COMPREHENSIVE EVERGLADES RESTORATION PLAN, CENTRAL EVERGLADES PLANNING PROJECT, INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT: FINAL JULY 2014, REVISED DECEMBER 2014

COMMUNICATION

FROM

THE ASSISTANT SECRETARY OF THE ARMY, CIVIL WORKS, THE DEPARTMENT OF DEFENSE

TRANSMITTING

THE FINAL COMPREHENSIVE EVERGLADES RESTORATION PLAN INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT, PURSUANT TO THE WATER RESOURCES DEVELOPMENT ACT OF 2000, SEC. 601

PART 5 OF 6

OCTOBER 6, 2015.—Referred to the Committee on Transportation and Infrastructure and ordered to be printed

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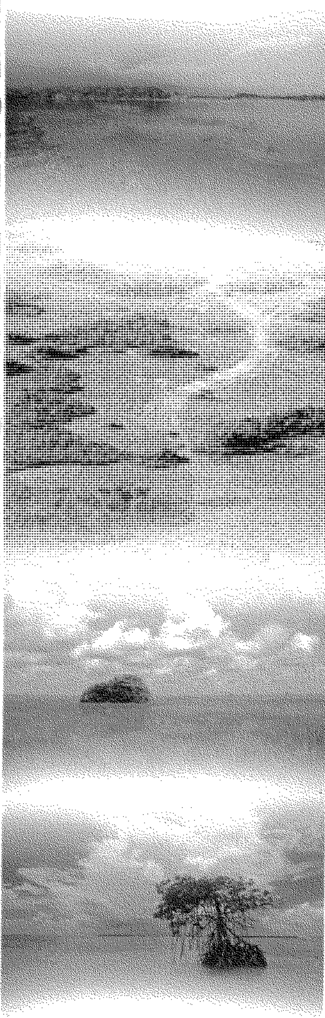
RESTORING THE HEART OF THE EVERGLADES

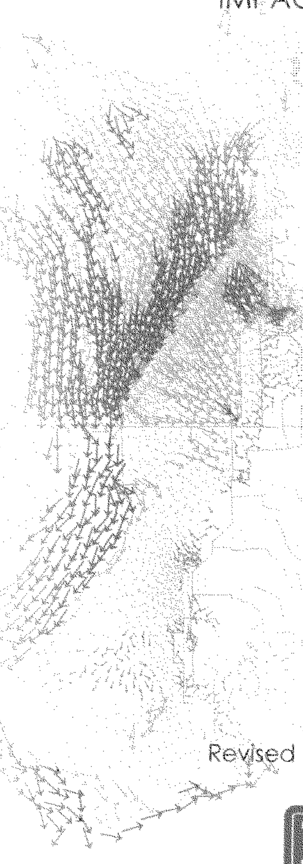


CENTRAL EVERGLADES PLANNING PROJECT

COMPREHENSIVE EVERGLADES RESTORATION PLAN

CENTRAL EVERGLADES PLANNING PROJECT

FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT



July 2014
Revised December 2014

Appendix D, E, F and G

Cover insets (left to right):

Landscapes: Lake Okeechobee, Water Conservation Area 3, Everglades National Park, Florida Bay; **Map:** Depicts Average Annual Overland Flow across the period of record (1965-2005) for existing conditions, as modeled by the CEPP regional hydrologic model (the coloration of the arrows represents the relative volume of flow, while the direction of the arrows represents the movement of flow across the landscape); **Small Landscapes:** Ponding, soil oxidation (peat reduction), dry area of Everglades National Park, juxtaposition of urban development.

APPENDIX D
REAL ESTATE

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D REAL ESTATE

D.1 STATEMENT OF PURPOSE OF THE REAL ESTATE PLAN (REP)

The purpose of this Real Estate Plan (REP) is to present the overall real estate requirements, costs, acquisition schedules, and other real estate requirements necessary for the Central and Southern Florida, Comprehensive Everglades Restoration Plan, Central Everglades Planning Project (CEPP). This Real Estate Plan is tentative in nature and both the final real property acquisition lines and estimates of value are subject to change after approval of the decision document to which this Plan is appended. The REP will identify the lands required for CEPP; the lands already acquired by the South Florida Water Management District (SFWMD), the Non-Federal Sponsor; the lands which have not been acquired by the SFWMD; the value of lands and what has already been cost shared under the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022) (Farm Bill); what lands have not been cost shared; and other details associated with land requirements and estates required for CEPP.

D.2 PROJECT AUTHORIZATION

In *Section 601* of the *Water Resources Development Act of 2000* (PL 106-541) (WRDA 2000), Congress approved the Central and Southern Florida (C&SF) Project Comprehensive Review Study Integrated Feasibility Report and Programmatic Environmental Impact Statement (known as the "Yellow Book"), which describes and outlines the Comprehensive Everglades Restoration Plan (CERP).The Central Everglades Planning Project (CEPP) components are encompassed in the Comprehensive Everglades Restoration Plan (CERP).

Section 601 (e)(3) of the WRDA 2000, (PL 106-541) details the cost sharing related to Federal funding provided to the non-Federal sponsor applicable to the acquisition of lands required for CERP projects:

"(e) COST SHARING.

(3) FEDERAL ASSISTANCE.

(A) IN GENERAL.--The non-Federal sponsor with respect to a project authorized by subsection (b), (c), or (d) may use Federal funds for the purchase of any land, easement, rights-of-way, or relocation that is necessary to carry out the project if any funds so used are credited toward the Federal share of the cost of the project.

(B) AGRICULTURE FUNDS.--Funds provided to the non-Federal sponsor under the Conservation Restoration and Enhancement Program (CREP) and the Wetlands Reserve Program (WRP) for projects in the Plan shall be credited toward the non-Federal share of the cost of the Plan if the Secretary of Agriculture certifies that the funds provided may be used for that purpose. Funds to be credited do not include funds provided under section 390 of the Federal Agriculture Improvement and Reform Act of 1996 (110 Stat.1022)."

For the CEPP, Federal Department of Interior funds were utilized to acquire some of the Project lands as detailed below.

D.3 PROJECT LOCATION AND DESCRIPTION

The project location is generally located in South Florida in Palm Beach, Broward and Miami-Dade counties. The study area for the Central Everglades Planning Project (CEPP) encompasses the Northern Estuaries (St. Lucie River and Estuary, Indian River Lagoon, and the Caloosahatchee River and Estuary), Lake Okeechobee, a portion of the Everglades Agricultural Area (EAA), the Water Conservation Areas (WCAs), Everglades National Park (ENP), the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast (LEC). The project footprint of the A-2 Flow Equalization Basin (A-2 FEB) is approximately 14,000 acres of land.

Water Conservation Areas 3A/3B (WCA 3A/3B) are comprised of approximately 578,597 acres. The adjacent canals and levees to the WCA 3A/3B include an additional approximately 11,599 acres. The adjacent levees and their borrow canals include the Levees 30, 33, 36, 38E, and 38W on the east ; Levees 4, 5, and 6 on the north; Levee 28 on the west; and Levee 29 on the south. The lands required along the right-of-way of Levee 31N consist of approximately 325 acres. The project study area has been divided into reaches as follows: North of Redline, South of Redline, Greenline/Blueline and Yellowline. As indicated above, the planning process has recently completed identification of a Recommended Plan. Project features include, but are not limited to, storage and treatment retention basins, canal modifications (plugging and re-routing), removal of existing levees, new levees, flow control structure, pump stations and seepage barriers. The Spatial Perspective Map of the project area is shown on **Figure D-1**.

