are located in inland areas where no endangered species under NMFS' purview are present.

This concludes consultation responsibilities under section 7 of the ESA. Consultation should be reinitiated if there is a take, new information reveals impacts of the identified activity that may affect listed species or their critical habitat, a new species is listed, the identified activity is subsequently modified or critical habitat designated that may be affected by the identified activity.

Pursuant to the essential fish habitat consultation requirements of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)(2) and 50 CFR 600.905-.930, Subpart K), the NMFS Habitat Conservation Division (HCD) is being copied with this letter. The HCD biologist for this region is Mike Johnson. If you have any questions about consultation regarding essential fish habitat for this project, please contact Mr. Johnson at (305)595-8352.

Please contact Mr. Eric Hawk at 727/570-5312 if you have any questions or if we may be of assistance.

Sincerely,

Gary D. Ritter

for, Joseph E. Powers, Ph.D.
Acting Regional Administrator

2

cc: F/SER43 - Mike Johnson

O:\section7\informal\irl-rifs.jax
File: 1514-22 f.1. FL
Ref: I/SER/2001/00697

C-111 Spreader Canal

FW: C-111 Spreader Canal Western Project (UNCLASSIFIED)

Tarr, Bradley A SAJ <Bradley.A.Tarr@usace.army.mil> Mon, Dec 16, 2013 at 4:21 PM
To: Stacie Auvenshine - NOAA Federal <stacie.auvenshine@noaa.gov>
Cc: "Ralph, Gina P SAJ" <Gina.P.Ralph@usace.army.mil>

Classification: UNCLASSIFIED
Caveats: NONE

Stacie,

As stated in Section 7.2.2.4 of the CERP Programmatic BA, I originally (7 May 2009) stated that the C-111 SC project would have a may affect, not likely to adversely affect the smalltooth sawfish and the five sea turtles. My rationale was that we anticipated some potential benefits with improved estuarine conditions for the sawfish, and improved salinities in the nearshore that would benefit seagrasses, thus benefitting sea turtles. NMFS didn't feel that there would be any impact, therefore, suggesting a "no effect" determination which essentially, closed consultation. Below is the excerpt from the CERP BA; and below that is related correspondence with NMFS. Call me if you need more info.

Brad

"On 7 May 2009, the Corps requested concurrence with NMFS on its determination of may affect, but is not likely to adversely affect smalltooth sawfish and sea turtles. In addition, the Corps determined that the project would not modify critical habitat for elkhorn or staghorn coral. Critical habitat for the smalltooth sawfish had not been designated until after publication of the final PIR/EIS. After further discussion with NMFS, the Corps changed their determinations to no effect for each species and their designated critical habitat, and NMFS concurred by email on 6 August 2009.
Construction is complete for this project; therefore, re-initiation is not required."

----Original Message----
From: Shelley Norton [mailto:Shelley.Norton@noaa.gov]
Sent: Thursday, August 06, 2009 9:06 AM
To: Eric G. Hawk
Cc: Tarr, Bradley A SAJ
Subject: Re: C-111 Spreader Canal Western Project

Hi Bradley, I spoke with Alisa today. We discussed the potential routes of effects to our listed species and critical habitat. Alisa could not determine any and neither can I. Alisa changed the determinations to no effect. Let me know if you have any questions.

Shelley

Eric G. Hawk wrote:
> Hi Bradley,
> Shelley Norton was working with Alisa Zarbo on this, and sent out a
> technical assistance/request for additional information letter on it
> on August 4.

> Eric
>
> Tarr, Bradley A SAJ wrote:
>> Hello all,
>>
>> Can you guide me to the NMFS POC for the reference project? The Corps is
>> seeking a concurrence letter regarding the threatened and endangered
>> species
>> determinations outlined in the Biological Assessment which is
>> contained in
>> Annex A of the final EIS.
>>
>> Thank you very much,
>>
>> Brad Tarr
>> US Army Corps of Engineers
>> Environmental Branch, Planning Division
>> 701 San Marco Blvd.
>> Jacksonville, Florida 32232-0019
>> 904-232-3582
>>
>>

Classification: UNCLASSIFIED
Caveats: NONE

Shelley_Norton.vcf
1K

Caloosahatchee – 43 West Basin Storage Reservoir

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
263 13th Avenue South
St. Petersburg, FL 33701
(727) 824-5317, FAX 824-5309
http://sero.nmfs.noaa.gov

MAR 28 2007

F/SER31:WW

Mr. David S. Hobbie
Jacksonville District Corps of Engineers
South Florida Restoration Program Office
1400 Centrepark, Suite 750
West Palm Beach, FL 33401

Re: SAJ-2005-5958 (IP-TKW)

Dear Mr. Hobbie:

This responds to your letter dated January 10, 2007, requesting section 7 consultation pursuant to the Endangered Species Act (ESA) for the subject Army Corps of Engineers (COE), permit application for the C-43 Basin Storage Reservoir Project (C-43 Project). You submitted a biological assessment and other supporting information prepared by Scheda Ecological Associates on behalf of the applicant, the South Florida Water Management District, along with your determinations that the project may affect but is not likely to adversely affect smalltooth sawfish and sea turtles, and requested our concurrence.

The C-43 Project is part of the Comprehensive Everglades Restoration Plan authorized by the Water Resources Development Act of 2000. The project is located in Hendry County, Florida, encompassing approximately 10,000 acres of low-lying uplands adjacent to the Caloosahatchee River. The purpose of the project is to capture excess storm water runoff and releases from Lake Okeechobee for later release into the Caloosahatchee River during times of need, preventing saltwater intrusion and providing water supplies during times of drought. The project would entail an above ground reservoir(s) with a total storage capacity of approximately 170,000 acre-feet within the Caloosahatchee Basin. Anticipated benefits of the C-43 Project include the attenuation of flood flows; improvement of water quality and timing of releases to the Caloosahatchee River and Estuary; protection of the Caloosahatchee Estuary from excessive fresh water deliveries; and improvement of water supply benefits for environmental, urban and agricultural users.

Five species of sea turtles (loggerhead, green, Kemp's ridley, hawksbill, and leatherback) and smalltooth sawfish, protected by the ESA under National Marine Fisheries Service (NMFS) purview can be found in or near the Caloosahatchee River and Estuary, may be affected by the project, and are included in this consultation.

Because of the project's inland location, NMFS believes there will be no direct effects to listed species. NMFS believes potential indirect effects of the action to sea turtles and sawfish are limited to saltwater regime changes that may alter the potential foraging and nursery habitat of smalltooth sawfish and foraging habitat for green sea turtles. Saltwater regime changes could alter survival and recruitment of seagrass beds and mangrove habitat. However, the project is intended to mediate current unnatural flows of freshwater and instead to replicate natural conditions in the Caloosahatchee Estuary resulting in preservation of aquatic flora and fawna in

its naturally occurring range. NMFS believes there will be no loss of habitat for these listed-species and the effects of the project will be beneficial to habitat utilized by protected species in the Caloosahatchee Estuary. Based on the above, NMFS concludes that the C-43 project may affect but is not likely to adversely affect sea turtles or smalltooth sawfish.

Changes to freshwater flows throughout the historic range of smalltooth sawfish, and in peninsular Florida in particular, may have affected how juvenile sawfish use nursery habitats. Little scientific research is available on the salinity preferences and tolerances of this species. This information needs to be collected and used to set appropriate freshwater flow regimes. NMFS is currently in the process of developing a Recovery Plan for smalltooth sawfish. Part of this plan will focus on the need to further research the role of salinity regimes in the lifecycle of smalltooth sawfish. While the C-43 Reservoir Project should be beneficial to smalltooth sawfish by simulating natural freshwater flows to the estuary, NMFS recommends the project should also allow for increased cooperation between the SFWMD, NMFS and smalltooth sawfish-associated research institutions in further defining the salinity requirements required by this species and allow the project, once implemented, to be operated in a manner consistent with its needs.

This concludes your consultation responsibilities under the ESA for species under NMFS' purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. We have enclosed additional information on other statutory requirements that may apply to this action, as well as NMFS' Public Consultation Tracking System to allow you to track the status of ESA consultations. The COE's user identification name and password for querying PCTS are: pctscoe and pcts22nmfs, respectively.

If you have any questions, please contact Walt Wilson at (727) 824-5312 or by e-mail at walt.wilson@noaa.gov.

Sincerely,

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.f.1.FL
Ref: I/SER/2007/00096

Additional Considerations for ESA Section 7 Consultations (Revised 12-6-2005)

Marine Mammal Protection Act (MMPA) Recommendations: The Endangered Species Act (ESA) section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA section 101 (a)(5) is necessary. Contact Ken Hollingshead of our NMFS Headquarters' Protected Resources staff at (301) 713-2323 for more information on MMPA permitting procedures.

Essential Fish Habitat (EFH) Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division (PRD) pursuant to section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the Magnuson-Stevens Fishery Conservation and Management Act's (MSA) requirements for essential fish habitat (EFH) consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Public Consultation Tracking System (PCTS) Guidance: PCTS is an online query system allowing federal agencies and U.S. Army Corps of Engineers' (COE) permit applicants to track the status of NMFS consultations under ESA section 7 and under MSA sections 305(b)2 and 305(b)(4): Essential Fish Habitat. Access PCTS via: www.nmfs.noaa.gov/pcts. Federal agencies are required to enter an agency-specific username and password to query the Federal Agency Site. The Corps Permit Site allows COE permit applicants the ability to check on the current status of Clean Water Act section 404 permit actions for which NMFS has conducted an ESA section 7 consultation with the COE since the beginning of the 2001 fiscal year (no password needed).

For COE-permitted projects, click on "Enter Corps Permit Site." From the "Choose Agency Subdivision (Required)" list, pick the appropriate COE district. At "Enter Agency Permit Number" type in the COE district identifier, hyphen, year, hyphen, number. The COE is in the processing of converting its permit application database to PCTS-compatible "ORM." An example permit number is: SAJ-2005-000001234-IPS-1. For the Jacksonville District, which has already converted to ORM, permit application numbers should be entered as SAJ (hyphen), followed by 4-digit year (hyphen), followed by permit application numeric identifier with no preceding zeros. E.g., SAJ-2005-123, SAJ-2005-1234, SAJ-2005-12345.

For inquiries regarding applications processed by Corps districts that have not yet made the conversion to ORM (e.g., Mobile District), enter the 9-digit numeric identifier, or convert the existing COE-assigned application number to 9 numeric digits by deleting all letters, hyphens, and commas; converting the year to 4-digit format (e.g., -04 to 2004); and adding additional zeros in front of the numeric identifier to make a total of 9 numeric digits. E.g., AL05-982-F converts to 200500982; MS05-04401-A converts to 200504401. PCTS questions should be directed to Eric Hawk at Eric.Hawk@noaa.gov. Requests for username and password should be directed to April Wolstencroft (PCTSUsersupport@noaa.gov).

A.6.2 US Fish and Wildlife Service Programmatic Biological Opinion for the Central Everglades Planning Project

United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

April 9, 2014

Colonel Alan M. Dodd
District Commander
U.S. Army Corps of Engineers
701 San Marco Boulevard, Room 372
Jacksonville, Florida 32207-8175

Service Conservation Planning Activity Code:	04EF2000-2012-CPA-0270
Service Consultation Code:	04EF2000-2012-F-0290
Date Received:	January 23, 2013
Early Consultation Initiation Date:	October 24, 2013
Project:	Central Everglades Planning Project

Dear Colonel Dodd:

This document transmits the U.S. Fish and Wildlife Service's (Service) Programmatic Biological Opinion to the U.S. Army Corps of Engineers (Corps) of the potential effects of construction, operation, and maintenance of the Tentatively Selected Plan (TSP; Alternative 4R2) for the Central Everglades Planning Project (CEPP) on the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) (snail kite) and its designated critical habitat, Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) (CSSS) and its designated critical habitat, wood stork (*Mycteria americana*), and eastern indigo snake (*Drymarchon corais couperi*). Our preliminary conclusion is that the proposed project is not likely to jeopardize the continued existence of the species listed above and is not likely to adversely modify critical habitat, where designated. This document is a revision of the Preliminary Biological Opinion issued to the Corps by the Service on December 17, 2013, and the Programmatic Biological Opinion issued to the Corps by the Service on March 28, 2014.

This document also transmits the Service's informal concurrence on the Corps' determinations for the Florida panther (*Puma concolor coryi*), West Indian manatee (*Trichechus manatus*) and its critical habitat, American crocodile (*Crocodylus acutus*) and its critical habitat, deltoid spurge (*Chamaesyce deltoidea* spp. *deltoidea*), Garber's spurge (*Chamaesyce garberi*), Small's milkpea (*Galactia smallii*), and tiny polygala (*Polygala smallii*). Furthermore, the Service concurs with all the "No Effect" determinations made by the Corps in regard to the applicable threatened or endangered species that are found in the action area. This Programmatic Biological Opinion is in accordance with section 7 of the Endangered Species Act of 1973, as amended in 1998 (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). The project site is located throughout multiple counties in south Florida.

Due to the uncertainty regarding when and how this project will be implemented (discussed in more detail below), the Service is providing the Corps with a Programmatic Biological Opinion which clearly states that further consultation will be needed when more specific project details are finalized. While this document does not provide provisions for incidental take of three endangered avian species (CSSS, snail kite, and wood stork), it does describe the anticipated effects based on current

information. The Service is attempting to provide the Corps with key information it will need for project authorization and for budgeting purposes. In the future, when predecessor projects are complete and the Corps is closer to constructing portions of the CEPP that will affect listed species, the Service will provide separate consultation document(s) which may authorize incidental take, and provide applicable RPMs and TCs. Where overlap exists with other projects in the action area, such as the Everglades Restoration Transition Plan (ERTP) and C-111 Spreader Canal Project, CEPP activities will be evaluated, to ensure that incidental take minimization and monitoring actions are not duplicated.

This Programmatic Biological Opinion is based on information provided in the Corps' August 5 and October 24, 2013, Biological Assessments, the Corps' Draft Project Implementation Report for the CEPP (August 28, 2013), maps, meetings, field investigations, telephone conversations, email correspondence, and other sources of information. A complete administrative record of this consultation is on file at the Service's South Florida Ecological Services Office (SFESO), Vero Beach, Florida.

Thank you for your cooperation in the effort to protect fish and wildlife resources. If you have any questions regarding this project, please contact Bob Progulske at 772-469-4299 or Kevin Palmer at 772-469-4280.

Sincerely yours,

Larry Williams

Larry Williams
State Supervisor

cc: w/enclosure (electronic copy only)
Biscayne National Park, Homestead, Florida (Sarah Bellmund)
Corps, Jacksonville, Florida (Eric Bush, Gina Ralph, Gretchen Ehlinger)
Corps, West Palm Beach, Florida (Kim Taplin)
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Service, Atlanta, Georgia (David Horning)
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PROGRAMMATIC BIOLOGICAL OPINION
AND SELECT CONCURRENCE
FOR THE
CENTRAL EVERGLADES PLANNING PROJECT
ON EFFECTS TO THREATENED OR ENDANGERED SPECIES
AND CRITICAL HABITAT

Service Consultation Code: 04EF2000-2012-F-0290

Submitted to:

Jacksonville District
U.S. Army Corps of Engineers
Jacksonville, Florida

Prepared by:

U.S. Fish and Wildlife Service
South Florida Ecological Services Office
Vero Beach, Florida

April 2014

A.4.2 United States Fish and Wildlife Service Endangered Species Act Biological Opinion

The USFWS provided the USACE with the Endangered Species Act Biological Opinion for the LOWRP on 19 December 2019.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

December 19, 2019

Andrew Kelly, Colonel
District Commander
U.S. Army Corps of Engineers
P.O. Box 4970
Jacksonville, Florida 32232-0019

Service Consultation Code: 04EF2000-2018-F-0885
Service CPA Code: 41420-2006-FA-0236
Date Received: June 21, 2018
Consultation Initiation Date: August 15, 2018
Project: Lake Okeechobee Watershed Restoration Project
Counties: Glades, Highlands, Martin, Okeechobee, Hendry, and Lee

Dear Colonel Kelly:

The U.S. Fish and Wildlife Service (Service) has received the U.S. Army Corps of Engineers' (Corps') request for consultation dated June 21, 2018 for the Lake Okeechobee Watershed Restoration Project (LOWRP) with the South Florida Water Management District (District) as the local sponsor. This document transmits the Service's Biological Opinion based on our review of the proposed LOWRP and its effects on threatened and endangered species. It is the opinion of the Service that LOWRP, as implemented, will not jeopardize the continued existence of the eastern indigo snake (*Drymarchon corais couperi*), Florida bonneted bat (*Eumops floridanus*), and northern crested caracara (*Polyborus plancus audubonii*; now *Caracara cheriway*, hereafter caracara). It also includes and summarizes our concurrences for the Corps' determinations for Everglade snail kite (*Rostrhamus sociabilis plumbeus*, hereafter snail kite), Florida grasshopper sparrow (*Ammodramus savannarum floridanus*), Florida panther (*Puma* [=*Felis*] *concolor coryi*), West Indian manatee (*Trichechus manatus*), wood stork (*Mycteria americana*), and Okeechobee gourd (*Cucurbita okeechobeensis*). This document is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

This Biological Opinion was based on information provided in the Corps' June 21, 2018 Biological Assessment, draft Project Implementation Report (PIR; Corps 2019), field investigations, and other sources of information. A complete record of this consultation is on file at the South Florida Ecological Services Office in Vero Beach, Florida.

Consultation history

From November 29, 2000, to about April 2006, there was an initial multi-agency Lake Okeechobee Watershed Project planning effort. Those efforts led up to, but stopped short, of a Tentatively Selected Plan (TSP), when the project was suspended due to fiscal constraints. Much of the work done in those years was utilized and updated for this Lake Okeechobee Watershed Restoration Project (LOWRP). The new project components are similar, but in some cases, in new locations.

On July 25, 2015, the Corps and District held a LOWRP "kick-off" meeting. The objectives of the kick-off meeting were to: 1) define planning objectives to include problems, opportunities, and constraints; 2) identify existing conditions and existing information; 3) identify key risk and uncertainties; and 4) identify and discuss potential management measures.

On July 8, 2016, the Service received the Corps' July 1, 2016 letter requesting confirmation of listed species or their critical habitats that may be present in the project area.

On August 23, 2016, the Service sent a letter to the Corps and District that identified the federally listed species and critical habitats potentially located in the project area.

On November 13, 2017, the Service received, via email from the Corps, an undated letter from the Seminole Tribe of Florida (STOF) to the Corps. The STOF expressed concerns, in part, about the project's potential effects to: 1) water supply availability resulting from water diversion during a drought; 2) cultural resources, and 3) threatened and endangered species displaced onto Tribal lands.

Between August 2015 and June 2018, the various LOWRP sub-teams met, analyzed data, and compiled reports that ultimately led to the TSP on June 7, 2018.

On June 18, 2018, the Service emailed a web-link to project partner agencies and the STOF for the Service's draft Fish and Wildlife Coordination Act Report for the LOWRP.

On June 21, 2018, the Service received the Corps' Biological Assessment for the LOWRP via email.

On July 6, 2018, the Corps posted the LOWRP Draft Project Implementation Report (PIR)/Environmental Impact Statement at: http://www.saj.usace.army.mil/Missions/Environmental/Ecosystem-Restoration/Lake-Okeechobee-Watershed-Project/.

On July 23, 2018, the Service was notified that the Wetland Attenuation Feature (WAF) and Paradise Run wetland boundaries were redesigned by the Modeling and Engineering Subteam. As a result, the size of the Paradise Run wetland was reduced from to 4,100 to 3,600 acres.

On August 15, 2018, the Corps provided additional changes to the TSP at a team meeting including: 1) replacing the intake weir with a pump station for the Kissimmee River Central wetland site, 2) re-plumbing the outflow from the WAF through the Paradise Run wetland site to

the C-38 at a location farther upstream, and 3) locating 25 ASR wells on the southeastern boundary of the WAF.

On November 19, 2018, the Service completed a draft Biological Opinion for the LOWRP and provided copies via email to the Corps, STOF, and Florida Fish and Wildlife Conservation Commission.

On December 19, 2018, the Corps hosted a meeting on the WAF configuration and hydrologic modeling output (anticipated stages over the Period of Record 1965-2005). The inflow pump station was set at 1,600 cubic feet per second (cfs). The WAF was divided into 3 cells with the North cell being the smallest (~1,900 acres), a Central cell (~2,500 acres), and a South cell (~8,000 acres). The maximum depth in any cell was 5 feet, and it would take a minimum of 15 days to fill all three cells. Aquifer Storage and Recovery (ASR) operations associated with the WAF would be driven by water depth (stage) in the most downstream (South) cell.

On January 30, 2019, a Project Delivery Team (PDT) meeting occurred. The Corps asked the Service to recalculate Habitat Units (HU) for the proposed WAF and Paradise Run wetland based on the new design. On February 4, 2019, the Service provided the Corps with those recalculated HUs.

On February 8, 2019, the Service received comments from the Corps and District on the draft Biological Opinion.

On April 4, 2019, the Corps notified the Service that they would not be claiming any environmental benefits, in terms of Habitat Units, within the proposed WAF footprint.

On April 11, 2019, the Corps indicated that they were revising and reissuing the draft PIR for another public review due to comments and subsequent changes.

On June 19, 2019, the Corps held another PDT meeting, and the Service presented on the status of minimization and conservation measures in the Corps' Biological Assessment (BA). The Service asked the Corps and District to re-confirm those measures. The WAF boundary was moved 1,000 feet away from State Road (SR) 78, and around an existing cell tower. The WAF outlet canal would cut through the lower end of the proposed Paradise Run wetland restoration component and flows would be controlled by four structures. The District indicated their intent to allow for passive recreation (waterfowl and alligator quota hunting) within the WAF when conditions would allow. The Corps also planned to update the draft PIR to include additional seepage analysis, an updated climate change analysis, and to discuss the anticipated 8 to 11 percent reduction in phosphorus loading to Lake Okeechobee.

On July 5, 2019, the Corps issued a Notice of Availability for the revised draft PIR. The definition of the proposed WAF was modified (Section 3.2.1.1.2 of the PIR) as, "…a shallow reservoir facility used for surface water storage to attenuate peak flows entering Lake Okeechobee. On an indirect basis, although a WAF provides aboveground storage like a typical reservoir, water levels may at times be suitable for growth of wetland vegetation due to the water depths typically realized through the designed operation of the facility."

On July 9, 2019, the Corps emailed the Service to indicate the changes in the revised draft PIR were not great enough to warrant a revised BA for section 7 consultation under the ESA.

On July 30, 2019, the Service received a copy of a July 22, 2019 letter from the District to the Corps stating that the District "...will be pursuing the ASR features of the LOWRP..." because of $50 million in funding from Florida legislators (Specific Appropriation 1642A), available July 1, 2019. The implication of this is that the District might begin construction or operation activities before Congress authorizes the LOWRP (2021 or later).