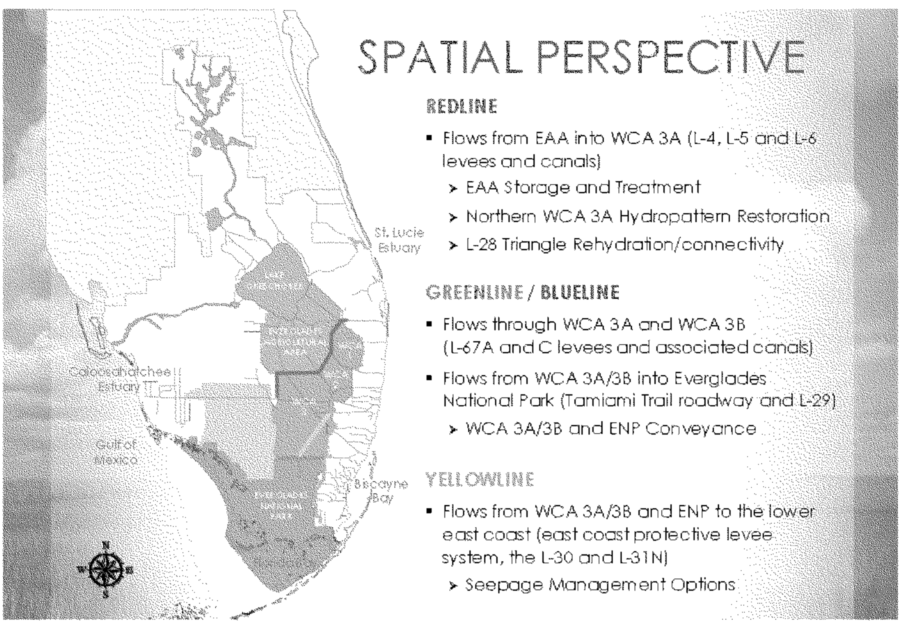


Figure D-1: SPATIAL PERSPECTIVE MAP

D.4 RECOMMENDED PLAN (ALT4R2)

The components of the Recommended Plan, Alternative 4R2, are organized into four geographic areas: North of the Redline, South of the Redline, the Greenline/Blueline and along the Yellowline.

D.4.1 Features-North of Redline-Storage and Treatment Flow Equalization Basin (FEB) A-2

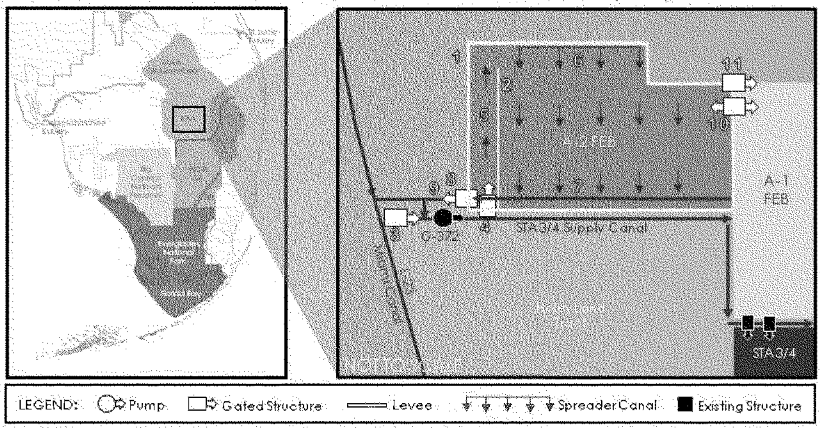
D.4.1.1 General Information and Location

Everglades Agricultural Area (EAA) (North of the Redline) includes construction and operations to divert, store and treat Lake Okeechobee regulatory releases.

Storage and treatment of new water will be possible with the construction of a 14,000 acre FEB and associated distribution features on the A-2 footprint that is operationally integrated with the state-funded and state-constructed A-1 FEB and existing STAs. The FEB will accept EAA runoff and undesirable discharges from Lake Okeechobee to the estuaries would be diverted to the FEB when FEB/STAs and canals have capacity.

The A-2 FEB is located in Palm Beach County, between the Miami Canal and North New River Canal, and north of WCA 3A. It is adjacent to the western boundary of the A-1 FEB. The inflow to the impoundment begins about 1.5 miles east of G-372 pump station. **Figure D-2** shows the Recommended Plan Treatment and Storage Features and Location. More Details regarding these features can be found in **Appendix A-Engineering Appendix**. **Table D-1** shows details on the lands required for the Recommended Plan Treatment and Storage Features only - North of the Redline.

NORTH OF THE REDLINE
STORAGE AND TREATMENT EQUALIZATION BASIN (FEB) – A2



#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	L-624	Levee		Perimeter Levee (~ 20 miles, 11.3 feet high, 14 feet wide, 3:1 side slope)
2	L-625	Levee		Interior levee (~ 4 miles, 11.3 feet high, 12 feet wide, 3:1 side slope)
3	S-623	Gated Spillway	3700	Delivers water from Miami Canal to existing G-372 pump station
4	S-624	Gated Sag Culvert (FEB inflow structure)	1550	Receives water from existing pump station G-372 via STA 3/4 Supply Canal and delivers it to C-624 FEB inflow canal
5	C-624	FEB Inflow Canal	1550	Conveys water from FEB inflow structure S-624 to FEB C-624 E spreader canal (length: ~ 4 miles)
6	C-624E	FEB Spreader Canal		Distributes FEB inflows across northern FEB; sheetflow within FEB is generally north to south (length: ~ 4 miles)
7	C-625E	FEB Collection Canal	400	Existing seepage canal for STA 3/4 Supply Canal, used to supplement FEB sheetflow during normal operating conditions
8	S-625	Gated Culverts (FEB discharge structure)	1550	Delivers water to FEB outflow canal (C-625W)
9	C-625W	FEB Outflow Canal	1550	FEB Outflow Canal is the extended seepage canal for the STA 3/4 Supply Canal; delivers water via existing G-372 pump station to STA 3/4 for water quality treatment
10	S-628	Gated Culvert (FEB intake/discharge structure)	930	Delivers water in both directions between A-2 FEB and A-1 FEB for operational flexibility
11	S-627	Emergency Overflow weir	445	Location to be determined
A-2 FEB design also includes an exterior seepage collection system (not illustrated):				
	C-626	Seepage Canal	400	~ 11 miles
	S-626	Seepage Pump Station	500	Delivers seepage back into the FEB outflow canal C-625W

Figure D-2. Recommended Plan Treatment and Storage Features and Location

Table D-1: North of Redline Lands

NORTH OF THE REDLINE – STORAGE AND TREATMENT FLOW EQUALIZATION BASIN (FEB) – A 2							
#	Structure/ Feature No	Structure/ Feature Type	Approximate Acres Required for Features	Estate Owned by SFWMD	Estate Required for CEPP	Federal Cost Share	Non-Federal Cost Share
1	L-624	FEB Perimeter Levee	516	Fee	Fee	Note 1	Note 1
2	L-625	FEB interior inflow canal levee	103	Fee	Fee	Note 1	Note 1
3	S-623 (DS-8)	Gated Spillway-On STA 3/4 Supply Canal	4	Fee	Fee	$0	$0
4	S-624 (DS-5)	Gated Sag Culvert (FEB inflow structure) On STA 3 / 4 Supply Canal	4	Fee	Fee	Note 1	Note 1
5	C-624	Inflow Canal-West side interior of FEB	77	Fee	Fee	Note 1	Note 1
6	C-624E	Spreader Canal-Northern boundary of FEB	116	Fee	Fee	Note 1	Note 1
7	C-625E	FEB interior collection canal along southern perimeter	116	Fee	Fee	Note 1	Note 1
8	S-625 (DS-7)	Gated Culverts (FEB discharge structure) in FEB perimeter levee L-624	4	Fee	Fee	Note 1	Note 1
9 (Eastern Portion)	C-625W (Eastern Portion)	FEB exterior outflow; between S-625 and G-372 headwater	34.23	Fee	Fee	$78,801	$10,246
9 (Western Portion)	C-625W (Western Portion)	FEB exterior outflow; between S-625 and G-372 headwater	57.02	None	Fee to be provided by State by Supplemental Agreement or Perpetual Channel Easement	$0	$712,750
10	S-628 (DS-9)	Gated Culvert FEB intake/ discharge structure, Between A-2 and A-1 FEB,	3	Fee	Fee	Note 1	Note 1
11	S-627 (CS-4)	Emergency Overflow weir-Between A-2 and A-1 FEB,	3	Fee	Fee	Note 1	Note 1
12	C-626	Seepage Canal-West and northern exterior perimeter of FEB	212	Fee	Fee	Note 1	Note 1
13	S-626 (PS-1)	Seepage Pump Station, West side of seepage canal, C-626	3	Fee	Fee	Note 1	Note 1
	A-2 FEB	A-2 FEB Interior Area	12,688.34	Fee	Fee	$30,220,406	$1,490,102
	Temporary Access	Potential Temporary Access from SR 78 to A-2 Feb	40.00	Fee	Temporary Access Easement	$0	$150,000
	TOTAL		**13,980.59**			**$30,299,207**	**$2,363,098**