On August 30, 2019, the Seminole Tribe of Florida sent a comment letter to the Corps on the revised draft PIR. Amongst their many concerns, they reiterated the potential for habitat loss from the WAF, and the resulting displacement of listed species onto Tribal lands. Additionally, that the draft PIR fails to explain the mitigation for this displacement, as well as the Service's evaluation process to identify those potential adverse effects to the Tribe.

On September 16, 2019, the Service, Corps and District met to discuss comments on the draft Biological Opinion. One concern was that the Corps could not participate in any monitoring, specifically for federally listed species, until Congress authorizes the project. Therefore, in light of the new funding for the District to accelerate ASR implementation, the Service reminded the District that they might be assuming liability for any activities that would pre-date the Terms and Conditions of this Biological Opinion, and recommended that the District coordinate with the Service to avoid non-exempted take of listed species.

BIOLOGICAL OPINION

This Biological Opinion provides the Service's opinion as to whether the proposed Project is likely to jeopardize the continued existence of the eastern indigo snake, Florida bonneted bat, and northern crested caracara. There is no designated critical habitat for these species; therefore, this Biological Opinion will not address destruction or adverse modification of critical habitat.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY DETERMINATIONS

Section 7(a)(2) of the ESA requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR § 402.02).

The jeopardy analysis in this Biological Opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of the species, the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determine the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) the Cumulative

Effects, which evaluate the effects of future, non-federal activities in the action area on the species. In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed federal action in the context of the current status of the species, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

DESCRIPTION OF THE PROPOSED ACTION

The objectives of the LOWRP are to improve the quality, quantity, timing and distribution of water entering Lake Okeechobee, provide for better management of lake water levels, reduce damaging releases to the Caloosahatchee and St. Lucie estuaries downstream of the lake, and improve system-wide operational flexibility. The primary purpose of the LOWRP is to capture and temporarily store surface water in either an above-ground Wetland Attenuation Feature (WAF; 13,600 acres) or underground Aquifer Storage and Recovery (ASR) system. The total estimated water storage for the WAF is 46,000 acre-feet (ac-ft). The WAF would hold water no deeper than about 5.5 feet to minimize dam safety concerns. Another purpose of the project is to restore previously drained wetlands for wildlife habitat, while secondarily achieving water storage and treatment. The expected hydrologic effects downstream in the estuaries would be beneficial only. Therefore, the effects of the action for this project are primarily the footprint effects (construction and operation) of the features. As part of all Everglades Restoration projects, the local sponsor (in this case the District) is responsible for any required chemical contaminant remediation and required to provide the Corps with lands free and clear of contaminants. The Corps reports the unconstrained implementation timeline to be 19.5 years; however, subsequent to the publication of the schedule in the revised Draft PIR, the District received funding to advance implementation of ASR. Operation and maintenance of the project would continue for 50 years. The project components are in Glades, Highlands, Okeechobee, and Martin Counties, with the downstream hydrological effects also extending into Hendry and Lee Counties. The latitude and longitude of the center of the WAF is 27.145780° and -80.926886°.

Wetland Attenuation Feature (WAF): The WAF is a shallow, 3-compartment reservoir facility used for surface water storage to attenuate peak flows entering Lake Okeechobee (Figure 1). On an indirect basis, although a WAF provides aboveground storage like a typical reservoir, water levels may at times be suitable for growth of wetland vegetation due to the water depths typically realized through the designed operation of the facility. However, any footprint benefits to plants and animals would be supplemental. The WAF would be located within the Indian Prairie sub-watershed west of the C-38 canal, north of SR 78, east of the STOF Brighton Reservation, and south of the C-41A canal. Modeling indicated maximum depths average 4.9 feet (North cell), 5.5 feet (Center cell), and 4.8 feet (South cell), with "full pool" average depth defined approximately as 3.0 feet (North cell), 4.0 feet (Center cell), and 3.8 feet (South cell). The WAF footprint, including the embankments, seepage canal, and other perimeter features, is approximately 13,600 acres with a "full pool" storage capacity of approximately 43,917 ac-ft. A proposed 1,600 cfs pump station located downstream of the existing S-84 structure on the C-41A canal will serve as the water source for the proposed WAF. The pump will draw water from the downstream areas of the C-38 canal considered (hydrologically) to be part of Lake Okeechobee.

Aquifer Storage and Recovery (ASR) Wells: ASR is the process of capturing and treating surface water prior to pumping it underground for storage within the aquifer, and the recovery of that water for use when there are system demands. We expect ASR wells installed within two distinct zones within the Floridan Aquifer System (FAS): 1) the Upper Floridan Aquifer (UFA) which is composed of porous limestone; and 2) a deeper, more saline zone, referred to as the Avon Park Permeable Zone (APPZ), composed of fractured dolomite. A total of 80 ASR wells are proposed in clusters, with 25 wells co-located with the WAF, and 55 wells located in the watershed (Figure 2). The well clusters will include a combination of UFA wells and APPZ wells. The 25 WAF-assisted ASR wells would increase operational flexibility and the overall total water storage capacity of the WAF. These ASR wells could discharge into the WAF and recharge ground water using the WAF surface water.

The remaining 55 ASR wells are to be located throughout the watershed. One proposed cluster of wells is located adjacent to the C-44 canal in Port Mayaca. Three potential clusters are located in the S-191 sub-watershed. Some of these wells would be adjacent to the L-63N canal and the rest would be adjacent to the L-63S canal. These would all flow into the lake at the S-191 structure. Two potential clusters are located adjacent to the C-38 canal downstream of S-65E that can discharge back into the C-38 canal. One cluster is located along Taylor Creek, downstream of S-192 and upstream of the S-133 pump station, which discharges to Lake Okeechobee. There is a proposed well cluster along the C-40 canal downstream of S-72 that can discharge to Lake Okeechobee, and another proposed well cluster along the C-41 canal downstream of S-71 that can discharge to Lake Okeechobee. There is a proposed well cluster along the C-43 canal in Moore Haven that can discharge to either Lake Okeechobee or the Caloosahatchee River. The clusters are two wells within a three-acre footprint. The capacity of each well is 5 million gallons per day (MGD). Therefore, the total pumping capacity is 400 MGD (80 wells x 5 MGD).

According to modeling, the total storage of LOWRP ASR is approximately 448,000 ac-ft/year. This amount of water, depending on the quality, has the potential to change conditions in receiving waters. The Corps and District have committed to modeling and monitoring water quality; therefore, if necessary, to manage discharges to preclude or minimize adverse effects on the local ecology (including listed species). These parameters include water temperature, dissolved oxygen, conductivity, hardness, total dissolved solids, chloride, phosphorus, sulfate, hydrogen sulfide, metals, mercury, barium, and strontium. Changes to the locations of the ASR wells may occur during the design phase of the project. The Corps acknowledged in their Biological Assessment that additional consultation might be necessary with the Service when the precise locations of ASR wells are determined in order to minimize or avoid any potential effects to listed species. This may require coordination with the State of Florida as the District recently received $50 million from the Florida Legislature in 2019 to accelerate implementation of ASR for the LOWRP (likely ahead of Congressional authorization).

Wetland Restoration Sites: Proposed wetland restoration sites include the Paradise Run and Kissimmee River–Center features (Figure 1). The Paradise Run site is approximately 3,600 acres and it contains portions of the historic Kissimmee River channel and floodplain. The site is located downstream of S-65E on the west bank of the C-38 canal, between the C-41A canal and the Buckhead Ridge community. A proposed 200-cfs pump station on the C-41A canal

downstream of S-84 serves as the water source for the wetland project (along with the previously mentioned WAF), which is intended to restore natural flow to the channel remnant and floodplain wetlands. Approximately 24,500 linear feet of historic river channel will be excavated to remove silt. An overflow weir between the north and south sections of Paradise Run will control the flow and to connect both sides through the L-59 berms. The S-370 will direct outflow to the C-38 and the S-372 will discharge to Paradise Run at the south end. The Kissimmee River Center site is approximately 1,200 acres and is located on the west bank of the C-38 canal about halfway between S-65D and S-65E. Excavation of about 21,500 linear feet of channel will create new riverine habitat and floodplain wetlands. A 100-cfs intake pump will divert C-38 water into the newly created river channel at the north end of the site.

Minimization and conservation measures

The Corps (2018) proposed minimization and conservation measures as part of the project description. They will conduct pre-construction surveys for caracara nests, Florida grasshopper sparrows, and Florida bonneted bats (FBB), but not until Congress authorizes the project. Florida grasshopper sparrows are not anticipated in the study area; therefore, if any are encountered during the surveys, the Corps has agreed to work closely with Service to identify options to eliminate or minimize any potential adverse effects. For FBB, acoustic and roost (if needed) surveys would be conducted in accordance with the Service's most recent guidance. If FBB are encountered, the Corps will coordinate measures with FWS to minimize or avoid adverse effects. The Corps also proposed the use of avoidance buffers around known FBB roosts during construction activities.

The Corps (2018) has agreed to implement the *Standard Protection Measures for Eastern Indigo Snakes* (Service 2013) throughout project construction. The Corps would also implement construction conservation measures as outlined in the *Habitat Management Guidelines for the Wood Stork in the Southeast Region* (Service 2009), *Standard Manatee Conditions for In-Water Work* (Service 2011), and *Draft Species Conservation Guidelines for Audubon's (Florida) Crested Caracara* (Service 2004) to avoid and minimize adverse effects on those species during construction activities. Additional standard protection measures regarding the Florida panther and snail kite shall be included in the Corps' Environmental Protection Plan for construction. In addition to the standard manatee protection guidance, the Corps (2018) has agreed to maintain the existing thermal profile in water bodies inhabited by manatees that receive discharges during ASR operation. This will preclude entrapment of manatees in temporary warm-water ASR plumes (expected to be 75 °F) when ambient surface water temperatures are below 60 °F.

The Corps (2018) agreed to adopt the measures from the Lake Okeechobee Regulation Schedule Biological Opinion for the LOWRP. These include, to the extent practical, to minimize the adverse effects of the project on snail kites, and communicate those measures to the Service. Examples may include implementing standard set-backs from nesting snail kites to minimize disturbance, controlling invasive plant species in snail kite habitat, and implementing appropriate water level recession rates that are protective of nesting snail kites.

Turbidity screening and diversion will be used to control effects to the drainage ditches and connected canals. Runoff from the construction site or storms shall be controlled, retarded, and

diverted to protected drainage courses by means of diversion ditches, benches, and any measures required by area wide plans approved under paragraph 208 of the Clean Water Act. Temporary and permanent erosion and sedimentation control features or screening will be installed (Corps 2018).

Action area

The action area for the project was defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The LOWRP action area includes the footprints of the WAF, wetlands, and ASR facilities, but also the downstream areas; therefore, as shown in Figure 3, the action area includes the portion of the Kissimmee River from the proposed Kissimmee River Center wetland restoration site downstream into Lake Okeechobee. For the ASR locations, each 2-well cluster is anticipated to cover up to 3 acres; however, the planning at this stage has identified general locations of about 1,000 acres. Therefore, the Service included the 1,000 acres around each potential ASR cluster into the action area. With regard to caracaras, the Service extended the action area around the WAF and wetlands to include a 1,500-meter buffer. This distance would include any adjacent breeding caracaras that do not nest within, but whose territories might overlap, the WAF or wetlands footprints. With regard to panthers, we extended the action area to include all lands located in the Service's Florida Panther Focus Area (Focus Area) within 25 miles (mi) (40.2 kilometers [km]) west of the WAF and wetlands (Figure 3). This 25-mi buffer is based on mean dispersal distances of 23.2 mi (37.3 1km) (Maehr et al. 2002) and 24.9 mi (40.0 km) (Comiskey et al. 2002). The 25-mi (40.2 km) buffer distance encompasses the dispersal distance of both male and female panthers; however, male panther dispersal distances are known to exceed those reported for female panthers (Maehr et al. 2002; Comiskey et al. 2002). This area also includes panther observations north and west of the Focus Area up to Lake Istokpoga.

Table 1. List of threatened and endangered species in LOWRP area (MANLAA = May Affect Not Likely to Adversely Affect, SSC = Species of Special Concern).

Scientific Name	Common Name	Federal Status	State Status	Corps' Effect Determination
Reptiles				
Drymarchon couperi	Eastern indigo snake	Threatened	Threatened	May Affect
Eumeces egregius lividus	Bluetail mole skink	Threatened	Threatened	No Effect
Neoseps reynoldsi	Sand skink	Threatened	Threatened	No Effect
Birds				
Ammodramus savannarum floridanus	Florida grasshopper sparrow	Endangered	Endangered	MANLAA
Aphelocoma coerulescens	Florida scrub jay	Threatened	Threatened	No Effect
Grus Americana	Whooping crane	Endangered	SSC	No Effect
Mycteria americana	Wood stork	Endangered	Endangered	MANLAA
Picoides borealis	Red-cockaded woodpecker	Endangered	SSC	No Effect
Polyborus plancus audubonii	Northern crested caracara	Threatened	Not listed	May Affect
Rostrhamus sociabilis plumbeus	Snail kite	Endangered	Endangered	MANLAA
Mammals				
Eumops floridanus	Florida bonneted bat	Endangered	Threatened	May Affect
Puma concolor coryi	Florida panther	Endangered	Endangered	MANLAA
Trichechus manatus	Manatee	Endangered	Endangered	MANLAA
Plants and Lichens				
Asimina tetramera	Four-petal pawpaw	Endangered	Endangered	No Effect
Cladonia perforata	Perforate reindeer lichen	Endangered	Endangered	No Effect
Cucurbita okeechobeensis	Okeechobee gourd	Endangered	Endangered	MANLAA
Dicerandra immaculate	Lakela's mint	Endangered	Endangered	No Effect
Halophila johnsonii	Johnson's seagrass	Threatened	Threatened	No Effect
Jacquemontia reclinata	Beach jacquemontia	Endangered	Endangered	No Effect
Liatrus ohlingerae	Scrub blazing star	Endangered	Endangered	No Effect
Paronchia chartacea	Papery whitlow-wort	Threatened	Endangered	No Effect
Polygala lewtonii	Lewton's polygala	Endangered	Endangered	No Effect
Polygala smallii	Tiny polygala	Endangered	Endangered	No Effect
Warea carteri	Carter's mustard	Endangered	Endangered	No Effect
Critical Habitat				
Rostrahamus sociabilis plumbeus	Everglade snail kite	Endangered	Endangered	MANLAA
Trichechus manatus	West Indian Manatee	Endangered	Endangered	MANLAA

SPECIES NOT LIKELY TO BE ADVERSELY AFFECTED BY THE PROPOSED ACTION

Florida Grasshopper Sparrow

The Florida grasshopper sparrow (*Ammodramus savannarum floridanus*) is a non-migratory subspecies of grasshopper sparrow that is endemic to the dry prairie of central and southern Florida. This subspecies is extremely habitat specific and relies on frequent fire to maintain its open, grassland habitat. This subspecies may nest April to July, on the ground under palmettos or in grass clumps. The female lays 3-5 eggs, and young fledge within 9 to 10 days. The male sings from a low perch to defend his territory – about the only time they are readily visible – and helps raise the young. Diet includes seeds and invertebrates. The sparrow is highly endangered due to loss of dry prairie habitat (more than 85 percent lost). Most prairie loss has resulted from conversion to domestic pasture grasses for cattle. Despite having a better understanding of their habitat requirements, reported sparrow populations have declined on all three conservation lands and one private ranch. The lowest counts ever reported of sparrows in the wild occurred in 2018 (approximately 51 males and 26 females). Unfortunately, reasons for the decline are unknown but suspects include: 1) suboptimal habitat management; 2) habitat loss, fragmentation, or conversion; 3) fire ants and other predators destroying nests; 4) diseases; and 5) genetic problems. There is a captive-propagation program with the first releases occurring in 2019. The closest sub-population of reported wild sparrows is about 30 miles north of the LOWRP features. The habitat within the LOWRP footprints is not suitable for this species; however, the Corps (2018) made a commitment to survey for sparrows prior to construction. Therefore, the LOWRP may affect, but is not likely to adversely affect the Florida grasshopper sparrow.

Wood Stork

The wood stork is a large, white, long-legged wading bird that forages in shallow wetlands throughout Florida and coastal southeastern U.S. It breeds in Florida and coastal Georgia and South Carolina. The primary cause of the wood stork population decline in the United States was loss of wetland habitats resulting in reduced prey availability. However, the wood stork was reclassified from endangered to threatened in 2014 based on a population increase. This was based on the 3-year population averages of total nesting pairs of wood storks being greater than 6,000 nesting pairs since 2003. In addition, productivity appears to be sufficient to support a growing population. However, the 5-year average number of nesting pairs is still below the benchmark of 10,000 nesting pairs identified in the recovery plan for delisting.

Typical foraging sites include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow, seasonally flooded roadside or agricultural ditches, and managed impoundments. During nesting, these areas must also be sufficiently close to the colony to allow wood storks to efficiently deliver prey to nestlings. The principal wood stork foraging habitat within the LOWRP area is the littoral zone of Lake Okeechobee. There is an active wood stork colony (named Brighton) about 6 miles southwest of the WAF border. There is another wood stork colony (Cypress Creek) about 19 miles east of the Paradise Run site. The LOWRP would provide additional foraging opportunities for the wood stork in the wetland restoration sites and the improved littoral marsh of Lake Okeechobee. The WAF may also provide foraging habitat for the times it is less than 15 inches deep if prey exist. Therefore, because of improved foraging opportunities, the Service concurs with the Corps determination that the LOWRP may affect, but is not likely to adversely affect the wood stork.

Everglade Snail Kite

The snail kite is a medium-sized raptor that forages over wetlands on aquatic apple snails – the native Florida apple snail (*Pomacea paludosa*) and the exotic *Pomacea maculata* (possibly other exotic *Pomacea* species). Several factors may affect snail kite foraging and nesting success – primarily related to water levels. For example, too much or too little precipitation can result in the temporary or permanent loss of apple snail habitat with a concomitant reduction in apple snail numbers or availability. Excessive precipitation, coupled with water management practices that maintain high water levels within wetlands for extended periods, can result in the death of emergent vegetation required by apple snails for successful feeding and reproduction. Conversely, apple snails may not be able to survive in wetlands that remain dry for extended periods during droughts, and juvenile native apple snails are less tolerant of dry conditions than adult snails.

The breeding season of the snail kite in Florida varies from year to year depending on rainfall and water levels (Sykes et al. 1995). Nesting usually occurs from December through July, although breeding can continue through the summer into fall. In Lake Okeechobee, there has been a summer snail kite nesting season in five of the last seven years (exception of 2015 and 2019). This is likely a response to the increase in number of exotic apple snails in the lake and water levels favorable for nest initiation.

The Service expects the LOWRP will keep the lake in the optimal stage range of 12.5 to 15.5 feet for more time than without the project (under the current version of the LORS). We also expect the project to reduce the amount of time below a lake stage of 12.5 feet. That should promote favorable habitat for snail kite nesting and foraging and therefore, be a benefit to the species. The Corps did not analyze the effects of lake recession rates on snail kites with the LOWRP. Water level recession rates in the lake are dictated by LORS, rainfall, evaporation, and District water supply operations (*i.e.,* not part of the LOWRP). We also expect that apple snails will colonize the wetlands and WAF and snail kites could subsequently forage in those areas. We expect that over time snail kites might also nest in the wetlands and WAF if suitable nesting substrate exists. However, recent ESA guidance (Williams 2019) is that the Service will not consult on species that are not reasonably certain to occur within an action area and therefore, are not likely to be adversely affected. Therefore, the Corps has agreed to monitor the LOWRP, and if snail kites are observed foraging or nesting within the WAF or wetlands, then the Corps will contact the Service to determine if reinitiation is necessary. The Corps determined that the LOWRP may affect, but is not likely to adversely affect the snail kite. The Service concurs with the Corps' determination.

Everglade Snail Kite Critical Habitat

Critical habitat for the snail kite was designated on September 22, 1977 (Federal Register Volume 42, Number 184). Approximately, 841,635 ac (340,600 ha) of critical habitat are located within nine critical habitat units that include most of the littoral marsh of Lake Okeechobee. Because the Service expects the LOWRP will keep the lake in the optimal range of 12.5 to 15.5 feet for more time than without the project, the LOWRP would maintain or improve the littoral marsh habitat for snail kites in Lake Okeechobee. The Corps determined that the LOWRP may affect, but is not likely to adversely affect snail kite critical habitat. Based on

project's anticipated habitat improvement to the Lake Okeechobee littoral zone, the Service concurs with the Corps' determination.

Florida Panther

Male Florida panthers are polygynous, maintaining large, overlapping home ranges containing several adult females and their dependent offspring. Panther dens are usually located closer to upland hardwoods, pinelands, and mixed wet forests and farther from freshwater marsh-wet prairie (Benson et al. 2008). Most den sites are located in dense saw palmetto (*Serenoa repens*), shrubs, or vines (Maehr 1990; Shindle et al. 2003; Benson et al. 2008). Litters (n = 82) are produced throughout the year, with 56 to 60 percent of births occurring between March and June (Jansen et al. 2005; Lotz et al. 2005). Panthers require large areas and numerous factors influence panther home range size, including habitat quality, prey density, and landscape configuration (Belden 1988; Comiskey et al. 2002). Comiskey et al. (2002) examined the home range size for 50 adult panthers (residents greater than 1.5 years old) monitored in south Florida from 1981 to 2000 and found resident males had a mean home range of 160,639 ac (65,009 ha) and females had a mean home range of 97,920 ac (39,627 ha).

In 2011, a panther preserve on the STOF Brighton Reservation was established and approved by the Service (Consultation Code: 41420-2011-TA-0174) to provide 2,464 panther habitat units for the purpose of construction activities on the Reservation. The preserve is located in the southwest portion of the Reservation and is about 9 miles from the WAF.

The closest recent record of a live Florida panther to the LOWRP was in a forested area at Buck Island Ranch on November 28, 2016, about 15 miles west of the proposed WAF (Figure 4). Another uncollared live panther was observed in forested habitat east of the town of Venus about 20 miles west of the WAF on May 29, 2014. There was a reported live panther about 20 miles east of the Paradise Run wetland site on December 24, 2015. This cat was collared, but the collar was not functioning. It was likely the sub-adult male panther that was released on Kissimmee Prairie Preserve which had traveled to Indian River County and then south. Other panther records include panther road mortalities along SR27 (two in 2016), about 20 miles west of the WAF. There are approximately 12 additional panther sightings according to the FWC database just within or outside the 25-mile buffer zone primarily along SR 27 (Figure 4).

Given the low number of panther observations in eastern Glades County and the general lack of forested cover associated with the improved pasture in the proposed WAF, it is not likely that panthers currently use this site. The WAF is also constrained by the lake to the south and the City of Okeechobee to the east, making it unsuitable as a corridor for panther movement. However, assuming the panther population increases north of the Caloosahatchee River in the future, panthers might be encouraged to forage in or around the WAF and the LOWRP-restored wetlands assuming sufficient prey items and vegetative cover are present. To that extent, the Corps should consider the future use of these features by panthers during the design phase. The Corps determined that the LOWRP may affect, but is not likely to adversely affect the Florida panther. Based on the lack of current panther use and unlikely future use as a corridor for panther movement, the Service concurs with the Corps' determination.

West Indian Manatee

The West Indian manatee (*Trichechus manatus*) is a large, plant-eating, aquatic mammal species that is listed as threatened under the ESA (16 U.S.C. 1531 et seq.)(32 FR 4001), and is further protected as a depleted subpopulation under the Marine Mammal Protection Act (16 U.S.C. 1361-1407). They were reclassified from endangered to threatened on March 30, 2017, due to increases in their population estimate and improvements in their habitat. Manatees may occupy any inland and coastal waters of south Florida including estuaries, bays, rivers, creeks, and canals (Service 2001) where water control structures allow. According to the Service's geographic information system database, they have been recently observed within Lake Okeechobee and its rim canal (*i.e.,* L-47 Canal), the Kissimmee River (*i.e.,* C-38 Canal), and the C-44 and C-43 Canals. Two significant threats to the Florida manatee population statewide are collisions with watercraft and the loss of warm water habitat (Runge et al. 2007). Other threats include crushing or entrapment in gates and locks; entanglement in ropes, lines, and nets; ingestion of fishing gear or debris; vandalism; poaching; and exposure to red tide brevetoxin (Bossart et al. 1998). In 2018, there was red tide bloom in the Gulf of Mexico that was either confirmed or suspected in the death of approximately 300 manatees (https://myfwc.com/media/18471/2018preliminaryredtide.pdf).

There are no synoptic surveys for manatees in Lake Okeechobee; therefore, the Service relies on manatee mortality reports as a way to indicate occurrence in the lake. Manatees may occur year-round in the lake. From 2000 through 2014, there were 33 manatee deaths reported from the northern Lake Okeechobee area. Twenty of these were in the lake near the confluence with the Kissimmee River. Six mortalities were recorded in the river downstream of S-65E; one in Indian Prairie canal; and six from Taylor Creek and the northern-most part of the lake (Figure 5).

Manatees may be at risk of thermal effects from ASR discharges in the lower Kissimmee River and Lake Okeechobee. For example, three different manatees were observed during 2012 (one each on April 24, May 24, and July 9) near the S-65E and S-84 structures. On July 17, 2012, four manatees were observed near the S-84. Two days later, one manatee was observed downstream of the S-65D and another near the mouth of the Kissimmee River. It is not clear if these individuals were the same as those observed two days prior or different individuals, but they were all present in the area targeted for LOWRP ASR implementation.

Manatees should migrate to coastal areas as water temperatures drop in the lake coincident with the onset of winter. However, from 2000 to 2014, there were 16 manatee deaths reported from the northern Lake Okeechobee area from November 1 to March 30. Waters colder than 20 °C (68 °F) increase the manatees' susceptibility to cold-stress and cold-induced mortality. Because of this temperature restriction, manatees seek out warm water refugia to help reduce energetic maintenance costs. The temperature of the Kissimmee River ASR (KRASR) pilot project discharge was consistently at or above 25°C (25.2 to 27.5 °C). Based on the ambient temperature data, the Service expects manatees would leave the Kissimmee River in November-December as the water temperature approaches 20°C, and would not return until February or March. However, data exist for at least two live manatee observations in January and February near the KRASR outfall (but prior to operation).

It is not clear if manatees can find existing thermal refugia in the Kissimmee River or Lake Okeechobee during the winter, primarily because the river and lake are not part of the systematic winter survey area. To eliminate the potential risk to manatees from cold-shock, the Corps has agreed that any ASR that will be discharging warmer water in November (or when ambient water temperatures drop below 20 °C), will continue until spring when ambient surface water temperatures will be above 20 °C. When the Ecological Risk Assessment was conducted in 2014 for the Regional ASR Project, the simulated hydrology from the Lake Okeechobee Operations Screening (LOOPS) model indicated there were no occurrences where ASR discharges were shut off during the January to April period for any of the alternatives. In cases where ASR was discharging in November or December (simulated), it continued until after April the following year when ambient temperatures would be warm enough to preclude thermal shock. Therefore, the risk of manatee mortality from thermal stress from ASR appeared to be minimal.

The Corps has agreed to maintain the existing thermal profile in water bodies inhabited by manatees which receive discharges during ASR operation. This will preclude entrapment of manatees in temporary warm-water ASR plumes when ambient water temperatures are below 60° F. Standard manatee protection guidelines will be used during construction along canals/rivers accessible to manatees to avoid effects. The LOWRP has the potential to directly affect water levels in Lake Okeechobee, and indirectly, the extent and health of SAV resources within the lake and downstream estuaries. However, in this case, the water storage provided by this project is expected to be only beneficial for the quality and amount of manatee foraging habitat in the lake and estuaries. The operation of ASR and the flow-through WAF are anticipated to reduce phosphorus concentrations entering Lake Okeechobee, which in turn should reduce the frequency or severity of algal blooms. The Corps determined that the LOWRP may affect, but is not likely to adversely affect manatees. Based on the Corps' minimization measures and anticipated project benefits to the manatee, the Service concurs with the Corps' effect determination.

West Indian Manatee Critical Habitat

The designated critical habitat for the manatee includes coastal U.S. territorial waters in Florida that encompass Crystal River (and its headwaters, King's Bay); Little Manatee River; Manatee River; and from Myakka River and Peace River southward into Whitewater Bay; portions of Barnes Sound, Card Sound and Biscayne Bay; and then northward along the Atlantic Coast through Lake Worth Lagoon, Indian River Lagoon, and St. Johns River to the confluence of the Intracoastal Waterway with the St. Marys River on the Georgia-Florida border. Within the action area, designated manatee critical habitat includes the St. Lucie Estuary, Indian River Lagoon, and Caloosahatchee Estuary and Pine Island Sound.

The LOWRP shows a slight performance improvement within the northern estuaries as indicated by fewer high-volume flow months, providing a minor beneficial effect to submerged aquatic vegetation (SAV). Reduction in high flows and accompanying flow velocities would result in lower suspended solid loading and decreased concentration of colored dissolved organic matter, thereby allowing greater light penetration to promote growth of SAV. In addition, reduction in high volume discharge events from Lake Okeechobee would reduce concomitant extreme salinity fluctuations. Although some SAV are tolerant of a wide range of salinity levels, a

reduction in high-volume discharge events would reduce stress to SAV and promote increases in seagrass shoots. A reduction in discharges would also have the potential to increase foraging opportunities for manatees in this region and provide a minor beneficial effect. Therefore, the Corps determined that the LOWRP may affect, but is not likely to adversely affect manatee critical habitat. Based on anticipated project improvements to manatee critical habitat, the Service concurs with the Corps' determination.

Okeechobee Gourd

The Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeensis*) is an annual or perennial vine endemic to Florida, known to occur in natural and man-made islands around the northwestern and southern portions of Lake Okeechobee. In the lake, the most stable colonies occur in the southeastern quadrant on Torry, Kreamer, and Ritta Islands. The documented population of the Okeechobee gourd around the southeastern shore of Lake Okeechobee is strongly associated with Torry muck, a soil formed in the extensive pond apple forests that once surrounded the lake. This species also occurs along the middle St. Johns River in Volusia County.

Lake water levels can affect this plant's success by drowning out individual plants (if too deep) or may facilitate seed dispersal. Around Lake Okeechobee, the gourd relies on pond apple trees to support its vines above rising water levels during the wet season. Other trees and shrubs, such as willow (*Salix caroliniana*) and cypress (*Taxodium distichum*), may also provide suitable support for the vines. Along the St. Johns River, Okeechobee gourds are most typically found growing on elderberry and common reed (*Phragmites* spp.). The Okeechobee gourd also germinates on alligator nests around Lake Okeechobee, which provide suitably elevated soil berms in full sun, with no competition from other plants. These disturbed sites provide areas where competition is reduced and elevated areas that promote the growth of elderberry, button bush, and other erect bushes and shrubs (Service 1999).

The decline of the gourd is largely attributable to conversion of swamp forests to agriculture and water level management in Lake Okeechobee. For the gourd to maintain viable healthy populations, fluctuations in lake level are necessary. High lake levels facilitate dispersal and inundate shorelines thereby destroying aggressive weeds in local habitats. As lake levels decrease, the cleared open habitats allow the quickly germinating Okeechobee gourd seeds to sprout and begin climbing before they have to compete with other pioneer species. Water regulation practices can greatly influence the timing and duration of flooding and drying cycles across remnant areas of suitable elevation and soils around Lake Okeechobee. Permanent inundation of suitable soils is detrimental to the plant. Another potential threat to this plant is the proliferation of exotic plant species around the edges of Lake Okeechobee (Service 1999). There is no designated critical habitat for the Okeechobee gourd.

Due to the changes in Lake Okeechobee stages and the increased amount of time that water levels are within the beneficial stage envelopes, the Corps has determined that there may be slight beneficial effects to the Okeechobee gourd. The Service recognizes that the ephemeral nature of gourd occurrences and the lack of a systematic survey makes it difficult to determine if the LOWRP will be beneficial to the gourd; however, we concur that the LOWRP is not likely to adversely affect the gourd.

STATUS OF THE SPECIES

Crested caracara

Please see https://www.fws.gov/verobeach/StatusoftheSpecies.html for the Status of the Species for the Audubon's crested caracara (April 2015).

Eastern indigo snake

Please see the https://ecos.fws.gov/ServCat/DownloadFile/157073 for the current Species Status Assessment for the indigo snake (Service 2018). Critical habitat has not been designated for the indigo snake; therefore, critical habitat will not be affected by the Project.

Florida bonneted bat

Please see Appendix A for the Status of the Species for the FBB. The critical habitat designation has not yet been finalized for this species.

Summary of threats to the species

Crested caracara

As the population of caracaras in Florida appears to be habitat-limited, the primary threat to adult caracaras is loss of breeding habitat. For juvenile and sub-adult caracaras, the threats are road mortality and loss of habitat, specifically gathering and roosting areas. This action is likely to result in complete or partial loss of habitats that support breeding pairs. There is also a likelihood for disturbance of the species during the construction and operation of the project.

Eastern indigo snake

The primary threats to eastern indigo snakes are habitat loss or fragmentation and direct injury or mortality from vehicle or equipment use. This action is likely to replace upland indigo snake habitat with less suitable wetland or open water habitats and result in mortality or disturbance during construction.

Florida bonneted bat

Threats to FBB stem primarily from a lack of information about their distribution and life history. This may lead to inadvertent habitat loss or fragmentation. While FBB roosts have been documented in native slash and long-leaf pine trees, roosts have also been reported on telephone poles (at least one occurrence) and under concrete roof tiles. For the proposed action, loss of FBB roost habitat (trees) is possible. The Service also anticipates that forage base will change as habitat is altered from uplands to wetlands, but prey items would be available after construction.

ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the status of the species, its habitat, and ecosystem, within the action area. It includes the impact of state or private actions, which occur simultaneously with the consultation in progress.

Status of the species within the action area

Crested caracara

Crested caracaras occupy and reproduce in the action area; it is within the center of the species' range in Florida (Service 1999). As a result, the territory density here is as high as anywhere within the species' range in Florida. For example, in 2015 there were 12 caracara nests reported from STOFs Brighton Reservation (Haas 2015) (on roughly 24,100 acres of pasture habitats). While Morrison and Humphrey (2001) identified an average caracara home range size of about 2,976 acres, the average home range size within this area of the Reservation (and presumably the adjacent LOWRP lands), is closer to 2,008 acres (24,100/12), assuming little overlap of territories. The overall numbers of caracara territories in the action area is directly proportional to the large amount of open, dry prairie, rangeland, or pasture habitats (*i.e.,* improved, unimproved, and woodland pastures). Despite some development around the City of Okeechobee, the area is primarily rural and agricultural in nature. From the mid-1990s to 2018, there were approximately 80 reported territories within the action area (not including Lake Okeechobee, C-43, C-44, or the northern estuary portions of the action area; which is essentially aquatic habitat). Figure 6 shows the caracara nest locations closest to the LOWRP components from 1994-2018.

Eastern indigo snake

Eastern indigo snakes occupy the action area. Due to their diurnal and somewhat cryptic nature (*i.e.,* being underground at night for some portion of daylight hours), they are not as readily observable as other Florida snakes (*e.g.,* black racers, corn snakes). Since 1970, approximately 57 indigo snakes have been reported in the action area, although none have been reported from the project footprints (Figure 7) with the exception of the potential ASR site at Port Mayaca (on the C-44 canal). The closest reported indigo snake to the WAF boundary was on Brighton Reservation in 1970 about 4 miles away. Another indigo snake was reported in 1952 about 3 miles east of the Paradise Run wetland border.

The size of the action area represents a small portion of the combined acreage of all habitats usable by indigo snakes in south Florida. Within the action area, much of the land cover is improved pasture. In general, this land use does not have the herbaceous cover needed by indigo snakes; therefore, is less suitable than habitat, for example, on Archbold Biological Station and the Lake Wales Ridge (scrub and scrubby forests on the western edge of the action area). Additionally, the distribution of improved pasture throughout the action area may cause fragmentation of other more suitable habitats. Other land uses such as roads and canals may further fragment the indigo snake habitat within the action area.

Recent studies demonstrated the densities of indigo snakes at Archbold Biological Station (in Highlands County, 25 miles west of the WAF) and the C-44 citrus grove (now reservoir and STA project in Martin County, 29 miles east of the WAF). A 26-year study conducted by Layne and Steiner (1996) at ABS estimated a population density of 2.6 indigo snakes (1.9 males, 0.7 females) per 100 hectares (ha) (247 ac). They also estimated a more conservative density based on 5 snakes (3 males and 2 females) that occupied 314 ha at 1.6 indigo snakes per 100 ha (0.96 males to 0.64 females). ABS encompasses a high percentage native Florida habitats for indigo snakes (*i.e.*, the study area was comprised of 60 percent xeric pine and oak uplands, and 40 percent pine flatwoods, bayheads, swale, and seasonal ponds). Indigo snakes have been observed at ABS in all natural and man-altered habitats with no obvious habitat preferences (Layne and Steiner 1996).

At the C-44 site, which was mostly citrus irrigated from canals, the average home range size for four male indigo snakes using the minimum convex polygon method was 42.61 ha (105.29 acres); one female snake tracked for 18 months had a home range of 13.79 ha (34.08 acres; Ceilley et al 2014). These home range sizes convert to a 100 ha density of 2.35 males and 7.25 females (9.60 total indigos per 100 ha). These home range sizes are smaller than previously reported in the literature, and Ceilley et al (2014) suggested the C-44 site contained high-quality habitat and/or a high indigo snake population density. In Bauder et al. (2016), radio telemetry data was summarized to provide an estimated mean annual home-range size of 369 ac for males (n = 40) and 121 ac for females (n = 31).

The density of indigo snakes in project features, and therefore, the number potentially affected by the action would be based on habitat quality and consequently the presence of resources like prey, cover, underground refugia, and other indigo snakes. Improved pasture, comprised primarily of short-stature exotic grasses, does not provide much cover for a large snake such as the indigo, especially if burrows or other underground refugia are sparse. Where there are forested or shrubby wetlands and uplands (including some agriculture like citrus), there is more likely to be abundant prey items and more refugia; hence, more indigo snakes.

Florida Bonneted Bat

Florida bonneted bats are expected to occupy the action area. The only reported observation was at Platt's Bluff Boat Ramp in 2008 about 1.2 miles east of the Kissimmee River Center wetlands site (Figure 8). Florida bonneted bats are closely associated with forested areas because of their tree-roosting habits (Robson 1989; Belwood 1992; Eger 1999), but specific information is limited. Eger (1999) noted that in forested areas, old, mature trees are essential roosting sites for this species. Recent acoustical data and other information indicate that the Florida bonneted bat uses forests and a variety of other natural areas. Improved pasture (treeless) is not likely to have many potential roost sites. The use of the pasture and pasture wetlands for foraging habitat would be predicated upon roosting habitat being within the FBB nightly flight ability. Average FBB foraging distance is unknown. Data from recovered GPS satellite tags on Florida bonneted bats tagged at Babcock-Webb Wildlife Management Area (WMA), found the maximum distance detected from a capture site was 24.2 mi (38.9 km); the greatest path length travelled in a single night was 56.3 mi (90.6 km) (Ober 2016; Webb 2018a-b). There are no FBB survey data for STOF's Brighton Reservation.

Factors affecting the species environment within the action area

The factors that have contributed to the baseline condition of the action area for the caracara is the relative rural nature that allows for maintenance of large areas of pasture or pasture-like habitat with wetlands and suitable cabbage palms for nesting substrate. In that regard, the preservation of ranching-type activities to maintain the open habitat in this area is important for long-term persistence of caracaras.

For the indigo snake, habitat is the key factor to the extent and abundance of this species in the action area. Where improved pasture is not very suitable due to lack of prey and cover, forested uplands, citrus, and wetland edges (including some canals or drainage features) with underground refugia are important habitats to maintain the indigo snake population in the action area.

For the FBB, habitat complexity with forested uplands for roost sites and suitable foraging areas (either uplands or wetlands with good insect productivity) will dictate where the species occurs. The open pasture setting of the action area may still provide foraging opportunities for the FBB as this species should be capable of foraging up to 25 miles, or more, from a roost site.

Climate Change

Our analyses under the ESA include consideration of observed or likely environmental effects related to ongoing and projected changes in climate. As defined by the Intergovernmental Panel on Climate Change (IPCC), "climate" refers to average weather, typically measured in terms of the mean and variability of temperature, precipitation, or other relevant properties over time; thus "climate change" refers to a change in such a measure which persists for an extended period, typically decades or longer, due to natural conditions (e.g., solar cycles) or human-caused changes in the composition of the atmosphere or in land use (IPCC 2013, p. 1450).

Detailed explanations of global climate change and examples of various observed and projected changes and associated effects and risks at the global level are provided in reports issued by the IPCC (2014 and citations therein). Information for the United States at national and regional levels is summarized in the National Climate Assessment (Melillo *et al.* 2014 entire and citations therein; see Melillo *et al.* 2014, pp.28-45 for an overview). Because observed and projected changes in climate at regional and local levels vary from global average conditions, rather than using global scale projections, we use "downscaled" projections when they are available and have been developed through appropriate scientific procedures, because such projections provide higher resolution information that is more relevant to spatial scales used for analyses of a given species and the conditions influencing it (see Melillo *et al.* 2014, Appendix 3, pp. 760-763 for a discussion of climate modeling, including downscaling). In our analysis, we use our expert judgment to weigh the best scientific and commercial data available in our consideration of relevant aspects of climate change and related effects.

Climate models predict Florida will experience warmer air and sea temperatures in future years. This has an increasing potential to create more frequent or stronger tropical storms or hurricanes during the rainy season or worse droughts during the dry season. Empirical evidence shows that

sea levels have risen about 8 inches over the last 100 years, and models predict that sea levels will rise an additional up to 2.5 feet by 2100. As a result, the human population may shift away from the Florida coast to more interior portions (*i.e.,* this action area). In that event, habitat for caracaras, indigo snakes, and FBB may be further lost or fragmented by residential and commercial development without adequate protection.

EFFECTS OF THE ACTION

Adverse effects

Crested caracara

Approximately 13,000 acres of caracara habitat will be lost via hydrologic conversion within the WAF. We do expect some of the proposed levees and seepage canals built for the WAF may serve as habitat, but cannot determine that spatial extent at this time. Up to 4,800 additional acres of existing caracara habitat may also be lost from within the wetland restoration sites. At this time, we cannot accurately quantify the acres of upland caracara habitat potentially lost in future wetland sites because we do not have detailed project designs. Some of the areas are currently wetlands (albeit lesser functioning) and may not be caracara habitat now. We expect any caracara nest trees within the WAF footprint will be removed and those territories may disappear depending on the percentage of habitat conversion by the action in each territory. Caracara nest trees could also be removed within wetland restoration sites or ASR sites, if they cannot be avoided.

Caracara territories with nest trees that are outside the WAF, ASR, or wetland footprints may also be affected (*i.e.,* reduced productivity) by disturbance during construction or operation, or if a substantial percentage of the territory is made unusable (even if the nest tree remains intact). Alternatively, territories may shift because of habitat loss or fragmentation. In this event, increased intra-or inter-specific aggression may result. Current understanding of caracara population dynamics in Florida is that suitable caracara breeding habitat is occupied. The significance of this is that any breeding caracara displaced by the LOWRP will need to either displace another breeder, or lose its territory (and productivity), unless new habitat is created (*e.g.,* conversion of citrus to pasture).

We do not know how many breeding pairs overlap the LOWRP footprint. However, until surveys are completed, we can use the density of nests on the Brighton Reservation to estimate the number of caracara territories affected by the action. Figure 6 shows the locations of reported caracara nests (1994 to 2018) around the WAF and wetland restoration sites. Using a simple formula of "acres of project" (13,600 + 4,800 = 18,400) divided by "average territory size" (2,008 acres, as explained previously in the Environmental Baseline), there would be room for nine caracara territories wholly within the project (18,400/2,008 = 9.16). However, we know the distribution of nests is based on habitat and there is likely to be portions of some territories both inside and outside of project component footprints. Therefore, the total number of caracara territories affected by the project could be more than nine (assuming all habitat inside the proposed WAF and wetlands is suitable).

To obtain a more realistic estimate of number of territories affected by the project, we used aerial images and land cover shapefiles in ArcGIS to predict the most likely location of caracara territories. We started by drawing 2,008-acres circles around reported nests (three of these are close enough to be directly affected by the project) to approximate the location and size of reported territories. We then placed additional adjacent 2,008-acre circles (to represent additional potential caracara territories) over the remaining pasture habitat that also included wetlands and cabbage palms until the project components were covered (Figure 9). The result was four whole territories and nine partial territories within, or affected by, the potential WAF and wetlands. Each of the three reported caracara territories were predicted to be partially affected because the most recent nest trees are just outside of the southern boundary of the WAF; therefore, approximately half of each of these territories is outside the footprint.

It is not clear if the creation of the WAF would cause these birds to abandon their territories. This estimate may change after those surveys are completed; however, for the purpose of this Biological Opinion, we will move forward with 13 caracara territories affected by the project; with a likelihood of some (as many as 7 territories) being completely lost. Eleven territories are associated with the WAF and Paradise Run wetland, and two territories with Kissimmee River Center wetland. We did not consider the ASR wells as having a measurable effect due to the small footprint (each 2-well cluster will occupy a 3-acre footprint) which would presumably allow the Corps to site them away from caracara nests. In addition, about 25 ASR wells will be adjacent to the WAF, so in essence, are part of the WAF's effects.