Note 1-costs included in A-2 FEB

D.4.1.2 Real Estate Required

The A-2 FEB and associated structures will be located on approximately 13,849.34 acres of which approximately 13,839.44 acres were acquired utilizing Federal Farm Bill funds and SFWMD funds.

The remaining approximately 9.90 acres were acquired by SFWMD with State funds. SFWMD owns fee to these lands and that will be the estate required for the A-2 FEB. For the C-625W FEB Outflow Canal, SFWMD owns fee title, which will be the required estate, to approximately 34.23 acres acquired utilizing Federal Farm Bill funds and SFWMD funds. The remaining approximately 57.02 acres required for the C-625W FEB Outflow Canal are owned by the State of Florida and the SFWMD will obtain a perpetual channel easement from the State or obtain fee from the State by Supplemental Agreement consistent with the terms of the CERP Master Agreement. The Federal government will receive credit for Federal funds and SFWMD will receive credit for its actual costs for those funds associated with the Talisman acquisition. Those lands purchased or to be purchased solely with State funds, the Non-Federal sponsor will be credited at the fair market value at the time of certification. More details on land costs and crediting are provided in paragraphs D.5 and D.26 below.

D.4.2 Features-South of Redline-Distribution & Conveyance

D.4.2.1 General Information and Location

WCA 2A and Northern WCA 3A (South of the Redline) includes conveyance features to deliver and distribute existing flows and the redirected Lake Okeechobee water through WCA 3A.

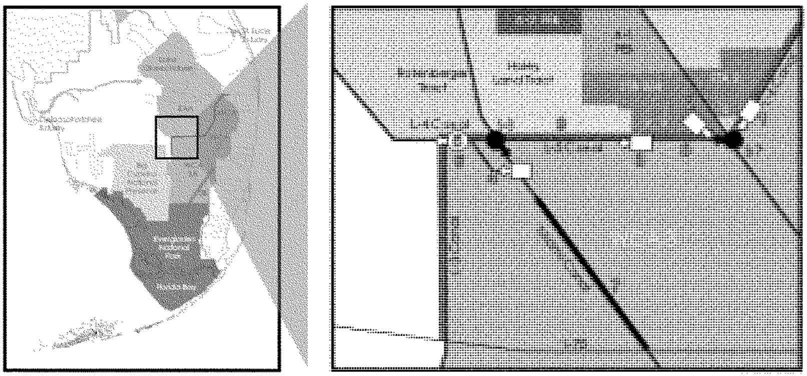
Backfilling 13.5 miles of the Miami Canal between I-75 and 1.5 miles south of the S-8 pump station, and converting the L-4 canal into a spreader canal by removing 2.9 miles of the southern L-4 levee are the key features needed to ensure spatial distribution and flow directionality of the water entering WCA 3A.

Conveyance features to move water into and through the northwest portion of WCA 3A include: a gated culvert to deliver water from the L-6 Canal to the remnant L-5 Canal, a new gated spillway to deliver water from the remnant L-5 canal to the western L-5 canal (during L-6 diversion operations); a new gated spillway to deliver water from STA 3/4 to the S-7 pump station during peak discharge events (eastern flow route is not typically used during normal operations), including L-6 diversion operations; a 360 cfs pump station to maintain Seminole Tribe of Florida water supply deliveries west of the L-4 Canal; and new gated culverts to deliver water from the Miami Canal (downstream of S-8, which pulls water from the L-5 Canal) to the L-4 Canal.

D.4.2.2 Features

Figure D-3 Recommended Plan Northern Conveyance and Distribution Features and Location shows the features south of the Redline. More Details regarding these features can be found in **Appendix A-Engineering Appendix**. **Table D-2** shows details on the lands required for the Recommended Plan Features South of the Redline. It does not include lands that will be required and recertified for the flowage of additional water in WCAs 3A/3B.

SOUTH OF THE REDLINE
DISTRIBUTION AND CONVEYANCE



LEGEND: Pump | Gated Structure | Levee Removal | Existing Structure

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-620	Gated Culvert	500	Delivers water from L-6 Canal to L-5 Canal
2	S-621	Gated Spillway	2500	Closed to direct STA 3/4 discharges to western L-5 Canal during normal operations; controls water from STA 3 /4 to the existing S-7 pump station during peak events
3	S-622	Gated Spillway	500	Delivers water from east to west in L-5 Canal (replaces existing L-5 canal plug)
4	S-8A	Gated Culverts with Canal	3080 & 1020	Existing S-8 pump station delivers water from L-5 Canal to Miami Canal; S-8A delivers water from Miami Canal to L-4 Canal (3120 cfs) and remaining Miami Canal segment (1040 cfs); potential design modifications to the existing S-8/G-404 complex will be assessed during PED
5	S-630	Pump Station	360	Delivers water from L-4 Canal west to maintain existing water supply deliveries
6		L-4 Levee Removal		Removes ~2.9 miles of south L-4 Levee
7		Miami Canal Backfill with Tree Islands Mounds		Remove ~ 13.5 miles of Miami Canal , from 1.5 miles south of S-8 to I-75; tree island mounds create habitat and promote sheetflow in WCA-3A within the footprint of the former Miami Canal
8		L-5 Remnant Canal	500	Enlarging canal to expand capacity of L-5 Canal (between S-621 & S-622)
9		L-5 Canal	3000	Enlarging canal to expand capacity of L-5 Canal (between S-622 & S-8)

Figure D-3. Recommended Plan Northern Conveyance and Distribution Features and Location.

Table D-2: South of Redline Lands

SOUTH OF THE REDLINE – DISTRIBUTION AND CONVEYANCE							
#	Structure/ Feature No	Structure/ Feature Type	Approximate Acres Required for Features	Estate Owned by SFWMD	Estate Required for CEPP	Federal Cost Share	Non-Federal Cost Share
1	S-620 (CS-1)	Gated Culvert In L-6 Canal	3	Perpetual Canal Easement	Perpetual Canal Easement	$0	$0
2	S-621 (CS-2)	Gated Spillway On STA 3 / 4 Outflow Canal	4	Fee	Fee	$0	$0
3	S-622 (CS-3)	Gated Spillway In L-5 Canal	3	Perpetual Canal Easement	Perpetual Canal Easement	$0	$0
4	New (S-8A)	Gated Culverts w/canal In Miami and L-4 Canal	3	Perpetual Canal Easement	Perpetual Canal Easement	$0	$0
5	S-630	Pump Station In L-4 Canal	3	Perpetual Canal Easement	Perpetual Canal Easement	$0	$0
6		L-4 Interior Levee Removal	20	Perpetual Canal Easement	Perpetual Canal Easement	$0	$0
7		Miami Canal Backfill with Tree Island Mounds	101	Perpetual Canal Easement	Perpetual Canal Easement	$0	$0
8		Canal, Remnant L-5 Canal east	31	Perpetual Surface Easement	Perpetual Surface Easement	$0	$0
9		Canal, L-5 Canal west	48	Perpetual Surface Easement	Perpetual Surface Easement	$0	$0
	TOTAL		216			$0	$0
Note: Total does not include lands that will be recertified for the flowage of additional water in WCAs 3A/3B.							