The Corps (2019) estimated unconstrained construction of the WAF would take 10.5 years. The two wetlands could be constructed in about 5 years (Paradise Run) and about 3 years (Kissimmee River Center). Therefore, it is possible that some adjacent nesting adult caracaras would experience disturbance which may result in lost productivity in those years concomitant with construction. The Service cannot accurately quantify these productivity losses until the schedule becomes more definite. For example, if both wetlands and the WAF are constructed simultaneously, disturbance would last for a minimum of 11 years; however, if they are constructed in sequence, then disturbance of nests could last for about 19 years (10.5 + 5 + 3). Regardless, there currently appears to be a surplus of juvenile and non-breeding caracaras in Florida, so loss of productivity for a few years is probably not as significant a threat to population persistence as permanent loss of breeding territories.

Eastern indigo snake

Upland habitat will be lost via hydrologic conversion in the WAF and possibly wetland restoration sites. For the purposes of this Biological Opinion, any improved pasture areas that have very low herbaceous cover (including sod areas) and open water are generally not indigo snake habitat. Within the LOWRP footprints, approximately 13,133 acres (or about 74 percent) are classified as improved pasture (Corps 2018) and 11 acres as reservoir. Therefore, approximately 11,057 acres within the WAF footprint is unsuitable indigo snake habitat. Within the wetlands restoration sites, 1,286 acres are unsuitable in Paradise Run, and 801 acres are unsuitable in the Kissimmee River Center site. As a result, the WAF and wetlands will hydrate approximately 5,635 total acres of habitat for the indigo snake.

Construction of ASR facilities might also destroy or fragment indigo snake habitat; however, we cannot accurately estimate the amount, so default to the maximum amount of 3 acres per 2 wells not associated with the WAF (approximately 83 total acres for 55 wells). Therefore, no more than 5,718 acres (5,635 + 83) of indigo snake habitat would be removed by the action. Any indigo snakes that occupy the project area will lose all or a part of their home range (in the case of the wetland restoration sites, this loss may be permanent or temporary depending on hydrology). The loss of reproduction and/or sheltering opportunities would depend on the amount and quality of the indigo snake's territory that is lost.

Indigo snakes might be killed, injured, or displaced by construction of the project including ASR sites (although the risk at ASR sites may be lower due to smaller footprints). Displaced snakes might also be subsequently killed or injured, including via inter- or intra-specific aggression. During construction, indigo snakes in underground refugia might be killed without being observed. Indigo snakes might also be crushed by vehicles or equipment if operators are unable to see snakes, either on the site or when traveling to and from the site. Despite the Corps' agreement to implement a 25 mph speed limit (to reduce the likelihood for vehicular mortality of indigo snakes), experience at the Corps' C-44 Reservoir and STA Project site indicates vehicles or equipment still kill indigo snakes.

We do have occurrence data for indigo snakes within the action area, but not within the project footprint with the exception of two of the potential ASR sites (Figure 7). The Service used data from other indigo snake studies in Florida to estimate the number of indigo snakes on the project site. In Bauder et al. (2016), radio telemetry data was summarized to provide an estimated mean annual home-range size of 369 ac for males (n = 40) and 121 ac for females (n = 31) (note - these data were reported in hectares in Bauder et al. (2016) but were converted to acres for this document). Using these mean home range estimates and allowing for overlap of home ranges among the sexes, we calculated that up to 15 males (5,718 ac/369 ac per a single male home range) and 47 female (5,718 ac/121 ac per a single female home range) indigo snakes or 62 indigo snakes total are likely to occur within the 5,718 ac project footprint. Because 47 female indigo snakes are expected to be present, we also estimate 47 nests with eggs could also be present during breeding season (April to July).

Florida Bonneted Bat

Within the WAF, the 11,051 acres of improved pasture is not likely FBB roosting habitat. There are about 2,000 acres (in disjointed patches) in the WAF with large trees that are potential FBB roost areas. It is not clear how many of these trees in the WAF will need to be removed during construction, but the assumption for this consultation is that all will be removed. For the wetland restoration sites, the natural habitat is likely of higher quality and there is a similar potential for FBB roost trees; however, we estimated that spatial extent at less than 1,000 acres (total in both Paradise Run and Kissimmee River Center sites). We expect some but not all of these trees to be removed during construction, especially those within the footprints for the inflow pump station and outlet features. Large interior trees at Paradise Run and Kissimmee River Center wetlands should remain to provide habitat complexity. We added a Conservation Recommendation at the end of this Biological Opinion to leave potential roost trees standing, if possible, so that they may provide FBB habitat during and after construction.

FBB generally forage over open areas, including wetlands. Until we have better data, we will assume that the entire LOWRP area is potential FBB foraging habitat. We do not know if the quality of foraging habitat will change after inundation of the project sites. Coleopteran (beetles) prey might decrease, as terrestrial insect species tend to be larger on average than aquatic species; conversely, dipteran (true flies and midges) productivity might increase as hydroperiod increases. Regardless, foraging habitat for FBB exists now within project footprints and will continue after the project is completed. We have no data to determine if hydrologic improvements to Lake Okeechobee from the implementation of the LOWRP will improve foraging conditions for the FBB over the lake or farther downstream.

We have one FBB occurrence record in the action area near Platt's Bluff boat ramp (an Okeechobee County park on the Kissimmee River, on 5/26/2008). This is 1.2 miles to the northeast of the Kissimmee River Center wetland site (Figure 8). The Corps intends to conduct surveys for FBB once Congress authorizes the LOWRP and access is available, but in the interim, we cannot estimate the number of FBB adversely affected by the action. Therefore, we will use acres of roosting habitat (3,000 acres) lost as a surrogate for effects of the action on FBB. When FBB survey data become available, reinitiation of consultation for FBB should be evaluated.

CUMULATIVE EFFECTS

Cumulative effects, as defined under the ESA, include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this Biological Opinion. Future Federal actions unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Cumulative effects within the action area could result from land clearing or land cover modification that alone may not trigger a section 7 or section 10 permit. For example, we are reasonably certain that private landowners might plant sugar cane or citrus on pasture, and convert upland tree habitat to pasture. As a result, adverse effects to listed species may occur. In the case of pasture conversion to other non-herbaceous (or tall herbaceous) land cover, habitat for caracaras may be lost. We cannot estimate the potential for loss to caracaras, however it would need to be on the order of 1,000 acres (the minimum breeding territory size). Similarly, if forested areas are cleared, habitat for indigo snakes or FBB roost sites may be lost. We do not have enough occurrence data to estimate the magnitude of this effect on indigo snakes or FBB, but expect to have better FBB occurrence data before the LOWRP goes to construction.

Increased vehicle traffic is another cumulative effect that may adversely affect listed species in the action area. Road mortality has been demonstrated for both indigo snakes and crested caracaras, but we do not have quantitative data other than a few caracara mortalities reported to the Service in an average year. Therefore, as central Florida becomes more developed (even outside the action area) we expect more vehicle use in the action area on State Route (SR) 78 and SR 70, and a concomitant increase in road mortality of listed species. We cannot accurately estimate this amount of mortality.

Within the action area, much of the land use is pasture and wetlands. It is unlikely that any medium or large-scale residential development or dispersed water project could happen without triggering a Corps 404 Permit (and therefore include a Service review). There is still considerable forested areas on the STOF Brighton Reservation; however, the Tribe generally consults with the Service on land management and fire management plans, and conducts caracara surveys.

CONCLUSION

After reviewing the current status of the crested caracara, eastern indigo snake, and FBB, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's Biological Opinion that the LOWRP, as proposed, is not likely to jeopardize the continued existence of the crested caracara, eastern indigo snake, or FBB. For the caracara, we have reached this conclusion because: 1) only 3 of the potential 13 caracara nests are verified; 2) of these three, the nest trees and approximately half of each territory is outside of the footprint of the project; 3) we do not know how many territories would be completely lost; however, we have predicted it is a low number considering the potential for territories on adjacent lands; 4) follow-up surveys will be conducted to verify the number and locations of active caracara nests prior to construction; and 5) at that time a re-initiation would either confirm or replace the non-jeopardy determination prior to construction. For the indigo snake, we have reached this conclusion because the amount of habitat anticipated to be flooded by the project is a small fraction of the available indigo snake habitat in south Florida. For the FBB, we have reached this conclusion based on: 1) a lack of occurrence data in the project footprints or in nearby STOF Brighton Reservation; 2) the Corps' willingness to survey for this species (and reinitiate if necessary) prior to construction; and 3) foraging habitat and some roosting habitat should still exist afterwards in the WAF and wetlands.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to, and not intended as part of the agency action, is not considered to be prohibited taking under the ESA provided such taking is in compliance with the terms and conditions of this incidental take statement.

The terms and conditions described below are nondiscretionary and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to the District, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to

regulate the activity covered by this incidental take statement. If the Corps: 1) fails to assume and implement the terms and conditions; or 2) fails to require the District to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps and District must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR § 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service has reviewed the biological information for the crested caracara, eastern indigo snake, and FBB. We have also reviewed information presented by the District and Corps, and other available information relevant to this action.

The Service anticipates incidental take in the form of, at least, partial territory habitat loss for up to 13 caracara breeding pairs. Some of these may be completely lost due to flooding of habitat in the WAF or wetland restoration sites. Construction is likely to take a minimum of 11 years; therefore, we also anticipate incidental take as disturbance of up to 13 breeding pairs of caracaras that may result in reduced reproductive success or complete nest failure for the duration of construction.

The Service anticipates incidental take of the eastern indigo snakes will be difficult to detect and quantify for the following reasons: 1) they spend much time underground even during the day; 2) they are difficult to observe in tall grass or brush; 3) a reliable survey method has not been developed so it will be difficult to know how many snakes are on the site once access is available; and 4) potential observers may be distracted or may not be experienced enough to recognize indigo snakes or snake sheds. We expect the LOWRP will remove up to 5,718 acres of indigo snake habitat. As these acres are not all contiguous, it is difficult to assess the number of territories, and therefore, the number of indigo snakes at risk. We have therefore defaulted to the conservative estimate of up to 62 indigo snakes that will be incidentally taken by the project, and of these, we anticipate half will be killed during construction (and probably most of these will never be observed). Therefore, we anticipate the LOWRP will kill up to 31 indigo snakes, either directly (crushing or burying) or indirectly (inter or intra-species aggression). The remaining 31 indigo snakes will be injured or disturbed but survive either within or adjacent to the LOWRP footprints.

At this time, due to lack of FBB survey data, we cannot estimate the number of FBBs that are likely to be incidentally taken by the project. The LOWRP will convert the type of FBB foraging habitat from upland pasture with some wetlands to longer-hydroperiod wetlands or WAF. Therefore, although the foraging habitat type will change (and we assume prey items may differ), there will still be FBB foraging habitat after the project is constructed. Therefore, the Service has opted to use acres of FBB roosting habitat lost as a surrogate for the number of individual FBB incidentally taken by the project until better data become available. When better data are available, we anticipate that no or a minimal number of FBBs will be killed by the project because roosts will be identified prior to construction and bats will either relocate

themselves or be relocated to adjacent areas (possibly within the wetland restoration areas). The Service anticipates incidental take of up to 3,000 acres of FBB roosting habitat.

If, during the course of this action, any of these levels of take is exceeded, such take would represent new information requiring review of the reasonable and prudent measures provided. The Federal action agency must immediately reinitiate consultation with the Service.

EFFECT OF THE TAKE

In the accompanying Biological Opinion, the Service determined that this level of expected take is not likely to result in jeopardy to the crested caracara, eastern indigo snake, or FBB. Critical habitat designation for the FBB is not available; however, the Service anticipates publishing the proposed rule in early 2020.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the incidental take along with terms and conditions that must be complied with, to implement the reasonable and prudent measures. The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize effects of the LOWRP on crested caracara, eastern indigo snake, and FBB: 1) implement the LOWRP as outlined in the Description of Proposed Action section of this Biological Opinion; including minimization and conservation measures; 2) implement the *Standard Protection Measures for Eastern Indigo Snakes* (Service 2013); and 2) implement the latest applicable FBB best management practices (*e.g.,* Appendix B).

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following terms and conditions, which carry out the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary: 1a) coordinate the planned surveys for chemical contaminants, crested caracaras, and FBB with Service biologists in a manner that allows the Service the opportunity to participate and provide input on the survey methods; 1b) provide the Service with the data from those surveys with sufficient time to review and request reinitiation, if necessary, prior to start of construction; 2) provide the Service with a list of applicable and implementable FBB BMPs (from Appendix B or as revised) prior to construction or reinitiation of consultation, whichever comes first.

MONITORING AND REPORTING REQUIREMENTS

Pursuant to 50 CFR § 402.14(i)(3), the Corps and/or District must provide adequate monitoring and reporting to determine if the amount or extent of take is approached or exceeded. After completing the already agreed upon caracara nest surveys, the Corps will conduct monitoring to determine if any breeding caracara pairs that are likely to be displaced by the project subsequently reproduce elsewhere. This may include capturing, leg banding, and tagging with

an appropriate transmitter, one or two adult caracaras from each breeding pair that is likely to lose its nest tree or more than 40 percent of its territory (*i.e.,* conversion of pasture or pasture like habitat to WAF or long-hydroperiod wetlands). This also includes the conversion of short-stature herbaceous caracara habitat to overgrown non-caracara habitat if the project footprint(s) lies fallow. The capture and tagging shall be conducted at an appropriate time so as to allow for data collection of each territory for at least one breeding season (minimum of 6 months that includes nesting) prior to construction, and at least two years following construction (or conversion of usable habitat to non-usable habitat by caracaras). In the event of tag failure or caracara mortality prior to completion of monitoring, the Corps will attempt to capture and tag the other adult from that pair. Person(s) conducting this activity must hold, or be authorized under, an active 10(a)(1)(A) Recovery permit issued by the Service. An annual report of the findings must be submitted to the Service with all data and shapefiles within 60 days after the end of the reporting period.

The Corps or District (on behalf of the Corps) must report any observation of a live eastern indigo snake or FBB in or adjacent to the LOWRP area to the Service (South Florida Ecological Services Office, Vero Beach, Florida; 772-562-3909) within seven business days. In the event that a live indigo snake or FBB represents a construction or operational challenge, it must be reported immediately to the Service.

DISPOSITION OF DEAD OR INJURED SPECIMENS

Any observations of dead or injured caracaras must be immediately reported by the Corps or District (on behalf of the Corps) to the Service (South Florida Ecological Services Office, Vero Beach, Florida; 772-562-3909). In the event that a dead caracara is found, photographs of the scene and setting showing the position of the caracara must be taken before the caracara is disturbed. Then the caracara will be placed in a plastic bag on ice or frozen as soon as possible for preservation. The Corps will require the agency in charge of construction to complete a report identifying, to their best ability, the activities surrounding the mortality or injury of any caracara and submit that to the Service within 7 days.

Any observation of dead or injured eastern indigo snakes must be reported to the Service by the Corps or District immediately. In the event that a dead indigo snake is found, photographs of the scene and setting showing the position of the snake must be taken before the snake is disturbed. Then the snake will be placed in a plastic bag on ice or frozen as soon as possible for preservation. The Corps will require the agency in charge of construction to complete a report identifying, to their best ability, the activities surrounding the mortality of the snake and submit that to the Service within 7 days.

Any observation of a dead or injured FBB must be reported to the Service by the Corps or District immediately. In the event that a dead FBB is found, photographs of the scene and setting showing the position of the FBB must be taken before the FBB is disturbed. Then the FBB will be placed in a plastic bag on ice or frozen as soon as possible for preservation. The Corps will require the agency in charge of construction to complete a report identifying, to their best ability, the activities surrounding the mortality or injury of any FBB and submit that to the Service within 7 days.

Upon locating a dead, injured, or sick threatened or endangered species, initial notification must be made to the nearest Service Law Enforcement Office: 20501 Independence Blvd., Groveland, Florida 34736; 352-429-1037, as well as the biologist identified below at the South Florida Ecological Service Office, 772-562-3909. Secondary notification should be made to the Florida Fish and Wildlife Conservation Commission: South Region; 8535 Northlake Boulevard West Palm Beach, Florida 33412; 561-625-5122. Care should be taken in handling sick or injured specimens to ensure effective treatment and in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens, or preservation of biological materials from a dead animal, the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The Service recommends the following:

1. To the extent practical, leave any trees interior to the WAF and wetlands standing (which would include potential FBB roost trees) so that they may continue to provide habitat after construction is complete.
2. Interview property owners within the action area for information regarding their observations of listed species near the LOWRP components to facilitate future surveys.
3. The Corps should include the Service in the Engineering Design phase for the Paradise Run and Kissimmee River Center wetlands.

The Service recommends notification if the Corps implements any conservation recommendation that either benefits or minimizes/avoids adverse effects to listed species or their habitats.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the LOWRP consultation request. As written in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Corps involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded (*i.e.,* if more than 9 partial or 4 complete caracara territories are taken; if more than 18 indigo snakes are injured or killed; or if any FBB are injured or killed); 2) new information reveals effects of the Corps' action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the Corps' action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease until reinitiation.

Thank you for your cooperation and effort in protecting federally listed species and fish and wildlife resources. If you have any questions regarding this project, please contact Steve Schubert at 772-469-4249.

Sincerely yours,

Donald R. Progulske
Field Supervisor
South Florida Ecological Services Office

cc: electronic only
Corps, Jacksonville, Florida (Angie Dunn, Tim Gysan, Andrew Loschiavo, Lisa Aley, Gretchen Ehlinger, Melissa Nasuti)
DEP, West Palm, Florida (Stan Ganthier)
DEP, Tallahassee, Florida (Ed Smith, Frank Powell, Natalie Barfield, Kristyn McClure)
District, West Palm Beach, Florida (Michelle Ferree)
EPA, West Palm Beach, Florida (Cecelia Harper)
FWC, Tallahassee, Florida (FWC-CPS)
FWC, West Palm Beach, Florida (James Erskine)
NOAA Fisheries, West Palm Beach, Florida (Joan Browder, Steph Bolden)
Seminole Tribe of Florida, Hollywood, Florida (Kevin Cunniff, Stacey Myers, Whitney Sapienza, Michelle Diffenderfer)
South Florida Water Management District, West Palm Beach, Florida (Jennifer Leeds)
Service, Vero Beach, Florida (Kevin Palmer, Andrew Eastwick, Steve Schubert)

FIGURES

Figure 1. The flow paths in the proposed 3-cell Wetland Attenuation Facility (WAF) and two wetland footprints for the Lake Okeechobee Watershed Restoration Project (figure from Corps 2019 Appendix A).

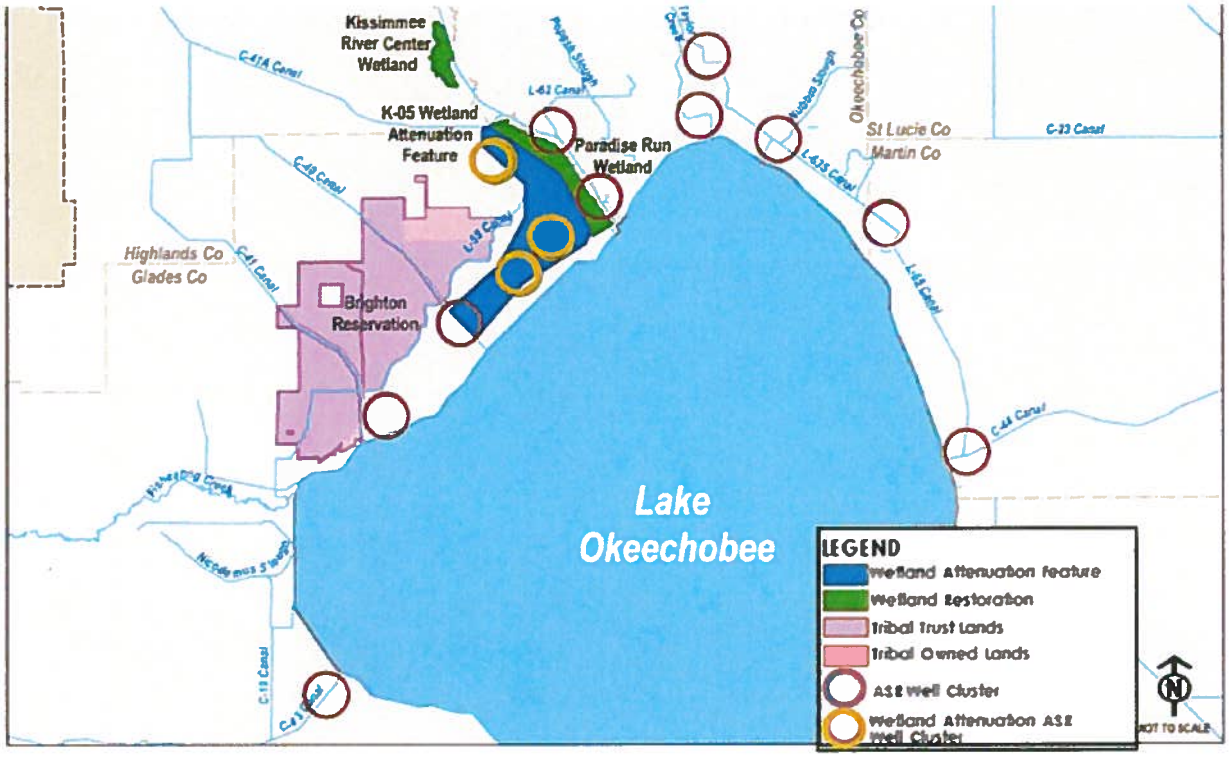

Figure 2. The location of LOWRP features including wetland restoration sites, WAF, and tentative Aquifer Storage and Recovery (ASR) clusters (figure from Corps 2019). The Seminole Tribe of Florida's Brighton Reservation is shown for context.

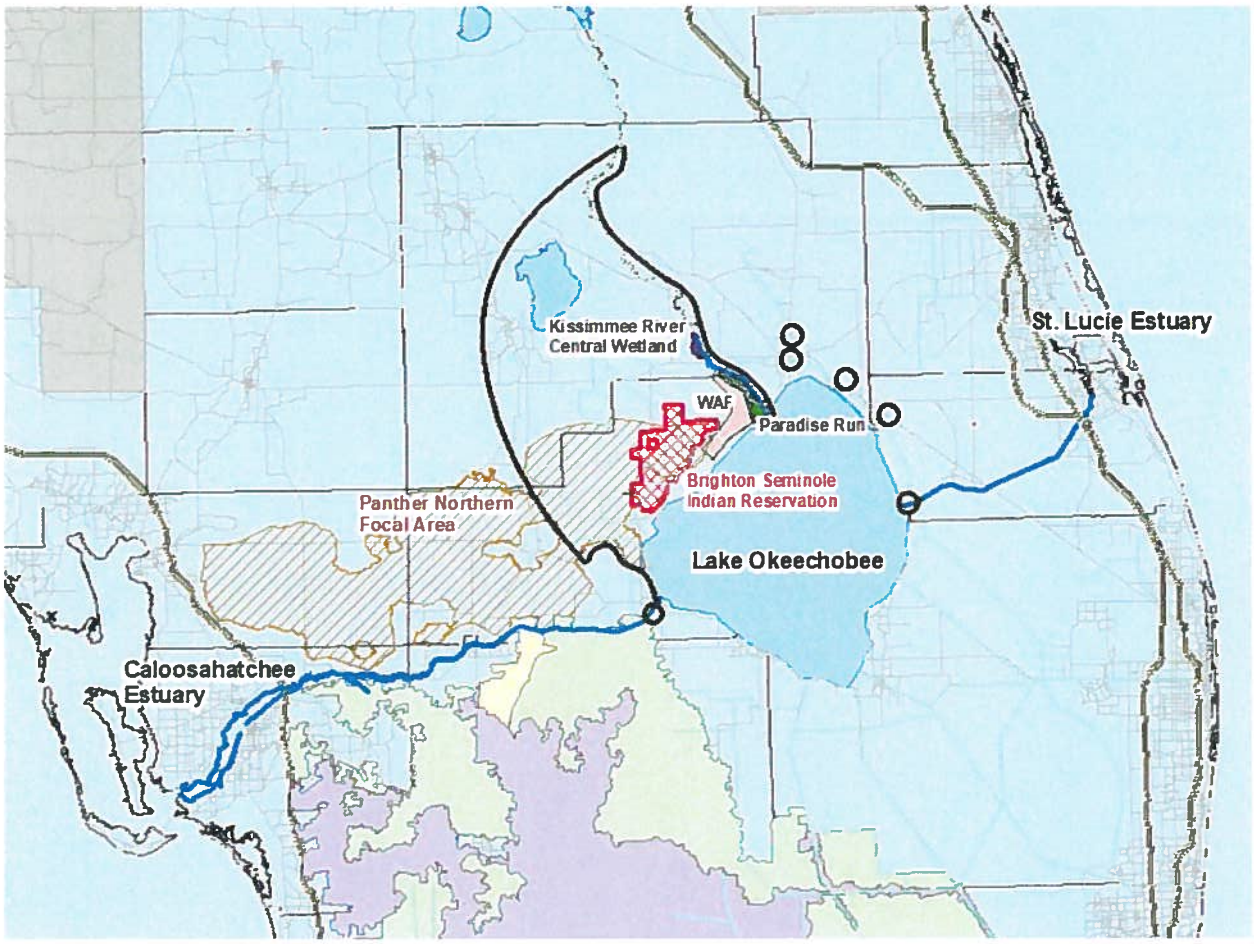

Figure 3. LOWRP Action Area including proposed ASR locations outside of the 25-mile panther buffer (both in black), Lake Okeechobee, C-43, C-44, St. Lucie River and Estuary, and Caloosahatchee Estuary (in blue).

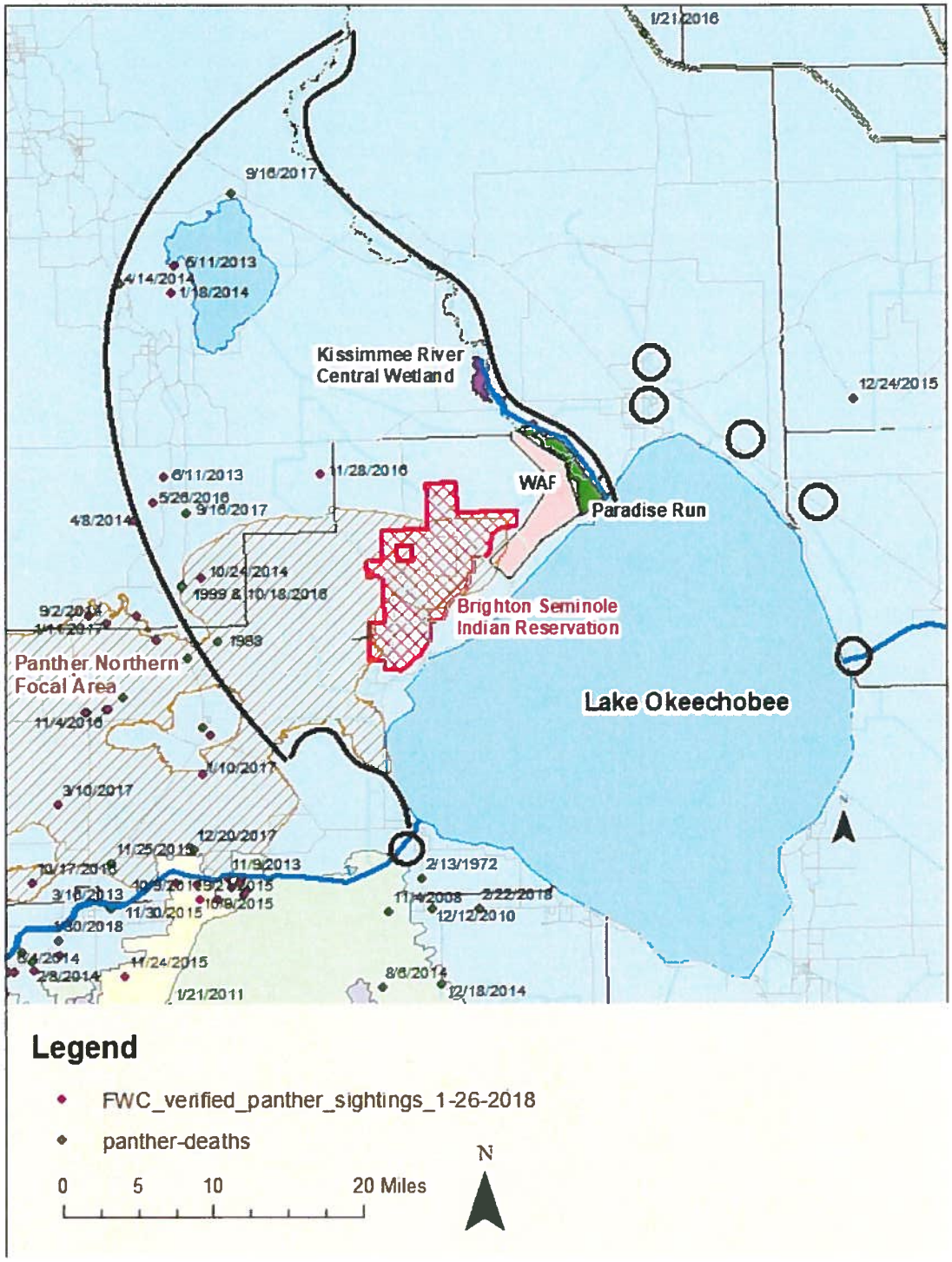

Figure 4. Florida panther mortality data and current observation data from FWC for LOWRP Action Area; panther observation website accessed August 15, 2018. https://public.myfwc.com/hsc/panthersightings/MapPoints.aspx

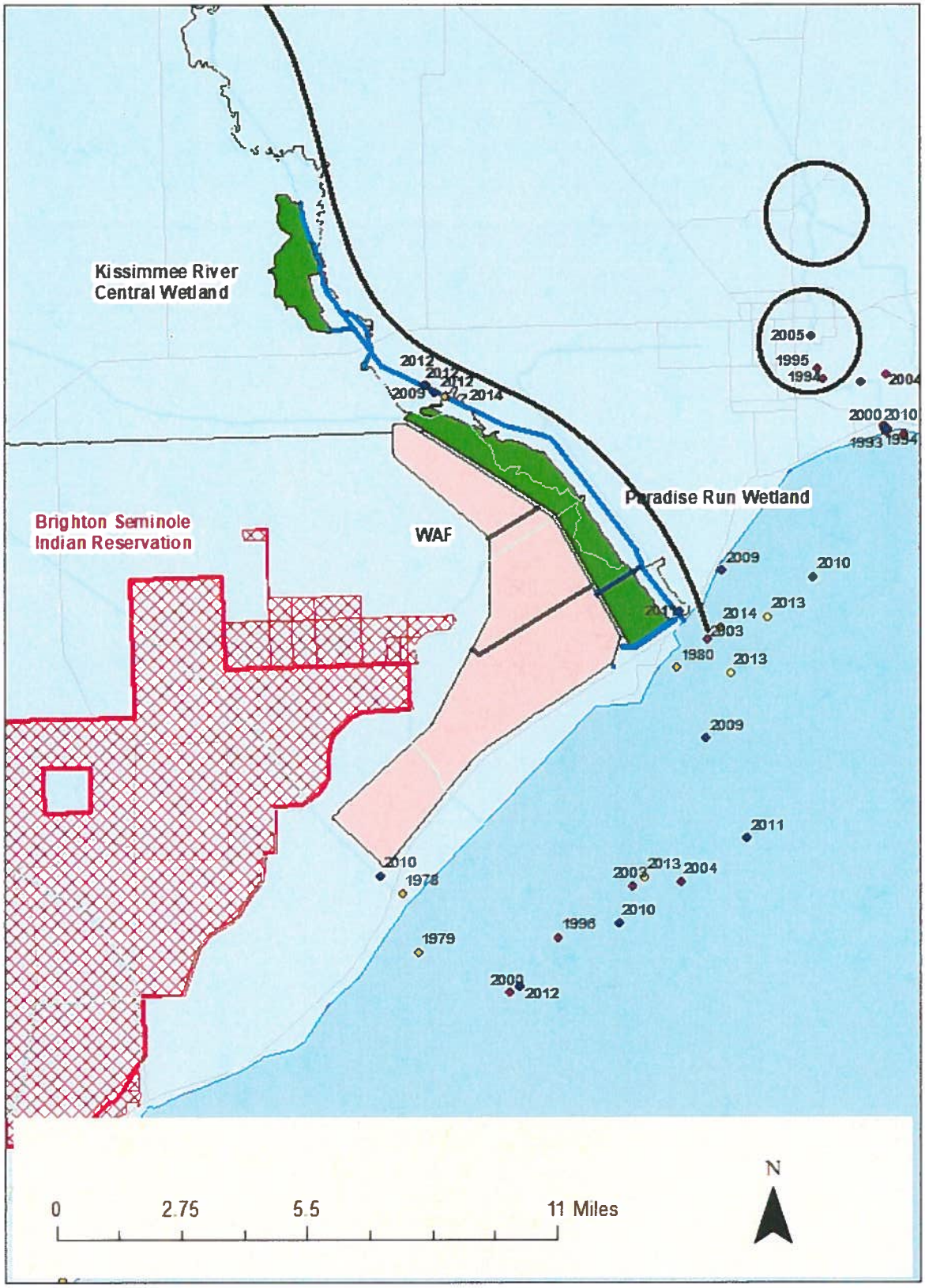

Figure 5. Manatee mortality data from 1978-2017 near the LOWRP features.

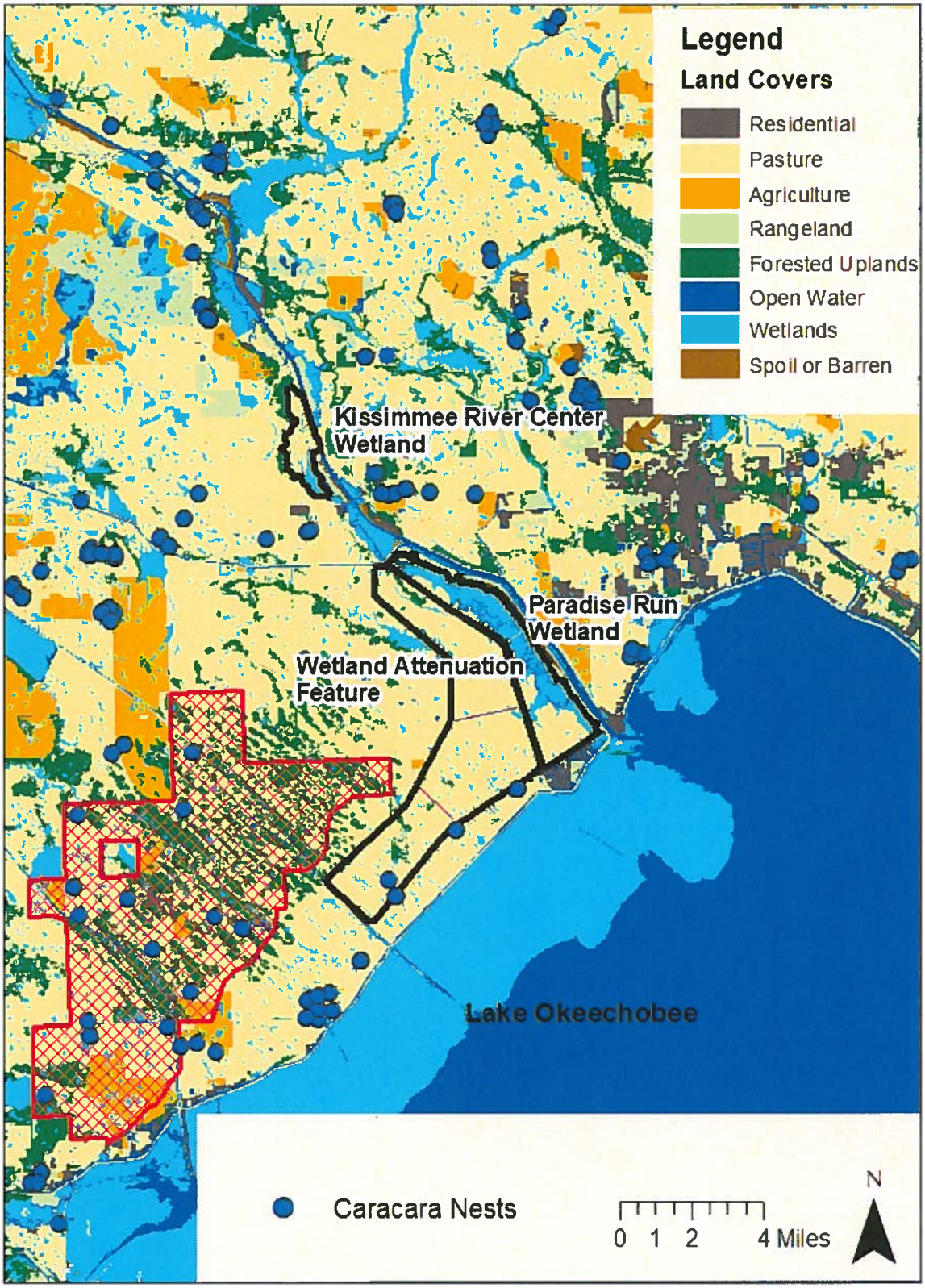

Figure 6. Caracara nest locations in and around the LOWRP from 1994-2018.

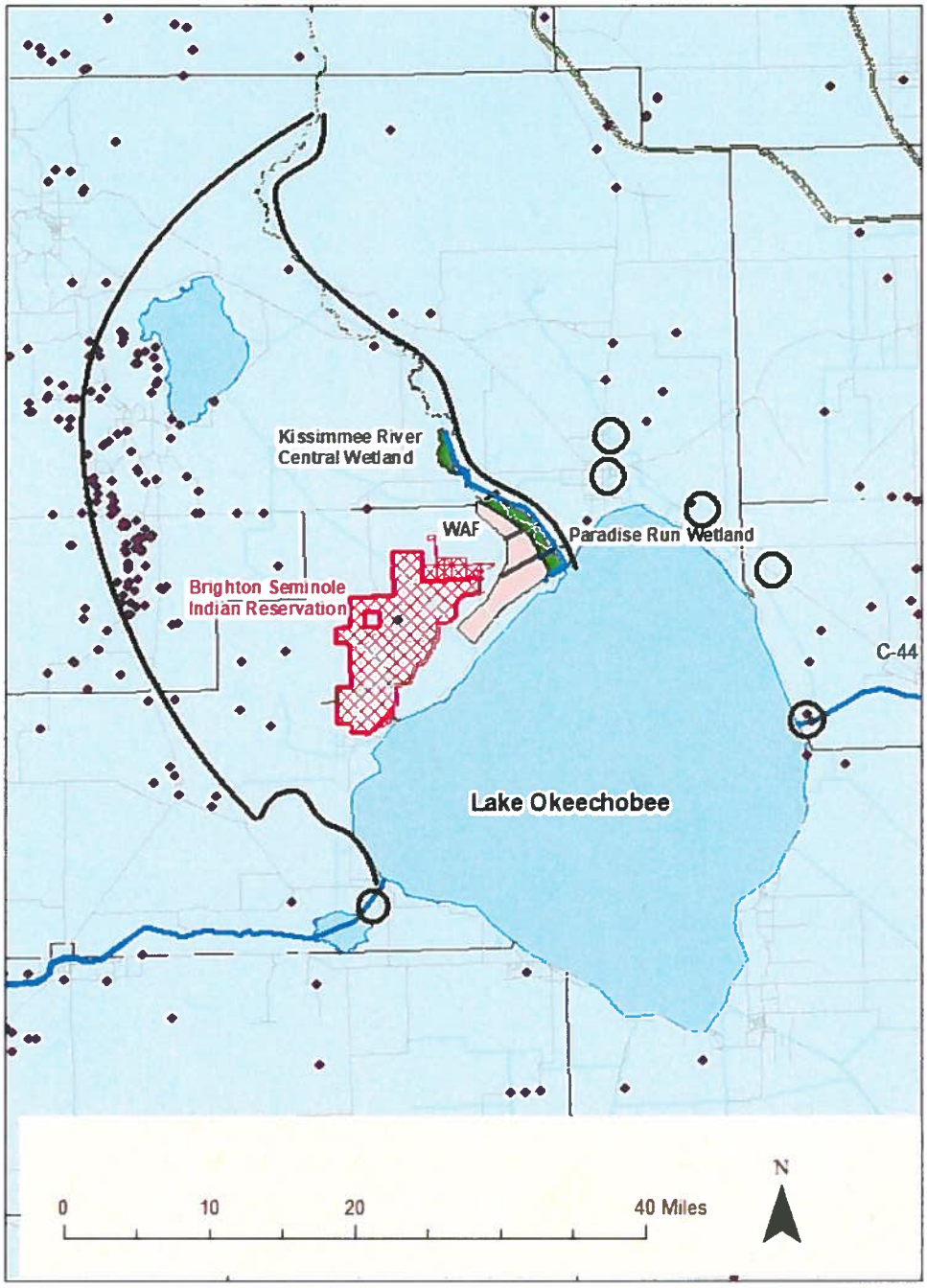

Figure 7. Eastern indigo snake locations in and around the LOWRP action area.

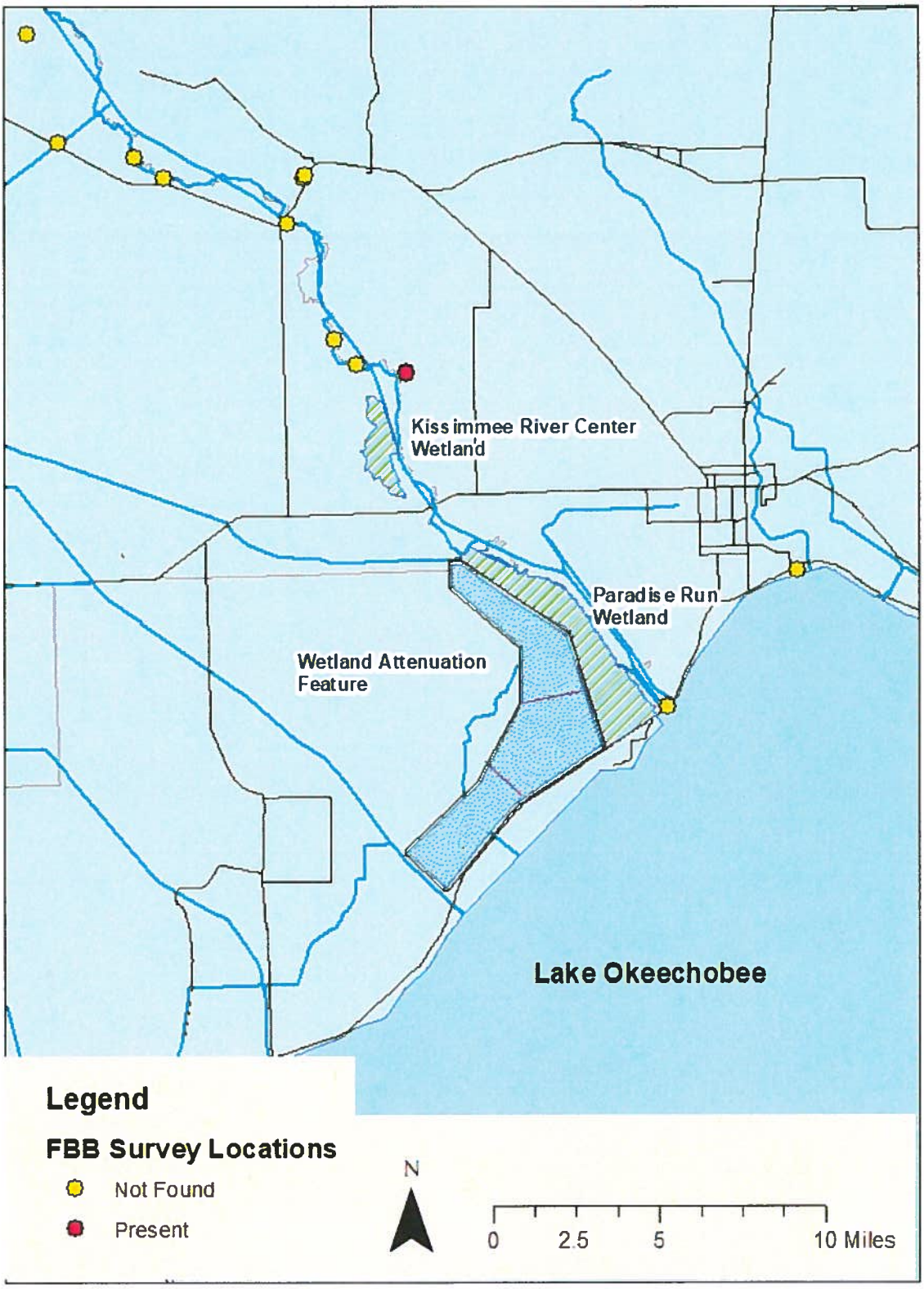

Figure 8. Florida bonneted bat (FBB) survey locations and present (red) or not found (yellow).