D.4.2.3 Real Estate Required

The structures listed above will be constructed on lands within the right-of-way of existing canals or levees or within lands in WCA 3A/3B which were previously acquired and provided as an item of local cooperation for the original C&SF Project. SFWMD owns sufficient interests in these lands for the construction of these project features. SFWMD owns fee or a perpetual easement. Where SFWMD owns a perpetual easement, the State of Florida owns the underlying fee title. SFWMD will not receive credit for the provision of these lands. More details on land costs and crediting are provided in paragraphs D.5 and D.26 below.

D.4.3 Features-Blueline/Greenline -Distribution and Conveyance

D.4.3.1 General Information and Location

Southern WCA 3A, WCA 3B, and ENP (Greenline/Blueline) includes conveyance features to deliver and distribute water from WCA3A to WCA 3B and ENP.

A new Blue Shanty levee extending from Tamiami Trail northward to the L-67A levee will divide WCA 3B into two subunits, a large eastern unit (3B-E) and a smaller western unit, the Blue Shanty Flowway (3B-W). The width of the 3B-W flow-way is aligned to the width of the downstream 2.6-Mile Tamiami Trail Next Steps bridge, optimizing the effectiveness of both the flow-way and bridge.

In the western unit, construction of two new gated control structures on the L-67A, removal of the L-67C and L-29 Levees within the flowway, and construction of a divide structure in the L-29 Canal will enable continuous sheetflow of water to be delivered from WCA 3A through WCA 3B to ENP. A gated control structure will also be added to the L-67A, outside the flowway, to improve the hydroperiod of the eastern unit of WCA 3B.

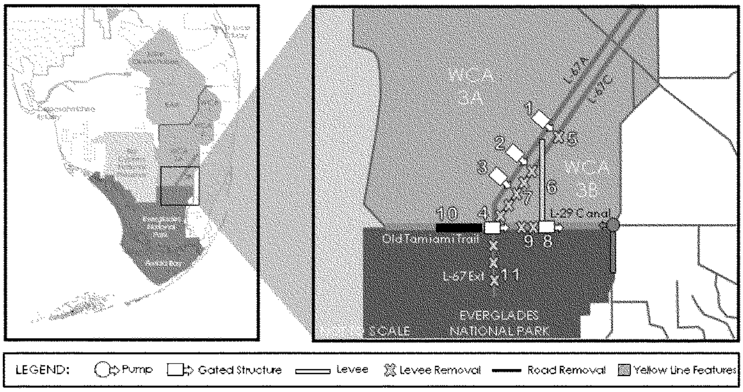
Increased outlet capability at the S-333 structure at the terminus of the L-67A canal, removal of approximately 5.5 miles of the L-67 Extension Levee, and removal of approximately 6 miles of Old Tamiami Trail between the ENP Tram Road and the L-67 Extension Levee will facilitate additional deliveries of water from WCA 3A directly to ENP. Detailed design and construction of these features will consider improving recreation access and minimize project footprints due to the nature of these environmentally sensitive areas. Establishment of expanded maintenance easements along the old Tamiami Trail for existing and new infrastructure, to facilitate road modifications, maintenance and water delivery are recommended.

The proposed CEPP features encompassed by the Blueline/Greenline lie within Miami-Dade County. The S-631, S-632, and S-633 gated culverts are located on the southern portion of the L-67A Canal, with S-333N south of the intersection of the L-67A and L-67C Canals. The proposed Blue Shanty Levee is located between the L-67A and the L-29 Canals, eastward of the L-67 Extension. The S-355W spillway is located at the intersection of the Blue Shanty Levee and the L-29 Canal.

D.4.3.2 Features

The CEPP project has the following hydraulic features within the Blueline/Greenline boundaries which are shown on **Figure D-4**. Recommended Plan Southern Distribution and Conveyance Features and Location. More Details regarding these features can be found in **Appendix A-Engineering Appendix**. **Table D-3** shows details on the lands required for the Recommended Plan Features Blue and Green Lines. It does not include lands that will be required and recertified for the flowage of additional water in WCAs 3A/3B.

BLUE AND GREEN LINES
DISTRIBUTION AND CONVEYANCE



#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-631	Gated Culvert	500	Delivers water from WCA 3A to 3B, east of L-67D Levee
2	S-632	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
3	S-633	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
4	S-333 (N)	Gated Spillway w/new canal	1150	Delivers water from L-67A Canal to L-29 Canal; supplements existing S-333 gated spillway
5		L-67C Levee Removal Gap		Gap, ~ 6000 feet (corresponding to S-631)
6	L-67D	Blue Shanty Levee		Levee, ~ 8.5 miles, connecting from L-67A to L-29 (6 feet high, 14-foot crest width, 3:1 side slopes)
7		L-67C Levee Removal		Complete removal of ~ 8 miles from New Blue Shanty Levee (L-67D)south to intersection of L-67A/L-67C; L-67C canal is not backfilled
8	S-355W	Gated Spillway	1230	Maintains water deliveries to eastern L-29 Canal
9		Levee Removal (L-29)		Removal of ~ 4.3 miles between L-67A and Blue Shanty Levee intersection with L-29 Levee
10		Removal of remnants of Old Tamiami Trail roadway		Removal of ~ 6 miles of roadway west of L-67 Extension
11		L-67 Extension Levee Removal and Canal Backfill)		Complete removal of ~ 5.5 miles of remaining L-67 Extension, including S-346 culvert

Figure D-4. Recommended Plan Southern Distribution and Conveyance Features and Location.

Table D-3: Blue and Green Lines Lands

BLUE AND GREEN LINES – DISTRIBUTION, CONVEYANCE & SEEPAGE MANAGEMENT							
#	Structure/ Feature No	Structure/ Feature Type	Approximate Acres Required for Features	Estate Owned by SFWMD	Estate Required for CEPP	Federal Cost Share	Non-Federal Cost Share
1	S-631	Gated Culvert In L-67A Levee	2	Fee	Fee	$0	$0
2	S-632	Gated Culvert In L-67A Levee	2	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
3	S-633	Gated Culvert In L-67A Levee	2	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
4	S-333 (N)	Gated Spillway w/new canal Just north of existing S-333	4	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
5		L-67C Levee Removal Gap	15	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
6	L-67D	New Levee In WCA 3B	5	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
7		L-67C Levee Removal	155	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
8	S-355W	Gated Spillway In L29 Canal, east of L-67D Levee terminus and 2.6 mile bridge	5	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
9		L-29 Levee Removal	75	Perpetual Levee and Flowage Easement	Perpetual Levee and Flowage Easement	$0	$0
10		Old Tamiami Trail Road Removal (from L-67 Ext west to ENP Tram Rd)	36	Permit	Permit	$0	$0
11		L-67 Ext levee Removal and Canal Backfill including removal of S-346 culvert	110	Perpetual Levee & Flowage Easement	Perpetual Levee & Flowage Easement	$0	$0
		Airboat Association	5	None	Perpetual and Occasional Flowage Easements	$0	$500,000
	TOTAL		**416**			**$0**	**$500,000**

Note: Total does not include lands that will be recertified for the flowage of additional water in WCAs 3A/3B.