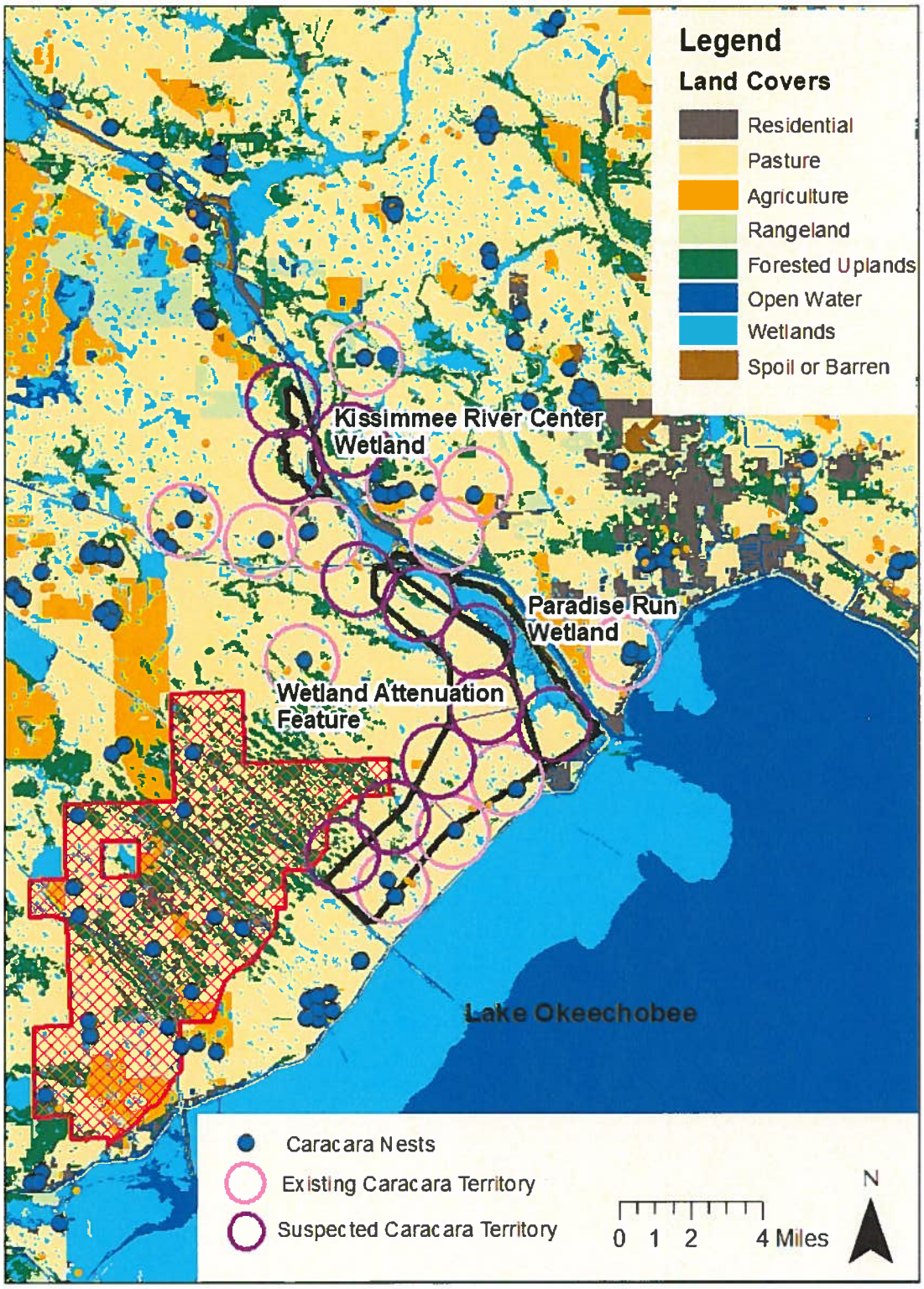

Figure 9. Reported caracara nest locations (1994-2018) with accompanying 2,008-acre territories and additional suspected caracara territories in and around the LOWRP.

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Appendix A. Status of the Species for the Florida Bonneted Bat
February 2016

STATUS OF THE SPECIES – Florida bonneted bat (*Eumops floridanus*)

Legal status – Federal: *endangered*, 2013; State: *Federally-designated endangered*

The U.S. Fish and Wildlife Service (Service) proposed to list the Florida bonneted bat under the Endangered Species Act of 1973, as amended in 1998 (Act) (87 Stat. 884; 16 U.S.C. 1531 et seq.), on October 4, 2012 (Service 2012). The final listing determination published on October 2, 2013, and became effective November 1, 2013 (Service 2013).

This species is also listed as "Federally-designated endangered" on the Florida List of Endangered and Threatened Species under the Florida Administrative Code (Chapter 68A–27 rules (68A–27.0011 and 68A–27.003)).

Critical habitat has not been designated for this species.

Species Description

Appearance/Morphology

The Florida bonneted bat is a member of the Molossidae (free-tailed bats) family within the order Chiroptera. The species is approximately 130 to 165 millimeters (mm) (5.1 to 6.5 inches (in) in length (Timm and Genoways 2004) and the largest bat in Florida (Owre 1978; Belwood 1992; Florida Bat Conservancy [FBC] 2005). The length of the tail ranges from 46 to 57 mm (1.8 to 2.2 in), hind foot 11 to 15 mm (0.4 to 0.6 in), ear 20 to 30 mm (0.8 to 1.2 in), and forearm 60.8 to 66.0 mm (2.39 to 2.60 in) (Timm and Genoways 2004). Masses average 39.7 grams (g) (1.4 ounces [oz]) and range from 30.2 to 46.6 g (1.1 to 1.6 oz) (Owre 1978; Belwood 1981; Belwood 1992; Timm and Genoways 2004). A pregnant female with a single fetus weighed 55.4 g (2.0 oz) (Belwood 1981). Males and females are not significantly different in size (Timm and Genoways 2004). Timm and Genoways (2004) found no pattern of size-related geographic variation in this species.

Members of the genus *Eumops* have large, rounded pinnae (ears), arising from a single point or joined medially on the forehead (Best et al. 1997). The common name of "bonneted bat" originates from characteristic large broad ears, which project forward over the eyes (FBC 2005). Ears are joined at the midline of the head. This feature, along with its large size, distinguish the Florida bonneted bat from the smaller Brazilian (=Mexican) free-tailed bat (*Tadarida brasiliensis*) (Belwood 1992).

Wings of the members of the genus *Eumops* are among the narrowest of all molossids (Freeman 1981, as cited in Best et al. 1997) and are well-adapted for rapid, prolonged flight (Vaughan 1959, as cited in Best et al. 1997). This wing structure is conducive to high-speed flight in open areas (Findley et al. 1972, as cited in Best et al. 1997).

The Florida bonneted bat's fur is short and glossy, with hairs sharply bicolored with a white base (Belwood 1992; Timm and Genoways 2004). Like other molossids, color is highly variable; color varies from black to brown to brownish-gray or cinnamon brown with ventral pelage paler than dorsal (Owre 1978; Belwood 1992; Timm and Genoways 2004). The basisphenoid pits (paired depressions in the basisphenoid bone) of the skull are ovoid (egg-shaped) and moderately deep (Timm and Genoways 2004). The tail projects beyond the interfemoral membrane (skin that stretches between the legs) (Owre 1978; Belwood 1992).

Taxonomy

The Florida bonneted bat (*Eumops floridanus*) was previously known as Florida mastiff bat, Wagner's mastiff bat, and mastiff bat (*E. glaucinus floridanus*) (Owre 1978; Belwood 1992; Best et al. 1997). While earlier literature found the Florida bonneted bat distinct at the subspecies level, the most current scientific information confirms that *E. floridanus* is a full species, and this taxonomic change has been accepted by the scientific community (Timm and Genoways 2004; McDonough et al. 2008; R. Timm, pers. comm. 2008, 2009; *in litt.* 2012; Baker et al. 2009). The International Union for Conservation of Nature and Natural Resources (Timm and Arroyo-Cabrales 2008), the Florida Natural Areas Inventory (FNAI) (2015), and the Florida Fish and Wildlife Conservation Commission (FWC) use the name *E. floridanus.*

Life History

Relatively little is known about the Florida bonneted bat's life history. Lifespan is not known. Based upon the work of Wilkinson and South (2002), Gore et al. (2010) inferred a lifespan of 10 to 20 years for the Florida bonneted bat, with an average generation time of 5 to 10 years.

The Florida bonneted bat has a fairly extensive breeding season during summer months (Timm and Genoways 2004). The maternity season for most bat species in Florida occurs from mid-April through mid-August (Marks and Marks 2008a). During the early portion of this period, females give birth and leave young in the roost while they make multiple foraging excursions to support lactation (Marks and Marks 2008a). During the latter portion of the season, young and females forage together until the young become sufficiently skilled to forage and survive on their own (Marks and Marks 2008a). The Florida bonneted bat is a subtropical species, and limited data suggest the species may be polyestrous (having more than one period of estrous in a year) (Timm and Genoways 2004; Florida Bat Conservancy [FBC] 2005). Recent studies at Babcock-Webb Wildlife Management Area (WMA) in 2014 have helped document pregnant bonneted bats in April with pups born in May (H. Ober, pers. comm. 2014a; J. Myers, pers. comm. 2014a–c). Preliminary data from the same site also suggest a prolonged maternity season, as some pregnant and post-lactating females were observed in late August (H. Ober, pers. comm. 2014b). Pups were also observed within a natural roost at Avon Park Air Force Range (APAFR) in mid-October (B. Scofield, pers. comm. 2014; P. Halupa, pers. obs. 2014b). The full extent of the maternity season is not well understood, but is a time of particular sensitivity, with increased energy demands and risks as females leave young in roosts while making multiple foraging excursions to support lactation (Kurta et al. 1989; Kurta et al. 1990; Kunz et al. 1995; Marks and Marks 2008a; H. Ober, pers. comm. 2014c). Exploitation of insects in patches that yield high energy returns for pregnancy and lactation is important (Kunz et al. 1995). Reduced insect populations in urban areas may make it difficult for females to successfully raise offspring to

maturity (Kurta et al. 1990; Kurta and Teramino 1992). Information on reproduction and demography is sparse. The Florida bonneted bat has low fecundity; litter size is one (FBC 2005; Timm and Arroyo-Cabrales 2008).

At present, only three active, natural roost sites have been reported, and only limited information on historical sites is available. Based upon limited information, the species roosts singly or in colonies consisting of a male and several females (Belwood 1992). G.T. Hubbell believed individuals in Miami roosted singly (Belwood 1992). However, Belwood (1981) suggested a colony, consisting of seven females and one male using a longleaf pine cavity as a roost site in Punta Gorda, was a harem group, based on its sex ratio. Belwood (1981; 1992) suggested this behavior has been recorded in a few bat species and such social groupings may be facilitated by roosting in tree cavities, which can be defended from other males (Morrison 1979). Few details are available for the composition of the currently known active natural roosts. At APAFR, approximately 22 bats emerged from the roost in October 2014, with several others including young remaining at the roost after emergence (P. Halupa, pers. obs. 2014b). At Florida Panther National Wildlife Refuge (FPNWR), 12 bats emerged from the roost tree on 2 consecutive nights in July 2015, with others, possibly pups, remaining in the roost after emergence (E. Braun de Torrez, pers. comm. 2015). At Big Cypress National Preserve (BCNP), 11 bats emerged from a natural roost in December 2015 (R. Arwood, pers. comm. 2015).

Information on roosting habits from artificial structures is also limited. The Florida bonneted bat colony using bat houses on private property in Lee County consisted of 8 to 25 individuals, including one albino (S. Trokey, pers. comm. 2006a, 2006b; 2008a, 2008b; 2012). Sex ratio is not known. Some movement between the houses has been observed (S. Trokey, pers. comm. 2006a). Periodic simultaneous counts taken at bat houses at Babcock-Webb WMA and recent research suggest that use fluctuates among the seven roost sites (artificial structures) (FWC, *in litt.* 2012; J. Myers, pers. comm. 2013, 2014a–b, d, 2015). Simultaneous counts taken at bat houses at emergence from 2012 to 2014 indicated that Florida bonneted bat roosts are generally small, occupied by 1-14 individuals, except for one location which generally supports 25-44 individuals among two houses (J. Myers, pers. comm. 2013, 2014b). It is not known if there is movement between houses and unknown natural roosts within Babcock-Webb WMA.

The Florida bonneted bat is active year-round and does not have periods of hibernation or torpor. The species is not migratory, but there might have been seasonal shifts in roosting sites (Timm and Genoways 2004). Belwood (1992) reported that, prior to 1967, G.T. Hubbell routinely obtained several individuals per year collected during the winter from people's houses. Precise foraging and roosting habits and long-term requirements are unknown (Belwood 1992). Active year-round, the species is likely dependent upon a constant and sufficient food supply, consisting of insects, to maintain its generally high metabolism. Based upon limited information, Florida bonneted bats feed on flying insects of the following orders: Coleoptera (beetles), Diptera (true flies), Hemiptera (true bugs), and Lepidoptera (moths) (Belwood 1981; Belwood 1992; FBC 2005). An analysis of bat guano (droppings) from the colony using the pine flatwoods in Punta Gorda indicated the sample (by volume) contained coleopterans (55 percent), dipterans (15 percent), and hemipterans (10 percent) (Belwood 1981; Belwood 1992). More recent analyses of bat guano collected from occupied bat houses at Babcock-Webb WMA

indicated that the samples contained high percentages of Lepidoptera and Coleoptera (Marks 2013).

Molossids, in general, seem adapted to fast flight in open areas (Vaughan 1966). Various morphological characteristics (*e.g.*, narrow wings, high wing-aspect ratios [ratio of wing length to its breadth]) make *Eumops* well-adapted for efficient, rapid, and prolonged flight in open areas (Findley et al. 1972; Freeman 1981; Norberg and Rayner 1987; Vaughan 1959, as cited in Best et al. 1997). Barbour and Davis (1969) noted that the species flies faster than smaller bats, but cannot maneuver as well in small spaces. Belwood (1992) stated *E. glaucinus* is "capable of long, straight, and sustained flight," which should allow individuals to travel large distances. Norberg and Rayner (1987) attributed long distance flights of Brazilian free-tailed bats to their high wing-aspect ratios, with that species capable of traveling 65 kilometers (km) (40 miles[m]) from its roosting site to its foraging areas (Barbour and Davis 1969). Like other molossids, the Florida bonneted bat's morphological characteristics make it capable of dispersing large distances and generally adapted for low cost, swift, long distance travel from roost site to foraging areas (Norberg and Rayner 1987; K. Gillies, *in litt.* 2012; H. Ober, *in litt.* 2012). Given this, it seems likely that foraging areas may be located fairly long distances from roost sites (H. Ober, *in litt.* 2012). Nonetheless, average foraging distances for the Florida bonneted bat are not known (G. Marks, pers. comm. 2012). Although the species can fly long distances, it likely does not travel farther than necessary to acquire food needed for survival (G. Marks, pers. comm.n 2012).

Bonneted bats are "fast hawking" bats that rely on speed and agility to catch target insects in the absence of background clutter, such as dense vegetation (Simmons et al. 1979; Belwood 1992; Best et al. 1997). Foraging in open spaces, these bats use echolocation to detect prey at relatively long range, roughly 3 to 5 m (10 to 16 ft) (Belwood 1992). Based upon information from G.T. Hubbell, Belwood (1992) indicated that individuals leave roosts to forage after dark, seldom occur below 10 m (33 ft) in the air, and produce loud, audible calls when flying; calls are easily recognized by some humans (Belwood 1992; Best et al. 1997; Marks and Marks 2008a).

Relatively little is known of the ecology of the Florida bonneted bat, and long-term habitat requirements are poorly understood (Robson 1989; Robson et al. 1989; Belwood 1992; Timm and Genoways 2004). Habitat for the Florida bonneted bat mainly consists of foraging areas and roosting sites, including artificial structures. At present, only three active, natural roost sites are known, and only limited information on historical sites is available.

Recent information on foraging habitat has been obtained largely through acoustical surveys, designed to detect and record bat echolocation calls (Marks and Marks 2008a). Acoustical methods have generally been selected over mist netting as the primary survey methodology because this species flies and primarily forages at heights of 9 m (30 ft) or more (Marks and Marks 2008a). The Florida bonneted bat has a unique and easily identifiable call. While most North American bats vocalize echolocation calls in the ultrasonic range that are inaudible to humans, the Florida bonneted bat echolocates at the higher end of the audible range, which can be heard by some humans as high-pitched calls (Marks and Marks 2008a). Most surveys conducted using acoustical equipment can detect echolocation calls within a range of 30 m (100 ft); call sequences are analyzed using software that compares calls to a library of signature calls (Marks

and Marks 2008a). Florida bonneted bat calls are relatively easy to identify because calls are issued at frequencies well below that of other Florida bat species (Marks and Marks 2008a).

More recently, radio-telemetry studies in natural environments are being used as part of studies to close data gaps on the Florida bonneted bat to better understand the species and its relationship and response to fire (Ober and McCleery 2012; A. Bailey, pers. comm. 2013; H. Ober, pers. comm. 2013). Results from a limited pilot study testing the tolerance and effectiveness of transmitters on three female bonneted bats at Babcock-Webb WMA in December 2014 indicated that individuals foraged several miles from their roosts (H. Ober, pers. comm. 2014d; E. Braun de Torrez, pers. comm. 2014).

Habitat

Relatively little is known of the ecology of the Florida bonneted bat, and long-term habitat requirements are poorly understood (Robson 1989; Robson et al. 1989; Belwood 1992; Timm and Genoways 2004). Habitat for the Florida bonneted bat mainly consists of foraging areas and roosting sites, including artificial structures. At present, only three active, natural roost sites are known, and only limited information on historical sites is available. Roosting and foraging areas appear varied, with the species occurring in forested, suburban, and urban areas (Timm and Arroyo-Cabrales 2008).

Florida bonneted bats are closely associated with forested areas because of their tree-roosting habits (Robson 1989; Belwood 1992; Eger 1999), but specific information is limited. Eger (1999) noted that in forested areas, old, mature trees are essential roosting sites for this species. Recent acoustical data and other information indicate that the Florida bonneted bat uses forests and a variety of other natural areas. Echolocation calls have been recorded in a wide array of habitat types: pine flatwoods, pine rocklands, cypress, hardwood hammocks, scrubby flatwoods, mixed shrubs, mangroves, wetlands, swamps, rivers, lakes, ponds, canals, developed park lands, groves, tropical gardens, disturbed nonnative areas, rural lands, residential areas, and urban landscapes (R. Arwood, pers. comm. 2008a–b, 2012, 2013a–c, 2014a–d; Marks and Marks 2008a–c; 2012; Smith 2010; S. Snow, pers. comm. 2011a–b, 2012a–g, 2013; *in litt.* 2012; M. Owen, pers. comm. 2012a–b; R. Rau, pers. comm. 2012; Maehr 2013; S. Maehr, pers. comm. 2013a–b; K. Relish, pers. comm. 2013; F. Ridgley, pers. comm. 2013a–d; 2014a–c; B. Scofield, pers. comm. 2013a–f; K. Smith, pers. comm. 2013).

One of the few historical roost sites used by a small colony of Florida bonneted bats used a longleaf pine (*Pinus palustris*) cavity that had been excavated by a red-cockaded woodpecker (RCW) (*Picoides borealis*) and later enlarged by a pileated woodpecker (*Dryocopus pileatus*); the cavity was 4.6 m (15.1 ft) high (Belwood 1981). One active natural roost at APAFR, discovered in 2013, is also in an enlarged cavity in a live longleaf pine; the cavity is 6.4 m (21 ft) high with a diameter at breast height (dbh) of 32.8 cm (12.9 in) (B. Scofield, pers. comm. 2013g–i; P. Halupa, pers. obs. 2014a). The active natural roost at FPNWR, discovered in July 2015, is in a slash pine (*Pinus elliottii*) snag; the cavity is ~9 m (30 ft) high with a dbh of 27.4 cm (10.8 in) and seems to have been formed from a decaying knot or branch (E. Braun de Torrez, pers. comm. 2015). The active natural roost at BCNP, discovered in December 2015, is also in an old woodpecker tree (slash pine snag); this cavity is also 9 m (30 ft) high (R. Arwood,

pers. comm. 2015). Limited information suggests that the Florida bonneted bat may prefer large pines (live and dead) with woodpecker activity for potential roosting, at least in some areas. However, since data are limited, any large or mature trees with suitable structure (e.g., cavities, hollows, or loose/exfoliating bark) may represent potential habitat.

In general, open, fresh water and wetlands provide prime foraging areas for bats (Marks and Marks 2008c). Bats will forage over ponds, streams, and wetlands and will drink when flying over open water (Marks and Marks 2008c). During dry seasons, bats become more dependent on remaining ponds, streams, and wetland areas for foraging purposes (Marks and Marks 2008c). The presence of roosting habitat is critical for day roosts, protection from predators, and the rearing of young (Marks and Marks 2008c). For most bats, the availability of suitable roosts is an important, limiting factor (Humphrey 1975). Bats in south Florida roost primarily in trees and manmade structures (Marks and Marks 2008a). Protective tree cover around bat roosts may be important for predator avoidance and allowing earlier emergence from the roost, thereby allowing bats to take advantage of the peak in insect activity at dusk and extend foraging time (Duverge et al. 2000).

The Florida bonneted bat also uses human structures and other non-natural environments. Florida bonneted bats have been found in the shafts of royal palm leaves (Belwood 1992), under Spanish tile roofs on dwellings (Belwood 1992), in buildings (*e.g.*, in attics, rock or brick chimneys of fireplaces, and especially buildings dating from about 1920–1930) (Timm and Arroyo-Cabrales 2008), in rocky crevices and outcrops on the ground (Timm and Genoways 2004), at golf courses in urban Coral Gables (Marks and Marks 2008a; 2008b; 2012), at a boat dock (R. Arwood, pers. comm. 2008a), at Zoo Miami and surrounding areas within urban public parks (Marks and Marks 2012; Ridgley 2012; F. Ridgley, pers. comm. 2013a, 2013b), and within tropical gardens (S. Snow, pers. comm. 2011b, 2012b, 2012g; Marks and Marks 2012).

Distribution

Records indicating historical range are limited. Morgan (1991) indicated that *E. glaucinus* had been identified from four late Pleistocene (approximately 11,700 years ago) and Holocene (time period beginning 10,000 years ago) fossil sites in the southern half of the Florida peninsula. Late Pleistocene remains are known from Melbourne, Brevard County, and Monkey Jungle Hammock in Miami-Dade County (Allen 1932; Martin 1977, as cited in Belwood 1981 and Timm and Genoways 2004; Morgan 1991). Holocene remains are known from Vero Beach, Indian River County (Ray 1958; Martin1977; and Morgan 1985, 2002, as cited in Timm and Genoways 2004; Morgan 1991), and also Monkey Jungle Hammock (Morgan1991). The largest fossil sample (9 specimens) was reported from the Holocene stratum at Vero Beach (Morgan 1985, as cited in Morgan 1991). The fossil records from Brevard County and Indian River County are considerably farther north than where living individuals have typically been recorded (Timm and Genoways 2004; Marks and Marks 2008b).