D.4.3.3 Real Estate Required

Except for the Old Tamiami Trail, the structures listed above will be constructed on lands within the right-of-way of existing canals or levees or within lands in WCA 3A/3B which were previously acquired and provided as an item of local cooperation for the original C&SF Project. SFWMD owns sufficient interests (fee or a perpetual easement) in these lands for the construction of these project features. Where SFWMD owns a perpetual easement, either the State of Florida or private parties own the underlying fee title. SFWMD will not receive credit for the provision of these lands unless a greater interest is required. The Old Tamiami Trail right-of-way is owned by the United States of America, National Park Service (NPS). The NPS will provide a permit authorizing use of these lands for removal of the Old Tamiami Trail.

Certain real estate interests were authorized and will be acquired on the Airboat Association of Florida property under the Modified Water Deliveries to Everglades National Park project including the right to permanently flow water up to elevation 8.5 NGVD and to occasionally flow water up to elevation 9.5 NGVD. Under CEPP, there may be a requirement to revisit this property. A takings analysis will be required to determine additional impacts to the property from CEPP. For planning purposes, the estimated amount of $500,000 has been added for the potential acquisition of additional easement rights.

More details on land costs and crediting are provided in paragraphs D.5 and D.26 below.

D.4.4 Features-Yellowline- Seepage Management

Lower East Coast Protective Levee (Yellowline): Includes features primarily for seepage management, which are required to mitigate for increased seepage resulting from the additional flows into WCA 3B and ENP.

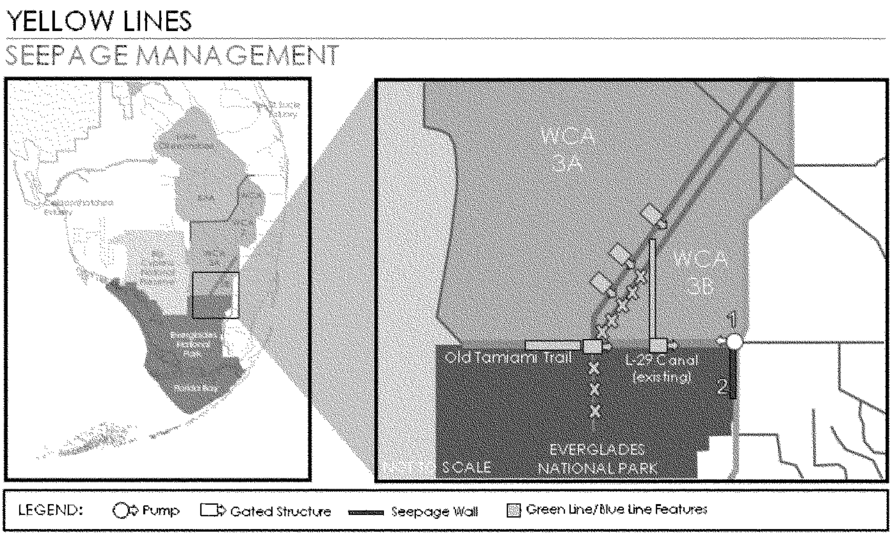
A newly constructed pump station with a combined capacity of 1,000 cfs will replace the existing temporary S-356 pump station, and a 4.2 mile seepage barrier cutoff wall will be built along the L-31N Levee south of Tamiami Trail.

There is an existing 2-mile seepage barrier cutoff wall in the same vicinity that was constructed by a permittee as mitigation. There is a possibility that the same permittee may construct an additional 5 miles of seepage wall south of the 2-mile seepage barrier cutoff wall, if permitted. Since the capability and effectiveness of the existing seepage barrier cutoff wall to mitigate seepage losses from ENP remains under investigation, the CEPP Recommended Plan conservatively includes an approximately 4.2 mile long, 35 feet deep tapering seepage barrier cutoff wall in the event construction is necessary.

The proposed CEPP features encompassed by the yellowline lie within Miami-Dade County. The S-356 is located on the L-29 Levee. The Seepage Barrier Cutoff Wall is located in the L-31N right-of-way.

D.4.4.1 Features

The CEPP within the yellowline boundaries project has the hydraulic features which are shown on **Figure D-5** Recommended Plan Seepage Management Features and Location. More details regarding these features can be found in **Appendix A-Engineering Appendix**. **Table D-4** shows details on the lands required for the Recommended Plan Features Yellow Line.



#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-356	Pump Station	1000	Provides seepage management for WCA 3B and NESRS stages
2		Seepage Barrier Cutoff Wall		Soil cement bentonite (SCB) wall (~4.2 miles, 3 feet wide, 35 feet deep)

Figure D-5. Recommended Plan Seepage Management Features and Location.

Table D-4: Yellow Line Lands

YELLOW LINE – DISTRIBUTION, CONVEYANCE & SEEPAGE MANAGEMENT							
#	Structure/ Feature No	Structure/ Feature Type	Approximate Acres Required for Features	Estate Owned by SFWMD	Estate Required for CEPP	Federal Cost Share	Non-Federal Cost Share
1	New S-356	Pump Station	5	Fee	Fee	$0	$0
2		Seepage Barrier Cutoff Wall	325	Fee	Fee	$0	$0
	TOTAL		330			$0	$0

D.4.4.2 Real Estate Required

The S-356 structure listed above will be constructed on lands within the right-of-way of existing L-29 Levee which was previously acquired and provided as an item of local cooperation for the original C&SF Project. The Seepage Barrier Cutoff Wall will be constructed within the right-of-way of the L-

31N Levee which was previously acquired and provided as an item of local cooperation for the original C&SF Project. SFWMD owns sufficient interests (fee or a perpetual easement) in these lands for the construction of these project features. SFWMD will not receive credit for the provision of these lands unless a greater interest is required and then only for the difference in value between the interest provided for the C&SF project and that required for CEPP.

More details on land costs and crediting are provided in paragraphs D.5 and D.26 below.

D.5 ANALYSIS OF ESTATE REQUIRED FOR THE PROJECT AND NON-FEDERAL OWNED LANDS ACQUIRED FOR THE CENTRAL AND SOUTHERN FLORIDA PROJECT

The Programmatic Regulations for the CERP, 33 Code of Federal Regulations (CFR) 385, Part 385.5, require the development of Six Program-Wide Guidance Memorandum. After completion of the Takings Analysis to determine the lands impacted by project operations, the July 2007 draft of the Six Program-Wide Guidance Memoranda in Section 1.10.3 provides that an analysis to determine the estates required for implementation of a project should be determined using the following guidelines.

D.5.1 Estates Required for Comprehensive Everglades Restoration Plan Projects

For all lands determined to be required for the CERP projects, the interests required for implementation generally will be fee simple, based on assumptions that all or a significant portion of the rights in the land will be required for project purposes. Although fee acquisition should be the standard estate for CERP projects, lesser estates such as flowage or conservation easements should be considered, as appropriate, if the benefits of the project can still be achieved with the lesser estate. The PIR should provide the rationale for such lesser estates. To verify the appropriateness of fee simple acquisition or less than fee acquisition, the PIR must include the following analysis and the conclusions must be reflected in the appropriate report sections. The level of detail required for the analysis will vary depending on the project feature involved. Determine the rights that are required to construct and perform operation, maintenance, repair, rehabilitation, and replacement for the CEPP project:

- Identify the affirmative rights on the land that are required to implement the project.
- In addition to affirmative rights that may be required, identify restrictions on use (restrictive covenants) by the fee owner that are required so as not to interfere with project purposes and outputs.
- Identify the length of time that the affirmative rights or restrictive covenants are needed for the project.
- Determine whether constructed project features may need to be modified over time due to uncertainties in science, formulation, or design (adaptive management).
- Determine whether project land, or portions thereof, will be open for public use (either active or passive uses).