Most of the historical records and sightings for this species are several decades old from the cities of Coral Gables and Miami in extreme southeastern Florida, where the species was once believed to be common (Belwood 1992; Timm and Genoways 2004; Timm and Arroyo-Cabrales 2008). G.T. Hubbell also reported a female with young from Fort Lauderdale in Broward County; all of his

sightings of Florida bonneted bats were near human dwellings (Belwood 1992). Prior to 1967, G.T. Hubbell regularly heard loud, distinctive calls at night as the bats foraged above buildings, and he routinely obtained several individuals per year that were collected during the winter months from people's houses (Belwood 1992). Other early literature also mentioned Fort Lauderdale as an area where the species occurred (Barbour and Davis1969; Belwood 1992). However, in their comprehensive review, none of the specimens examined by Timm and Genoways (2004) were from Broward County. Belwood (1981) found a colony in Punta Gorda; however, the longleaf pine in which the bats roosted was felled during highway construction. Recent specimens are only known from extreme southern and southwestern Florida, including Miami-Dade County on the east coast and Charlotte, Collier, and Lee Counties on the Gulf coast (Timm and Genoways 2004).

Endemic to Florida, the Florida bonneted bat has one of the most restricted distributions of any species of bat in the New World (Belwood 1992; Timm and Genoways 2004). Although numerous acoustical surveys for the Florida bonneted bat have been conducted in the past decade by various parties, the best scientific information indicates that the species exists only within a very restricted range, confined to south Florida (Timm and Genoways 2004; Marks and Marks 2008a, 2012).

Based upon available information, the Florida bonneted bat appears to be restricted to south, southwest, and south-central Florida. The core range may primarily consist of habitat within Charlotte, Lee, Collier, Monroe, and Miami-Dade Counties. Recent data also indicate use of portions of Okeechobee, Polk, DeSoto, Hendry, and Broward Counties and possible use of areas within Glades and Highlands Counties.

Population Dynamics

Little information exists on historical population levels. The Florida bonneted bat was considered common in the Miami-Coral Gables area because of regular collection of specimens from 1951 to 1965 (Robson 1989; Belwood 1992). Jennings (1958) indicated the species was not abundant, noting a total of 20 individuals had been taken from 1936 to 1958. Prior to 1967, G.T. Hubbell regularly heard loud, distinctive calls at night as the bats foraged above buildings in the Miami area (R. Timm, pers. comm. 2012), and he routinely obtained several individuals per year that were collected from people's houses (Belwood 1992). Barbour and Davis (1969) indicated that, on average, about two individuals per year were brought to the Crandon Park Zoo in Miami, due to injuries, but no time period was specified.

Unpublished data from a survey of 100 pest control companies in 1982 on the southeastern coast of Florida showed that requests to remove "nuisance" bats from this area all but ceased beginning in the 1960s (Belwood 1992), indicating a sharp decline in bats in general. Timm and Genoways (2004) found only three records of Florida bonneted bats in the greater Miami area after 1965. The colony found near Punta Gorda in 1979 appeared to be the only recorded occurrence since 1967 (Belwood 1981). A 6-week field trip in 1980 to locate other occurrences was unsuccessful and led to the belief this species was ''probably extinct in Florida'' (Belwood 1992). No new evidence of this species was found from 1979 until 1988 when Robson et al. (1989) found a pregnant female in Coral Gables (Robson 1989).

Timm and Genoways (2004) surmised the Florida bonneted bat may have been uncommon for several decades, based upon the work of previous researchers (Barbour 1945, as cited in Timm and Genoways 2004; Jennings 1958; Layne 1974), who noted the scarcity of bats in southern Florida. Owre (1978) observed fewer than a dozen individuals in roughly 25 years and noted few mammalogists had success in finding the species. Robson (1989) indicated the decline of specimens and sightings in the mid-1960s is reflected in the museum record and noted the 1950s and 1960s was a period of rapid growth in the Miami area. Robson (1989) suggested the resulting disturbance and destruction of native habitat may have flushed a large number of specimens out of established roosts, resulting in a high collection rate. A status survey conducted in 1989, encompassing 25 sites within natural areas within a nine county area, found no new evidence of this species (Robson 1989).

Based upon available data and information, the Florida bonneted bat occurs within a restricted range and in apparent low abundance (Marks and Marks 2008a; 2012; Timm and Arroyo-Cabrales 2008; FWC 2011a; FWC 2011b; R. Timm, pers. comm. 2012, *in litt.* 2012). Actual population size is not known, and no population viability analyses are available (FWC 2011a; 2013; K. Bohn, *in litt.* 2012). However, population size is thought to be less than that needed for optimum viability (Timm and Arroyo-Cabrales 2008; K. Bohn, *in litt.* 2012). As part of their evaluation of listing criteria for the species, Gore et al. (2010) found the extent of occurrence appears to have declined on the east coast, but trends on the west coast could not be inferred due to limited information.

In his independent review of the FWC's Biological Status Report, Ted Fleming, Emeritus Professor of biology at University of Miami, noted anecdotal evidence from the 1950s and 1960s suggests this species was more common along Florida's southeast coast compared with the present (FWC 2011b). Fleming stated, "There can be no doubt that *E. floridanus* is an uncommon bat throughout its very small range. Its audible echolocation calls are distinctive and easily recognized, making it relatively easy to survey in the field" (FWC 2011b). He also stated he does not doubt the total State population numbers "in the hundreds or low thousands" (FWC 2011b).

Similarly, in response to a request for information as part of the Service's annual Candidate Notice of Review, Robert Timm (pers. comm. 2012), Curator of Mammals at Department of Ecology and Evolutionary Biology and Biodiversity Institute at the University of Kansas, indicated that numbers are low, in his view, as documented by survey attempts. "*Eumops* are very obvious bats where they occur because of their large size and distinctive calls. Given the efforts to locate them throughout southern Florida, if they were there in any significant numbers, they would have been located" (R. Timm, pers. comm. 2012).

Results of the 2006-2007 range-wide survey suggested that the Florida bonneted bat is a rare species with limited range and low abundance (Marks and Marks 2008a). Based upon results of both the range-wide study and survey of select public lands, the species was found at 12 locations (Marks and Marks 2008b), but the number and status of the bat at each location are unknown. Based upon the small number of locations where calls were recorded, the low numbers of calls recorded at each location, and the fact that the species forms small colonies, Marks and Marks (2008a) stated that it is possible that the entire population of Florida bonneted bats may number less than a few hundred individuals.

Results of the 2010 to 2012 surveys and additional surveys by other researchers identified new occurrences within the established range (*i.e.*, within Miami area, areas of Everglades National Park [ENP] and BCNP) (S. Snow, pers. comm. 2011a, 2011b, 2012; R. Arwood, pers. comm. 2012; Marks and Marks 2012), however, not in sufficient numbers to alter previous population estimates. In their 2012 report on the status of the species, Marks and Marks (2012) provided an updated estimation of population size, based upon 120 nights of surveys at 96 locations within peninsular Florida, results of other known surveys, and personal communications with others involved in Florida bonneted bat work. Based upon an average colony size of 11 and an estimated 26 colonies within the species' range, researchers estimated the total Florida bonneted bat population at 286 bats at that time (Marks and Marks 2012). Since that time, the discovery of the three natural roost sites and the continuation of additional research at occupied bat houses has provided opportunities for more quantitative emergence counts. This suggests that previous estimates of hundreds to a few thousand might be more representative of population size.

In summary, we cannot accurately estimate population size at this time. This is in part because so few roosts are known, roost switching can occur, emergence counts are not conducted simultaneously (or even at the same time of year), and precise counts are difficult to obtain due to environmental conditions and the propensity for some individuals to remain within roosts during counts.

Threats

The uncertainty regarding the Florida bonneted bat's specific habitat needs and requirements (*i.e.*, location of roost sites) arguably contributes to the potential impacts from the following threats by increasing the likelihood of inadvertent impacts to and losses of habitat.

Present or Threatened Destruction, Modification or Curtailment of its Habitat or Range

Loss of Forested Habitat and Other Land Use Changes
Loss of native forested habitat and roost sites are major threats to the Florida bonneted bat (Belwood 1992; Timm and Arroyo-Cabrales 2008). The retention of old trees with hollows and cavities are particularly important to this species. In natural areas, this species may be impacted when forests are converted to other uses or when old trees with cavities are removed (Belwood 1992; Timm and Arroyo-Cabrales 2008).

Significant land use changes have occurred through time in south Florida, including major portions of the species' historical and current range. In his examination of Florida's land use history, Solecki (2001) stated that tremendous land use changes took place from the early 1950s to the early and mid-1970s. The human population in south Florida increased from fewer than 20,000 people in 1920, to more than 4.6 million by 1990 (Solecki 2001). The population of Miami-Dade County, one area where the Florida bonneted bat was historically common, increased from fewer than 500,000 people in 1950, to more than 2.6 million in 2014 (http://quickfacts.census.gov). In one projection, all counties with current Florida bonneted bat occurrences were forecasted to increase in human population density, with most counties expected to grow by more than 750 people per square mile by 2060 (Wear and Greis 2011). As a result of the growth in human population, approximately 90 percent of the forested habitats in

Florida have been altered or eliminated, and losses are expected to continue (Wear and Greis 2002). In the Southern Forest Resource Assessment, Florida was identified as one of the areas expected to experience substantial losses of forest in response to human population and changes in income (Wear and Greis 2002).

Land Management Practices
Although species occurrences on conservation lands are inherently more protected than those on private lands, habitat alteration during management practices may impact natural roosting sites because the locations of such sites are unknown. For example, removal of old or live trees with cavities during activities associated with forest management (*e.g.*, thinning, pruning), prescribed fire, exotic species treatment, or trail maintenance may inadvertently remove roost sites, if such sites are not known. Loss of an active roost or removal during critical life-history stages (*e.g.*, when females are pregnant or rearing young) can have severe ramifications, considering the species' small population size, low fecundity, and roost site fidelity.

Loss of Artificial Structures
Since the Florida bonneted bat will use human dwellings and other artificial structures, it is also vulnerable to habitat loss and alteration in urban environments (Belwood 1992; Timm and Arroyo-Cabrales 2008). Removal of buildings with spaces suitable for roosting is a threat to this species (Timm and Arroyo-Cabrales 2008). Robson (1989) stated that seemingly innocuous activities like destroying abandoned buildings and sealing barrel-tile roof shingles may have a severe impact on remaining populations in urban areas. The use of buildings or other structures inhabited by or near humans places bats at risk of inadvertent or purposeful removal and displacement.

Disease or Predation

The effects of disease and predation are not well known. Given the Florida bonneted bat's overall vulnerability, both disease and predation could pose threats to its survival. White-nose syndrome (WNS) is an emerging infectious disease affecting insectivorous, cave-dwelling bats. WNS is caused by the cold-loving fungus, *Geomyces destructans,* a newly described fungus, and is named after the white fungal growth that often occurs on the muzzle of affected bats (Gargas et al. 2009; Lorch et al. 2011). In North America, *G. destructans* appears to infect bats only during winter hibernation. Because the Florida bonneted bat spends its entire life cycle outside of caves and mines and in subtropical environments where no torpor or hibernation is required, we do not anticipate that it will be adversely affected by WNS. However, since the fungus is new to science and North America, it is not known how it may evolve or change in the future. At this time, it is difficult to assess whether disease is currently or likely to become a threat to the Florida bonneted bat. With anticipated climatic changes and increased environmental stress, it is possible that disease will have a greater impact on the Florida bonneted bat in the future.

In general, animals such as owls, hawks, raccoons, skunks, and snakes prey upon bats (Harvey et al. 1999). However, few animals consume bats as a regular part of their diet (Harvey et al. 1999). There is only one record of natural predation on the Florida bonneted bat (Timm and Genoways 2004). A skull of one specimen was found in a regurgitated owl pellet at the Fakahatchee Strand Preserve State Park (FSPSP) in June 2000 (Timm and Genoways 2004; C. Marks, pers. comm.

2006; Marks and Marks 2008a; M. Owen, pers. comm. 2012a, 2012b). Although evidence of predation is lacking, the species is presumably affected by some level of predation from native wildlife (*e.g.*, hawks, owls, raccoons, rat snakes) and the large number of introduced and nonnative reptiles (*e.g.*, young Burmese pythons, boa constrictors) (Krysko et al. 2011; M. Ludlow, *in litt.* 2012; R. Timm, *in litt.* 2012). Giant constrictors are habitat generalists, can grow and reproduce rapidly, and are arboreal when young, placing birds and arboreal mammals, such as bats, at risk (*http://www.fort.usgs.gov/FLConstrictors/*). Due to limited information, we are not able to determine the extent to which predation may be impacting the Florida bonneted bat at this time. However, given the species' apparent small population size and overall vulnerability, it is reasonable to assume that predation is a potential threat, which may increase in the future.

Other Natural or Manmade Factors Affecting its Continued Existence

Inadvertent and Purposeful Impacts from Humans

In general, bats using old or abandoned and new dwellings are at significant risk. Bats are often removed when they are no longer tolerated by humans or inadvertently killed or displaced when structures are demolished. Adverse human impacts on bats involve direct killing, persecution, vandalism, and disturbance of hibernating and maternity colonies (Harvey et al. 1999). Homeowners and professionals use a variety of methods to remove bats, including lethal means. Even when attempts are made to remove bats humanely, bats may be sealed into buildings. Despite regulations and efforts to raise awareness, in some situations, bats are still likely removed through inhumane and prohibited methods (*e.g.*, removed from roosts with vacuum cleaner–like apparatuses) and excluded from artificial roost sites during sensitive time periods (*e.g.*, inside the maternity season before young are volant (capable of flying)) (A. Kropp, pers. comm. 2009). Since roosting sites are largely unknown, the potential to remove and exclude Florida bonneted bats from human dwellings and artificial structures, either inadvertently or accidentally, is high. Despite regulatory protections provided under Federal and Florida laws, direct and indirect threats from humans continue, especially in urban, suburban, and residential areas.

Bonneted bats using urban or suburban areas may be negatively impacted by activities such as: routine landscaping, removing dead pine or royal palm trees, pruning or trimming trees (especially cabbage palms), sealing barrel-tile roof shingles with mortar, destroying abandoned buildings, and clearing lots of native vegetation (Robson 1989). As the species may also use palm fronds for roosting, the trimming of fronds and removal of mature palm trees for landscaping may negatively impact individuals (K. Gillies, *in litt.*2012). Disturbance to summer maternity colonies of bats is extremely detrimental (Harvey et al. 1999). In general, maternity colonies of bats do not tolerate disturbance, especially when flightless newborns are present (Harvey et al. 1999). Newborns or immature bats may be dropped or abandoned by adults if disturbed (Harvey et al. 1999). In short, wherever this species occurs in or near human dwellings or structures, it is at risk of inadvertent or purposeful removal, displacement, and disturbance.

Routine maintenance and repair of bridges and overpasses or other infrastructure are potential threats. Bats can use highway structures either as day or night roosts (Keeley and Tuttle 1999). An estimated 24 of the 45 species of bats in the United States have been documented to use bridges or culverts as roosts, and 13 other bat species are likely to use such structures based upon

their known roosting preferences (Keeley and Tuttle 1999). To date, the Florida bonneted bat has not been documented to use these structures. However, like other molossids, bonneted bats can potentially use these structures for roosting (Keeley and Tuttle 1999). When bridges and overpasses are cleaned, bats may be subjected to high water pressure from hoses, which likely results in injury or death (C. Marks, pers. comm. 2007). Incidences involving high pressure water hoses have reportedly decreased in Florida, and the FDOT is working with FWC to increase their efforts to protect bats during maintenance and repair activities at bridge sites with bats (FWC, *in litt.* 2012).

Competition for Tree Cavities

Suitable natural roost sites in south Florida appear limited, and competition for available tree cavities may be greater now than historically. In 1992, Belwood (1992) stated that tree cavities were rare in southern Florida and that competition for available cavities from native wildlife (*e.g.*, southern flying squirrel, red-headed woodpecker, corn snake) was intense. Competition for cavities since that time has presumably increased, due largely to continued loss of cavity trees and habitat and the influx of nonnative or introduced species, which vie for available roosting or nesting locations.

Proposed Wind Energy Facilities

Migratory, tree-dwelling, and insectivorous bat species are being killed at wind turbines in large numbers across North America (Kunz et al. 2007; Cryan and Barclay 2009). Based upon data modified from Johnson (2005, as cited in Arnett et al. 2008), researchers found that the Brazilian free-tailed bat comprised 85.6 percent of bat mortalities noted at a wind energy facility in Woodward, Oklahoma, and 41.3 percent of bat mortalities at a High Wind, California, wind energy facility. Since the Florida bonneted bat is also a free-tailed bat, it may demonstrate some similar behaviors that place it at risk when encountering wind energy facilities.

The cause of bat mortality at wind energy facilities is not a simple one of direct contact with blades or towers. Baerwald et al. (2008) found that barotrauma is the cause of death in a high proportion of bats found at wind energy facilities. Barotrauma involves tissue damage to air–containing structures (such as lungs) caused by rapid or excessive pressure change; wind turbine blades may create zones of low pressure as air flows over them. In their examination, Baerwald et al. (2008) found 90 percent of the bat fatalities involved internal hemorrhaging consistent with barotrauma, suggesting that even if echolocation allows for bats to detect and avoid turbine blades, they may be incapacitated or killed by internal injuries caused by rapid pressure reductions that they cannot detect.

While bat fatalities from wind energy facilities are well documented, potential impacts to the Florida bonneted bat are difficult to evaluate at this time, partly due to the uncertainty involving many factors (*e.g.*, location of facilities, operations, foraging distance). Certain aspects of the species' status and life history may increase vulnerability to impacts from wind energy facilities. The species' small population and low fecundity make any additional potential sources of mortality cause for concern. The species' high and strong flight capabilities and fast-hawking foraging behavior may increase risk. Conversely, as the species is non-migratory, potential impacts from wind energy facilities may not be as great in magnitude as perhaps other bat species that are migratory.

Pesticides and Contaminants
The impacts of pesticides and other environmental contaminants on bat species are largely unstudied, particularly in the case of the Florida bonneted bat. The life history of the Florida bonneted bat may make it susceptible to pesticide exposure from a variety of sources. Mosquito control spraying activities commonly begin at dusk when mosquitoes are most active (http://www.miamidade.gov/publicworks/mosquito-spraying.asp). Because the Florida bonneted bat forages at dusk and after dark, the possibility exists for individuals to be directly exposed to airborne mosquito control chemicals or to consume invertebrates containing pesticide residues from recent applications. Additionally, because the Florida bonneted bat has been documented to roost in residential areas (Belwood 1992), it is possible for individuals to be exposed, either directly or through diet, to a variety of undocumented, localized pesticide applications conducted by homeowners. The potential exposure to or impacts of agricultural chemical application on the Florida bonneted bat in Florida are largely unknown.

A reduction in the number of flying insects is a potential secondary effect to consider when evaluating the impact of pesticides on the Florida bonneted bat. In his status survey for the Florida bonneted bat, Robson (1989) suggested that mosquito control programs are contributing to reduced food supplies for bats.

In addition to pesticide exposure, mercury represents another potential threat to the Florida bonneted bat that has not been investigated. According to the National Atmospheric Deposition Program, the mercury deposition rate in south Florida is among the highest in the United States (*http://nadp.isws.illinois.edu*). The movement of mercury through the aquatic system and into the terrestrial food web through emergent invertebrates has been documented in other areas (Cristol et al. 2008; Konkler and Hammerschmidt 2012). Assuming that a similar mechanism is occurring in south Florida, coupled with high mercury deposition rates, the consumption of such invertebrates may constitute a pathway for the Florida bonneted bat to be exposed to mercury.

Ecological Light Pollution
Depending upon scale and extent, ecological light pollution can have demonstrable effects on behavioral and population ecology of organisms by: disrupting orientation (or causing disorientation), affecting movements (attraction or repulsion), altering reproductive behaviors, and influencing communication (Longcore and Rich 2004). The effects of artificial lighting on bats and their prey have been partially studied. A wide array of insects have been found to be attracted to lights (Frank 1988; Eisenbeis and Hassel 2000; Kolligs 2000, as cited in Longcore and Rich 2004). Although the primary prey items for the Florida bonneted bat are not known, it is possible that artificial lighting may be affecting insect abundance or availability and prey base in some locations. Longcore and Rich (2004) suggested that increased food concentration at artificial light sources may be a positive effect for those species that can exploit such sources, but it also could result in altered community structure. The Florida bonneted bat's behavioral response to ecological light pollution has not been examined, and effects are not known. The species' fast-flight and long range flight capabilities may make it more able to exploit insects congregated at artificial light sources or more susceptible to risks associated with such responses (*e.g.*, increased predation or harm from humans).

Effects of Small Population Size, Isolation, and Other Factors
The Florida bonneted bat is vulnerable to extinction due to its small population size, restricted range, few occupied areas, low fecundity, and relative isolation. The Florida bonneted bat only occurs in south, southwest, and south-central Florida and only in limited numbers (Timm and Genoways 2004; Marks and Marks 2008a; 2008b; 2012). Based on the small number of locations where calls were recorded, the low numbers of calls recorded at each location, and the fact that the species forms small colonies, Marks and Marks (2008a) stated that it is possible that the entire population of Florida bonneted bats may number less than a few hundred individuals. Other experts suggested the population may be "in the hundreds or low thousands" (FWC 2011b). In general, species with restricted ranges are often characterized by small population sizes and high habitat specialization and are, therefore, more vulnerable to stochastic, demographic, and environmental processes (Lande et al. 2003, as cited in Lee and Jetz 2011).

Slow reproduction and low fecundity are also serious concerns because this species produces only one young at a time and roosts singly or in small groups (FBC 2005; Timm and Arroyo-Cabrales 2008). Assuming a lifespan of 10 to 20 years for bats of this size (Wilkinson and South 2002), the average generation time is estimated to be 5 to 10 years (Gore et al. 2010). The small numbers within localized areas may also make the Florida bonneted bat vulnerable to extinction due to genetic drift (loss of unique genes through time), inbreeding depression (reduced fitness or survival due to low genetic diversity), extreme weather events (*e.g.*, hurricanes), and random or chance changes to the environment (Lande 1988; Smith 1990) that can significantly impact its habitat.