Other factors to be considered:

- Compare the cost/value of specific types of easements to fee value.
- Assess potential for severance damages from fee acquisition.
- Determine whether public owners have legal capability to convey fee.
- Assess stewardship operation, maintenance, repair, rehabilitation, and replacement considerations regarding the risk and consequences of encroachment on project land by adjacent

owners; the risk and consequences of violation of easement terms by fee owners; and monitoring and enforcement capabilities of sponsor.
• Assess negative perception by public of private benefits or gain due to landowner reservations where easements are selected.
• Assess whether State Marketable Title Act requires re-recording of easement instruments-the Marketable Record Title Act has been amended to exempt State Agencies from the requirements of the act.

The majority of land required for CEPP was previously acquired in conjunction with the C&SF Project.

D.5.2 A-2 FEB Compartment A-Talisman Exchange

D.5.2.1 A-2 FEB

The SFWMD owns fee to approximately 13,849.44 acres within Compartment A required for the A-2 FEB. The A-2 FEB will be operated essentially as a reservoir; therefore, all the lands within the footprint will be required in fee. The project footprint of the A-2 FEB and structures requires approximately 13,849.34 acres of Compartment A, of which 13,839.44 acres were acquired in the Talisman Exchange. The remaining approximately 9.90 acres in Compartment A was acquired by SFWMD using State funds.

D.5.2.2 A-2 FEB Outflow Canal

The SFWMD also owns fee to Section 35, Township 46 South, Range 35 East, where a portion of the proposed FEB Outflow Canal from the Miami Canal to the Reservoir will be constructed, consisting of approximately 34.23 acres. These lands were acquired for CERP, as part of the Talisman Exchange, where a portion of the proposed FEB Outflow Canal will be constructed.

The State of Florida owns fee to that portion of Section 36, Township 46 South, Range 35 East where the remaining portion of the proposed FEB Outflow Canal from the Miami Canal to the A-2 FEB will be constructed, consisting of approximately 57.02 acres. Florida Law prohibits the State from conveying fee title These lands will be acquired by SFWMD from the State, either through direct acquisition of a permanent canal easement from the State or the State will provide a permanent canal easement or fee by Supplemental Agreement with the SFWMD, prior to construction of the FEB Outflow Canal. As set forth in Article IV.D.1. of the Master Agreement for the Central Everglades Restoration Project, if the lands are acquired by SFWMD prior to execution of the Partnership Agreement (PPA), SWFMD will receive credit for the fair market value as of the date the SFWMD provides the Government with authorization for entry thereto for construction and if the lands are acquired after execution of the Project Partnership Agreement (PPA); SFWMD will receive the fair market value of such real property interests at the time the interests are acquired.

D.5.3 Analysis of Estates owned by the SFWMD in WCA 3A/3B, Levees, and Canals previously acquired and provided for the C&SF Project

The SFWMD also owns fee or a perpetual canal easement interest to the portion of the Miami Canal required for the Project. Each of the easement interests owned by the SFWMD and provided for the original C&SF Project have been determined in a legal analysis to be sufficient for project purposes. The legal analysis concluded that the easement interests owned by SFWMD in the WCA 3A/3B would allow construction of project features listed in Tables D-1 through D-4 above required for CEPP as well as the increases in inundation within the WCA 3A/3B required for CEPP. WCA 3A/3B, which are part of the C&SF project, are comprised of approximately 578,597 acres. SFWMD has various estates and interests in these lands. SFWMD owns fee to approximately 134,280.95 acres, a perpetual flowage easement over approximately 444,316.05 acres and canal right-of-way deeds for over approximately 11,598.84 acres for the following levees and their adjacent borrow canals: L-30, L-33, L-36, L-38E, L-38W, L-4, L-5, L-6, L-28, and L-29, which are also part of the original C&SF project. SFWMD owns fee title to approximately 325 acres within the L-31N right-of-way which will be required for construction of the Seepage Barrier Cutoff Wall. The interest and estates are discussed in this paragraph in more detail below. SFWMD will not receive credit for the provision of these lands for the CEPP Project as these lands have been previously acquired for the C&SF project. More details on land costs and crediting are provided in paragraph D.26 below.

It is recommended that the estates previously acquired by SFWMD and provided for the original C&SF Project be approved for the CEPP Project.

SFWMD owns a variety of different interest in WCA 3A/3B which were previously acquired and provided as an item of local cooperation for the original C&SF Project. SFWMD owns sufficient interests in these lands for the construction of these project features. As set forth below, SFWMD owns fee or a perpetual easement. Where SFWMD owns a perpetual easement, either the State of Florida or private parties own the underlying fee title. SFWMD will not receive credit for the provision of these lands unless a greater interest is required.

SFWMD owns fee to approximately 134,280.95 acres in WCA 3A/3B.

The SFWMD was conveyed Canal and Levee right-of-way easements from the State of Florida over approximately 11,598.84 acres. They provide the following: "NOW, THEREFORE, to facilitate Central and Southern Florida Flood Control District in carrying out the purposes for which said district was created, the State of Florida, in the public interest and for the public convenience and welfare, and for the public benefit, have granted and conveyed unto Central and Southern Florida Flood Control District a perpetual easement for the right-of-way for the works of the district, the construction, operation and maintenance of same, over and across the lands hereinafter described, and grants the further right to said District to convey to the United States of America in connection with the District's purposes, the rights herein granted to said district by said Trustees." This estate held by SFWMD has been determined in a legal analysis to be sufficient for the CEPP Project purposes.

SFWMD also acquired perpetual easements from private parties over approximately 70,612.53 acres. These easements conveyed to the predecessor of the SFWMD contain the following language: "...the right, privilege, use and easement in and to the lands hereinafter described for any and all purposes necessary to the construction, maintenance and operation of any project in the interest of flood control, reclamation, conservation and allied purposes now or that may hereafter be conducted by the grantee herein, its successors or assigns, including the right to permanently or intermittently flood all or any part of the area covered hereby as a result of the said construction, maintenance, or operation, in carrying out the purposes and intents of the statutes of the State of Florida relating to the Central and Southern Florida Flood Control District presently existing or that may be enacted in the future pertaining hereto." While private owners could convey and SFWMD could acquire fee, the current easement estates acquired and owned by SFWMD and provided for the prior Central and Southern Florida Flood Control Project are sufficient to allow construction, operation and maintenance of the CEPP and Central and Southern Florida Flood Control Project.

The rights held by the SFWMD in these lands were determined to be legally sufficient to construct any necessary CEPP project features as well as to increase inundation. Acquisition of fee was deemed unnecessary since the existing easement estates have allowed the SFWMD and Corps to construct, operate and maintain existing and new structures and the C&SF Project since the 1950s. This estate held by SFWMD has been determined in a legal analysis to be sufficient for the CEPP Project purposes.

The State of Florida, through the Trustees of the Internal Improvement Trust Fund conveyed perpetual easements over approximately 300,343.52 acres within the WCA 3A/3B. While the State of Florida still retains the fee title to these lands, the estate conveyed to SFWMD predecessor is as follows: "...the right, privilege, use and easement in and to the lands hereinafter described for any and all purposes necessary to the construction, maintenance and operation of any project in the interest of flood control, reclamation, conservation and allied purposes now or that may hereafter be conducted by the grantee herein, its successors or assigns, including the right to permanently or intermittently flood all or any part of the area covered hereby as a result of the said construction, maintenance, or operation, in carrying out the purposes and intents of the statutes of the State of Florida relating to the Central and Southern Florida Flood Control District presently existing or that may be enacted in the future pertaining hereto." This estate held by SFWMD has been determined in a legal analysis to be sufficient for the CEPP Project purposes.

The SFWMD was also conveyed surface rights over approximately 73,360 acres in WCA 3A/3B by the State Board of Education of the State of Florida. The rights conveyed to SFWMD predecessor was "...for the purposes for which the District was created, the surface rights to the lands hereinafter described, including the right to permanently or intermittently flood all or any part of said land within established water conservation areas, and to construct, operate and maintain works of flood control thereon;". The State Board of Education of the State of Florida later conveyed the fee title to all these lands to the State of Florida Trustees of the Internal Improvement Trust Fund. These estates and interest owned by the SFWMD are sufficient for CEPP Project purposes. This estate held by SFWMD has been determined in a legal analysis to be sufficient for the CEPP Project purposes.

For the approximately 325 acres required along the L-31N right-of-way, SFWMD owns fee title.

D.6 HUNT CAMP LEASES

Throughout WCA 3A/3B are hunt camps. The hunt camps are on lands owned in fee by the SFWMD, on lands owned in fee by the State and on lands owned in fee by private parties over which the SFWMD has perpetual easements.

In WCA 3A/3B, the SFWMD has approximately 18 hunt camp leases allowing construction or maintenance of existing facilities. Each of these leases contain the following provision: "WATER LEVELS: The LESSEE hereby waives any and all claims on the part of the LESSEE and agrees to indemnify and hold harmless LESSOR, the United States of America and the State of Florida from any and all claims, damages or losses or demands of any kind or nature, which may arise or be incident to regulation of water levels associated with the leased premises by the LESSOR and/or the U.S.

Army Corps of Engineers. LESSOR will neither guarantee groundwater levels nor guarantee any level of flood protection." Most of these leases expire in 2020.

The State of Florida through the Board of Trustees has executed approximately 52 hunt camp leases in WCA 3A/3B. Each of these leases contain the following provision: "WATER LEVELS: The LESSEE hereby waives any and all claims on the part of the LESSEE and agrees to indemnify and hold harmless LESSOR, the United States of America and the State of Florida from any and all claims, damages or losses or demands of any kind or nature, which may arise or be incident to regulation of water levels associated with the leased premises by the LESSOR, the South Florida Water Management District, and/or the U.S. Army Corps of Engineers. LESSOR will neither guarantee groundwater levels nor guarantee any level of flood protection." Most of these leases expire in 2020.

There are 16 hunt camps within the WCA 3A/3B located on lands over which SFWMD has perpetual flowage easements that are private and with no record of any lease or permit from either the State of Florida or the SFWMD. The perpetual flowage easements owned by the SFWMD provide the rights to permanently overflow these lands and does not provide any restriction as to the depth. These easements conveyed to the predecessor of the SFWMD contain the following language: "...the right, privilege, use and easement in and to the lands hereinafter described for any and all purposes necessary to the construction, maintenance and operation of any project in the interest of flood control, reclamation, conservation and allied purposes now or that may hereafter be conducted by the grantee herein, its successors or assigns, including the right to permanently or intermittently flood all or any part of the area covered hereby as a result of the said construction, maintenance, or operation, in carrying out the purposes and intents of the statutes of the State of Florida relating to the Central and Southern Florida Flood Control District presently existing or that may be enacted in the future pertaining hereto."

Because SFWMD owns either fee or perpetual flowage easements over the lands where these hunt camps are located and because the leases from the State and SFWMD contain the provisions related to the regulation of water levels, no acquisition or relocation of these hunt camps are required.

Additionally, there are hunt camps on lands within WCA 3 that are leased to the Miccosukee Tribe of Indians of Florida. The Governor and Cabinet as the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida; the South Florida Water Management District granted to the Miccosukee Tribe of Indians of Florida a perpetual lease covering approximately 189,000 acres in WCA 3A. Among the rights granted to the Miccosukee Tribe of Indians of Florida pursuant to the lease are the following: "(a) Subject to the provisions of paragraph 2. of this Lease Agreement and the approval of appropriate legislation to such effect by the Florida Legislature as required in the Settlement Agreement described in paragraph 8 below, the members of the Miccosukee Tribe of Indians of Florida shall have the right during the term of this Lease Agreement to hunt and fish for subsistence purposes and to take frogs for consumption as food and for commercial purposes without restriction as to season in the Leased Area and the Miccosukee Reservation and shall not be required to purchase any license or permit from the Commission in order to exercise such rights; (b) The Miccosukee Tribe of Indians of Florida and its members shall have the right to engage in traditional subsistence-agricultural activities in the Leased Area. It is understood that revenue producing agricultural activities on the Leased Area at this time are inconsistent with the proper use of the area as a water flowage and storage area by the SFWMD. However, should conditions change, the Tribe may seek permission from the SFWMD to engage in revenue-producing agricultural activities if such activities will not interfere with the rights and uses of the SFWMD. Approval by the SFWMD shall be pursuant to the permit procedures applicable to any private citizen: (c) The Miccosukee Tribe of Indians of Florida, and members of the Miccosukee Tribe of Indians of Florida under regulations the Tribe may adopt, shall have the right: (1) to reside in the Leased Area, including the construction of traditional homes, subject to the provisions of paragraph 6; (2) to use the Leased Area for tribal religious purposes; and (3) to take and use native materials from the Leased Area for tribal purposes, fabrication into artifacts, utensils, handicrafts and/or souvenirs for sale, subject to the provisions of subparagraph 3e below."

The lease is subject to the following provision: "6. Rights of South Florida Water Management District. The Leased Area has for many years comprised a portion of a large reservoir utilized for the flowage and storage of water servicing the area of Broward, Dade, Monroe and Collier Counties and designated as Water Conservation Area 3 as part of the federally authorized project of flood control and water management for central and southern Florida. The Commission and the Miccosukee Tribe of Indians of Florida agree that all of the rights set forth in paragraphs 1 through 5 and 7 are subject to and shall not interfere with the rights, duties and obligations of the SFWMD or the United States Army Corps of Engineers, pursuant to the requirements of the aforesaid federally authorized project, conveyances, easements, grants, rules, statutes, or any other present or future lawful authority to manage, regulate, raise, or lower the water levels within the Leased Area or Water Conservation Area 3, including, but not limited to the Dedication from the Board of Commissioners of State Institutions of the State of Florida dated August 8, 1950."

Because this lease from the State and SFWMD contains the above provision related to the regulation of water levels, no acquisition or relocation of these hunt camps located on the Miccosukee Tribe of Indians of Florida leased lands are required.

D.7 AGRICULTURAL LEASES AND RESERVATIONS

D.7.1 SFWMD LEASE AND RESERVATIONS

When the Talisman Exchange deeds were executed in March 1999, they contained certain reservations in favor of the Grantors. The following is a synopsis of the reservations in the deeds:

Each reservation provides that the reservation continues through March 31, 2005 and thereafter annually until the Property is needed for a Project as determined by the District and the Army Corps. The reservations, if not otherwise terminated earlier, expire on March 31, 2014. Provided however, that if the lands are determined by the District and Army Corps to be not needed for a Project, such surplus property (and all other property subject to the reservation) shall continue to be made available for farming by the reservation holder through the earlier of March 31, 2019 or the date an exchange of such lands is consummated between the District and the reservation holder. After March 31, 2019, the reservation holder has a right of first refusal to any lease of such lands for agricultural use. The farmers have the right to continue farming any field covered by the reservation annually unless and until the Property is needed for a Project as determined by the District and the Corps. Grantor has the right to continue farming any field unless and until: farming or access for farming purposes becomes incompatible with, as reasonably determined by the District and the Corps, the initiation of actual construction or the Implementation of a District/Corps Project("Project") and the required notices are given. The term "Project" is defined to include (1) the Everglades Construction Project pursuant to section 373.4592, (2) a water storage, water quality, or other facility pursuant to the Restudy and further acts of Congress authorizing Implementation, (3) an Everglades restoration project unrelated to the Corps Restudy approved by the District and the United States Department of the Interior. "Implementation" is defined as the actual operation of a Project or the need for possession of a field to condition or prepare the Property or the actual operation of a Project.

Talisman Sugar Company assigned its reserved rights to New Hope Sugar Company. Okeelanta Corporation and New Hope Sugar have both executed leases with SFWMD with similar termination dates and provisions.