In general, isolation, whether caused by geographic distance, ecological factors, or reproductive strategy, will likely prevent the influx of new genetic material and can result in low diversity, which may impact viability and fecundity (Chesser 1983). Distance between subpopulations or colonies, the small sizes of colonies, and the general low number of bats may make recolonization unlikely if any site is extirpated. Isolation of habitat can prevent recolonization from other sites and potentially result in extinction. The probability of extinction increases with decreasing habitat availability (Pimm et al. 1988; Noss and Cooperrider 1994; Thomas 1994; Kale 1996). Although changes in the environment may cause populations to fluctuate naturally, small and low density populations are more likely to fluctuate below a minimum viable population (*i.e.*, the minimum or threshold number of individuals needed in a population to persist in a viable state for a given interval) (Shaffer 1981; Shaffer and Samson 1985; Gilpin and Soule´ 1986). If populations become fragmented, genetic diversity will be lost as smaller populations become more isolated (Rossiter et al. 2000). Fragmentation and aspects of the species' natural history (*e.g.*, reliance on availability of suitable roost sites, constant supply of insects) can contribute to and exacerbate other threats facing the species.

Environmental Stochasticity
Natural events such as severe hurricanes may cause the loss of old trees with roosting cavities (Timm and Genoways 2004). Major impacts of intense storms may include mortality during the storm, exposure to predation immediately following the storm, loss of natural or artificial roost sites, and impacts on foraging areas and insect abundance (Marks and Marks 2008a; W. Kern, Jr. *in litt.* 2012; R. Timm, *in litt.* 2012). In general, bats could be blown into stationary objects or impacted by flying debris, resulting in injury or mortality (Marks and Marks 2008a).

Trees with cavities can be snapped at their weakest point, which for the Florida bonneted bat may have the most severe impact since the species uses cavities (Marks and Marks 2008a); competition for available cavities in south Florida is intense (Belwood 1992), and suitable roosting sites in general are often limiting factors (Humphrey 1975). Displaced bats may be found on the ground or other unsuitable locations and exposed to natural predators, domestic pets, and humans (Marks and Marks 2008a). As pregnant females have been found in June through September, hurricanes in Florida can occur at critical life-history stages—when females are pregnant or rearing young—possibly resulting in losses of pregnant females, newborns, or juvenile pups (Marks and Marks 2008a). Because the entire population may be less than a few hundred individuals (Marks and Marks 2008a; 2012), the Florida bonneted bat may not be able to withstand losses from intense storms or storms at a critical life-history stage. Alternatively, less intense hurricanes or mild, isolated storms may create roosting opportunities, if tree snags (dead trees) are left in place.

Given the Florida bonneted bat's tree-roosting habits, apparent low abundance, few isolated colonies, and use of coastal areas, the species is at risk from hurricanes, storms, or other extreme weather. Depending on the location and intensity, it is possible that the majority of Florida bonneted bats could be killed in a fairly broad area during a single, large, high-intensity hurricane (R. Timm, *in litt.* 2012). More frequent and intense storms, increased storm surges, and coastal flooding can impact Florida bonneted bats and roosting and foraging habitat.

This species is also vulnerable to prolonged extreme cold weather events. Molossids, the family of bats which includes the Florida bonneted bat, appear to be an intermediate between tropical and temperate zone bat families (Arlettaz et al. 2000). Members of this family that inhabit the warmer temperate and subtropical zones incur much higher energetic costs for thermoregulation during cold weather events than those inhabiting northern regions (Arlettaz et al. 2000). At such temperatures, bats are likely unable to find food and cannot rewarm themselves. Such a stochastic, but potentially severe, event poses a significant threat to the entire population. Impacts of past cold weather events are evident, but the effect on all colonies is not known.

Climate Change and Sea Level Rise

The effects resulting from climatic change, including sea level rise and coastal squeeze, are expected to become severe in the future and result in additional habitat losses, including the loss of roost sites and foraging habitat. Three subpopulations of the Florida bonneted bat occur in at-risk coastal locations (Gore et al. 2010), and the effects of sea level rise are expected to be a continual problem for species using coastal habitats (Saha et al. 2011). Within the species' range, low-lying areas in Collier, Lee, Miami-Dade, and Monroe Counties appear most vulnerable to inundation. Much of low-lying, coastal south Florida "will be underwater or inundated with saltwater in the coming century" (U. S. Climate Change Science Program (CCSP) 2008). This means that large portions of occupied, suitable, and potential roosting and foraging habitat for the Florida bonneted bat in low-lying areas will likely be either submerged or affected by increased flooding.

Climate change is likely to increase occurrence of saltwater intrusion as sea level rises (Intergovernmental Panel on Climate Change [IPCC] 2008), resulting in changes to plant species

composition based upon tolerance to salinity and drought. Such changes in vegetation will likely impact the Florida bonneted bat, since the species uses forested areas and coastal habitats.

Hydrology has a strong influence on plant distribution in these and other coastal areas (IPCC 2008). Such communities typically grade from salt to brackish to freshwater species. Human developments will also likely be significant factors influencing whether natural communities can move and persist ((IPCC 2008; CCSP 2008). Climate change, human population growth, forest management, and land use changes are also expected to increase water stress (water demand exceeding availability) within areas of the south, and south Florida is considered a hot spot for future water stress (Wear and Greis 2011). For the Florida bonneted bat, this means that some habitat in coastal areas will likely change as vegetation changes and additional human developments encroach.

Drier conditions and increased variability in precipitation are also expected to increase the severity of wildfire events. Climate changes are forecasted to extend fire seasons and the frequency of large fire events throughout the Coastal Plain (Wear and Greis 2011). Increases in the scale, frequency, or severity of wildfires could also have severe ramifications on the Florida bonneted bat, considering its forest-dwelling nature and general vulnerability. Climate changes may also affect foraging habitat and prey availability. Increased plant water stress is likely to impact vegetation community composition and chemical composition of plants, which would likely affect insect availability and the timing of insect availability to foraging bats (H. Ober, *in litt.* 2012).

Ongoing Conservation Efforts

Extensive conservation efforts are underway by researchers, government agencies, non-profit organizations, stakeholders, and private individuals. Efforts are focusing on: (1) filling information gaps regarding the species and its habitat needs and preferences; (2) conserving roosting and foraging habitats; (3) reducing known threats, wherever possible; and (4) increasing public awareness.

Research efforts continue to examine life history, population dynamics, and habitat needs for the Florida bonneted bat. Studies are being conducted to identify additional occupied areas, evaluate diet, determine roost site fidelity, examine population dynamics, understand movement and foraging distance, develop a protocol for attachment of radio transmitters, identify habitat needs, analyze effects of fire, and locate natural roost sites.

Identifying natural roost sites is particularly important, as only three are currently known. Finding additional roost sites is a key component to better understanding the species' habitat needs, which will greatly contribute to conservation of the species. Knowing where roosts occur and determining better methods to detect them will enhance endeavors to learn more about life history and help focus habitat protection efforts on specific locations, especially if roost sites may be a limited resource for the species.

The FWC's Species Action Plan details the actions necessary to improve the conservation status of the Florida bonneted bat. The Florida Bonneted Bat Working Group was established in 2012

to bring together a consortium of public and private agencies, organizations, and educational institutions to leverage available resources, prioritize conservation actions, and collaborate on research directives for the Florida bonneted bat. The Service intends to work with stakeholders to develop a recovery outline and recovery plan in the near future.

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Appendix B: Florida Bonneted Bat (FBB) Best Management Practices (BMPs) for Construction and Land Management Projects (Draft September 2018)

A. FBB BMPs for development, construction, and other general activities:

1. If potential roost trees or structures need to be removed, check cavities for bats prior to removal of trees, snags, or structures. If evidence of use by any bat species is observed, discontinue removal efforts in that area and coordinate with the Service on how to proceed.
2. When using heavy equipment, establish a 250 foot (76 m) buffer around known or suspected roosts to limit disturbance to roosting bats.
3. For every 5 acres of impact, retain 1.0 acre of native vegetation. If upland habitat is impacted, then upland habitat with native vegetation should be retained.
4. For every 5 acres of impact, retain 0.25 acre of native vegetation. If upland habitat is impacted, then upland habitat with native vegetation should be retained.
5. Conserve open freshwater and wetland habitats to promote foraging opportunities and avoid impacting water quality. Created habitat should be designed to replace the function of native habitat.
6. Conserve and/or enhance riparian habitat. A 50-ft (15.2 m) buffer is recommended around water bodies and stream edges. In cases where artificial water bodies (*i.e.,* stormwater ponds) are created, enhance edges with plantings especially in cases in which wetland habitat was affected.
7. Avoid or limit widespread application of insecticides (*e.g.,* mosquito control, agricultural pest control) in areas where Florida bonneted bats are known or expected to forage or roost.
8. Retain natural vegetation to promote insect diversity, availability, and abundance.
9. Retain mature trees and snags that could provide roosting habitat. These may include live trees of various sizes and dead or dying trees with cavities, hollows, crevices, and loose bark. See "Roosting Habitat" in "Background" above.
10. Protect known Florida bonneted bat roost trees, snags or structures and trees or snags that have been historically used by Florida bonneted bats for roosting, even if not currently occupied, by establishing a 250 foot (76 m) buffer around the roost tree, snag, or structure to ensure that roost sites remain suitable for use in the future.
11. Avoid and minimize the use of artificial lighting, retain natural light conditions, and promote the use of environmentally friendly lighting practices to minimize effects to wildlife. Limit permanent night-time lighting.
12. Incorporate engineering designs that discourage bats from using buildings or structures. If Florida bonneted bats take residence within a structure, contact the Service and Florida Fish and Wildlife Conservation Commission prior to attempting removal or when conducting maintenance activities on the structure.
13. Use or allow prescribed fire to promote foraging habitat.

Appendix B: (continued)

B. FBB BMPs for Ecological Land Management

The Service reviews and develops Ecological Land Management projects that use land management activities to restore and maintain native, natural communities that are beneficial to bats. These activities include prescribed fire, mechanical treatments to reduce vegetation densities, timber thinning to promote forest health, trail maintenance, and the treatment of exotic vegetation. The following BMPs provide recommendations for conserving Florida bonneted bat roosting and foraging habitat during ecological land management activities. The Service recommends incorporating these BMP into ecological land management plans.

If potential roost trees need to be removed, check cavities for bats prior to removal of trees or snags. If evidence of use by any bat species is observed, discontinue removal efforts in that area and coordinate with the Service on how to proceed.

- Protect potential roosting habitat during ecological land management activities, if feasible. Avoid removing trees or snags with cavities.
- Rake and/or clear vegetation around the base of known or suspected roost trees to remove fuel prior to prescribed burning.
- If possible, use ignition techniques such as spot fires or backing fire to limit the intensity of fire around the base of the tree or snag containing the roost. The purpose of this action is to prevent the known or suspected roost tree or snag from catching fire and also to attempt to limit the exposure of the roosting bats to heat and smoke. A 250-ft (76 m) buffer is recommended.
- If prescribed fire is being implemented to benefit Florida bonneted bats, Braun de Torrez et al. (2018) noted that fire in the dry/spring season could be most beneficial.
- When creating firebreaks or conducting fire-related mechanical treatment, mark and avoid any known or suspected bat roosts.
- When using heavy equipment, establish a buffer of 250 feet (76 m) around known roosts to limit disturbance to roosting bats.
- Establish forest management efforts to maintain tree species and size class diversity to ensure long-term supply of potential roost sites.
- For every 5 acres (2 hectares) of timber that is harvested, retain a clump of trees 0.25 acre (0.1 hectare) in size containing potential roost trees, especially pines and royal palms (live or dead). Additionally, large snags in open canopy should be preserved.

<u>Literature Cited:</u>

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A.5 Endangered Species Act Correspondence

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
701 San Marco Boulevard
JACKSONVILLE, FLORIDA 32207-8175

JUL 01 2016

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

Mr. Larry Williams, Field Supervisor
U. S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960

Dear Mr. Williams,

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is preparing a National Environmental Policy Act (NEPA) assessment for the Lake Okeechobee Watershed Project (LOWP). The objectives of the LOW Project are to improve the quality, quantity, timing and distribution of water entering Lake Okeechobee, provide for better management of lake water levels, reduce damaging releases to the Caloosahatchee and St. Lucie estuaries downstream of the lake and improve system wide operational flexibility. The LOW Project preliminary project area, where placement of features will be considered, covers a large portion of the Lake Okeechobee Watershed north of the lake (Figure 1) and spans the following six counties: Okeechobee, Highlands, Charlotte, Glades, Martin and St. Lucie.

Pursuant to the Endangered Species Act, as amended, the Corps is requesting written confirmation of species or their critical habitat either listed or proposed for listing that may be present within the referenced project area within 30 days upon receipt of this letter. The Corps has tentatively determined that the following list of threatened and endangered species may be present within the project area as illustrated in the enclosed Table 1.

If you have any questions, or need further information, please contact Gretchen Ehlinger by email gretchen.s.ehlinger@usace.army.mil or telephone 904-232-1682. Thank you for your assistance in this matter.

Sincerely,

Gina Paduano Ralph, Ph.D.
Chief, Environmental Branch

Enclosure

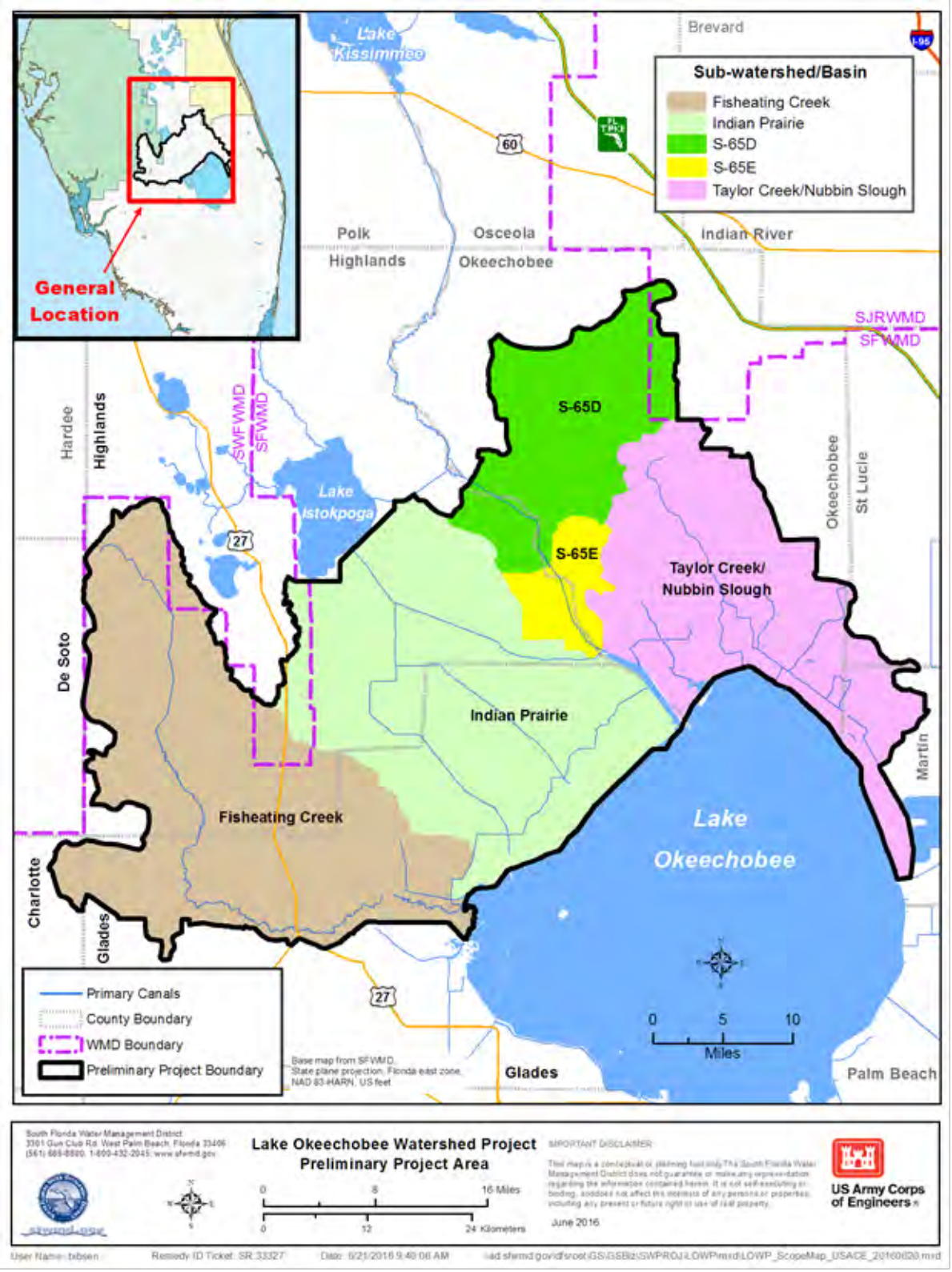

Figure 1. Lake Okeechobee Watershed Project preliminary project area.

Table 1. Federal and State Listed Land Plant and Animal Species Occurring in Okeechobee, Highlands, Charlotte, Glades, Martin and St. Lucie Counties, Florida.

Scientific Name	Common Name	Federal Status	State Status
Amphibians			
Rana capito	Gopher frog	Not listed	S*
Reptiles			
Caretta caretta	Loggerhead sea turtle	Threatened	Threatened
Chelonia mydas	Green sea turtle	Endangered	Endangered
Crocodylus acutus	American crocodile	Threatened	Endangered
Drymarchon couperi	Eastern indigo snake	Threatened	Threatened
Eumeces egregius lividus	Bluetail mole skink	Threatened	Threatened
Gopherus polyphemus	Gopher tortoise	Not listed	Threatened
Pituophis melanoleucus mugitus	Florida pine snake	Not listed	S
Birds			
Ammodramus savannarum floridanus	Florida grasshopper sparrow	Endangered	Endangered
Aphelocoma coerulescens	Florida scrub jay	Threatened	Threatened
Aramus guarauna	Limpkin	Not listed	S
Athene cunicularia	Burrowing owl	Not listed	S
Calidris canutus rufus	Red knot-migrant	Candidate	Candidate
Campephilus principalis	Ivory-billed woodpecker	Endangered (Historic)	Endangered
Charadrius melodus	Piping plover	Threatened	Threatened
Egretta caerulea	Little blue heron	Not listed	S
Egretta thula	Snowy egret	Not listed	S
Egretta tricolor	Tricolored heron	Not listed	S
Eudocimus albus	White ibis	Not listed	S
Falco sparverius paulus	Southeastern American kestrel	Not listed	Threatened
Grus Americana	Whooping crane	Endangered	S
Grus canadensis pratensis	Florida sandhill crane	Not listed	Threatened
Haematopus palliates	American oystercatcher	Not listed	S
Mycteria americana	Wood stork	Endangered	Endangered
Pandion haliaetus	Osprey	Not listed	S
Pelecanus occidentalis	Brown pelican	Not listed	S
Picoides borealis	Red-cockaded woodpecker	Endangered	S
Platalea ajaja	Roseate spoonbill	Not listed	S
Polyborus plancus audubonii	Audubon's crested caracara	Threatened	Not listed

Scientific Name	Common Name	Federal Status	State Status
Rostrhamus sociabilis plumbeus	Snail kite	Endangered	Endangered
Rychops niger	Black skimmer	Not listed	S
Sterna antillarum	Least tern	Threatened	Threatened
Invertebrates			
Anaea troglodyte floridalis	Florida's leafwing butterfly	Candidate (historical)	Not listed
Strymon acis bartrami	Bartram's hairstreak butterfly	Candidate (1974)	Not listed
Mammals			
Eumops floridanus	Florida bonneted bat	Endangered	Threatened
Podomys floridanus	Florida mouse	Not listed	S
Puma concolor coryi	Florida panther	Endangered	Endangered
Sciurus niger shermani	Sherman's Fox Squirrel	Not Listed	S
Trichechus manatus	Manatee	Endangered	Endangered
Ursus americanus floridanus	Florida black bear	Not Listed	Threatened
Gastropods (Snails and Allies)			
Orthalicus reses reses	Stock Island tree snail	Threatened	Endangered
Plants and Lichens			
Acrostichum aureum	Golden leather fern	Not Listed	Threatened
Argusia gnaphalodes	Sea lavender	Not Listed	Endangered
Asimina tetramera	Four-petal pawpaw	Endangered	Endangered
Calopogon multiflorus	Many-flowered grasspink	Not Listed	Endangered
Chamaesyce cumulicola	Sand-dune spurge	Not Listed	Endangered
Cladonia perforata	Perforate reindeer lichen	Endangered	Endangered
Coccothrinax argentata	Silver palm	Not Listed	Threatened
Cucurbita okeechobeensis	Okeechobee gourd	Endangered	Endangered
Dalea carthagenensis floridana	Florida prairie cover	Candidate (1918)	Endangered
Dicerandra immaculate	Lakela's mint	Endangered	Endangered
Glandularia maritima	Coastal vervain	Not Listed	Endangered
Halophila johnsonii	Johnson's seagrass	Threatened	Threatened
Hypericum edisonianum	Edison's ascyrum	Not Listed	Endangered
Jacquemontia reclinata	Beach jacquemontia	Endangered	Endangered
Lantana depressa var. *floridana*	Atlantic Coast Florida lantana	Not Listed	Endangered
Lantana depressa var.*sanibelensis*	Gulf Coast Florida lantana	Not Listed	Endangered
Lechea cernua	Nodding pinweed	Not Listed	Threatened

Scientific Name	Common Name	Federal Status	State Status
Lechea divaricata	Pine pinweed	Not Listed	Endangered
Liatrus ohlingerae	Scrub blazing star	Endangered	Endangered
Linum carteri var. *smallii*	Carter's large-flowered flax	Not Listed	Endangered
Nemastylis floridana	Celestial lily	Not Listed	Endangered
Okenia hypogaea	Burrowing four-o'clock	Not Listed	Endangered
Ophioglossum palmatum	Hand fern	Not Listed	Endangered
Panicum abscissum	Cutthroat grass	Not Listed	Endangered
Paronchia chartacea	Papery whitlow-wort	Threatened	Endangered
Polygala lewtonii	Lewton's polygala	Endangered	Endangered
Polygala smallii	Tiny polygala	Endangered	Endangered
Pteris bahamensis	Bahama brake	Not Listed	Threatened
Pteroglassaspis ecristata	Giant orchid	Not Listed	Threatened
Sacoila lanceolata var. *paludicola*	Fahkahatchee ladies' tresses	Not Listed	Threatened
Schizaea pennula	Ray fern	Not Listed	Endangered
Tephrosia angustissima var. *cutissii*	Coastal hoary-pea	Not Listed	Endangered
Thelypteris serrata	Toothed maiden fern	Not Listed	Endangered
Tillandsia flexuosa	Banded wild-pine	Not Listed	Threatened
Tolumnia bahamensis	Dancing-lady orchid	Not Listed	Endangered
Warea carteri	Carter's mustard	Endangered	Endangered
Critical Habitat			
Rostrahamus sociabilis plumbeus	Everglade snail kite	Endangered	Endangered
Trichechus manatus	West Indian Manatee	Endangered	Endangered
Chelonia mydas	Green sea turtle	Endangered	Endangered
Halophila johnsonii	Johnson's seagrass	Threatened	Threatened

*S=species of special concern