Of the approximately 13,849.34 acres owned by SFWMD and required for the A-2 FEB, approximately 8,759.23 acres are being farmed by New Hope Sugar Company and approximately 5,000.17 acres are being farmed by Okeelanta Corporation. The approximately 34.23 acres owned by SFWMD required for the FEB Outflow Canal are currently being farmed by the Okeelanta Corporation.

D.7.2 STATE OF FLORIDA LEASE

The proposed FEB Outflow Canal requires approximately 57.02 acres of lands owned by the State of Florida in Section 36, Township 46 South, Range 35 East. The State will provide a perpetual channel easement to SFWMD or will provide fee to the SFWMD through a Supplemental Agreement as set forth in the CERP Master Agreement. The lands will be required in the seventh year after congressional authorization of CEPP and execution of the PPA. The estimated year in which the lands would have to be provided is 2030, which would be the fourteenth year of a new lease. The State of Florida through the Board of Trustees of the Internal Improvement Trust Fund of the State of Florida has leased Sections 24 and 36, Township 46 South, Range 35 East to New Hope South, Inc. The date of the lease is October 20, 1995 with the term ending on January 31, 2016. The State has already agreed to lease this land for another 20 year period when the existing lease expires. The current lease contains a termination provision, which provides:

> Notwithstanding the term specified in the preceding sentence, after the ninth Lease Year (as hereinafter defined) LESSOR may terminate this lease provided that: (1) LESSOR determines that LESSEE has ceased to be impacted as provided in Section 373.4592, Florida Statutes (1994 Supp.); and (2) LESSOR then gives LESSEE two years written notice of its intention to terminate this lease. For purposes of this lease the term "Lease Year" shall mean a period of twelve (12) consecutive months beginning on the date of this lease. If this lease is terminated by LESSOR based on a finding that LESSEE has ceased to be impacted, LESSEE shall be entitled to be compensated for any documented, unamortized planting costs and any unamortized capital costs associated with the lease and incurred prior to notice. No other right of compensation shall exist after expiration or termination of the lease, except that, if after any other termination of this lease, ratoon, stubble or residual crop remaining on the leased premises is harvested or otherwise utilized by LESSOR or any third party, LESSEE shall be entitled to be compensated for any documented, unamortized planting costs and any unamortized capital costs associated with the lease and incurred prior to notice. If LESSOR and LESSEE cannot mutually agree as to the unamortized planting and capital costs, such costs shall be determined by an independent certified public accountant selected by the Florida Institute of Certified Public Accountants. The cost of such

certified public accountant shall be paid equally by LESSEE and LESSOR. In no event will occupation by Lessee extend beyond January 31, 2016.

It is unknown whether this termination provision and the cost associated with the termination will be in the new lease. An incremental real estate cost has been calculated to provide for costs associated with the potential for termination of the lease for the approximately 57.02 acres required for the FEB Outflow Canal.

When this Lease was originally negotiated, SFWMD was contemplating construction of Stormwater Treatment Area 3/4 (STA 3/4) and the lease made provision for the removal of the lands in Section 36 required for the STA 3/4 Canal to the Miami Canal. The provision in the current lease provides:

> 54. SPECIAL PROVISIONS REGARDING PARCEL B: Parcel B is designated to be included in works for a stormwater treatment area (STA) of the Everglades Construction Project as provided in Section 373.4592, F.S. LESSEE may lease Parcel B during the term of this lease until such time as SFWMD requires possession of said parcel for STA construction purposes. The lease shall terminate as to Parcel B upon 2.5 years' written notice to LESSEE by LESSOR that the parcel must be surrendered for STA construction. In such case, the rental amount shall be adjusted on a pro rata basis in accordance with the last mandatory appraisal. LESSEE shall be credited for any advance payment made as to Parcel B. With regard to Parcel B, SFWMD or their authorized agents, representatives, or employees shall have the right, after reasonable notice to LESSEE, of access and investigation purposes associated with STA design.

The SFWMD will request the same provision in the new lease for the lands required for the FEB Outflow Canal; however, it is uncertain whether the provision will be included.

D.8 EXISTING FEDERAL PROJECTS

The Miami Canal (L-25, L-24 and L-23) is part of the original Central and Southern Florida (C&SF) Project. The right-of-way for the Miami Canal varies in width from 250 to 500 feet in the Project Area; all improvements within or filling of the Miami Canal will be conducted within the existing right-of-way owned in fee or perpetual easement by SFWMD. Water Conservation Areas 3A/3B and the L-67 Levees are part of the C&SF project. The adjacent levees and their borrow canals which include the L-30, L-33, L-36, L-38E, and L-38W to the east; L-4, L-5, and L-6 on the north; L-28 on the west; and L-29 and L-31N on the south are also part of the original C&SF project. The interest and estates held by SFWMD are sufficient for the CEPP Project purposes as set forth in paragraph D-11 below. Because these lands were acquired and provided for the prior Federal project (C&SF), SFWMD will not receive credit for these lands for the CEPP Project in accordance with the CERP Master Agreement Article IV. A. which states: "... However, no amount shall be included in project construction costs, no credit shall be afforded, and no reimbursement shall be provided for the value of any lands, easements, rights-of-way, or relocations that have been provided previously as an item of cooperation for another Federal project." More details on land costs and crediting are provided in paragraph D.26 below.

D.9 FEDERALLY OWNED LANDS

There are Federally-owned lands in the project area located underlying the Old Tamiami Trail, which are owned by the United States of America, National Park Service (NPS). The Old Tamiami Trail will be removed. NPS will provide a permit authorizing use of these lands for removal of the Old Tamiami Trail and removal of S-346 metal culvert.

D.10 PROPOSED STANDARD ESTATES

D.10.1 Fee

The fee simple title to (the land described in Schedule A), subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

While is anticipated that only fee title will be required for the A-2 FEB; and fee or perpetual channel easement for the A-2 FEB Canal, the following standard estates may be identified as required during the PED Phase of the Project.

D.10.2 Temporary Access Road Easement

A temporary and assignable easement and right-of-way in, on, over, and across (the land described in Schedule A) for a period not to exceed (PERIOD TO BE DETERMINED) for the location, construction, operation, maintenance, alteration, replacement and use of (an) access road(s) and appurtenances thereto; together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions and other vegetation, structures, or obstacles within the limits of the right-of-way; (reserving however, to the owners, their heirs and assigns, the right to cross over or under the right-of-way as access to their adjoining land at the locations indicated in Schedule B); subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

D.10.3 Channel Improvement Easement

A perpetual and assignable right and easement to construct, operate, and maintain channel improvement works on, over and across (the land described in Schedule A) for the purposes as authorized by the Act of Congress approved (FUTURE WRDA TO BE ENTERED), including the right to clear, cut, fell, remove and dispose of any and all timber, trees, underbrush, buildings, improvements and/or other obstructions therefrom; to excavate: dredge, cut away, and remove any or all of said land and to place thereon dredge or spoil material; and for such other purposes as may be required in connection with said work of improvement; reserving, however, to the owners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements far public roads and highways, public utilities, railroads and pipelines.

D.10.4 Temporary Work Area Easement

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A), for a period not to exceed (PERIOD TO BE DETERMINED), beginning with date possession of the land is granted to the South Florida Water Management District, for use by the South Florida Water Management District and the United States of America, their representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Central Everglades Planning Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

D.10.5 Borrow Area Easement

A temporary easement and right-of-way in, on, over and across (the land described in Schedule A), for a period not to exceed (PERIOD TO BE DETERMINED), beginning with date possession of the land is granted to the South Florida Water Management District, for use by the South Florida Water Management District and the United States of America, their representatives, agents, and contractors as a (borrow area) (work area), including the right to (borrow and/or deposit fill, spoil and waste material thereon) (move, store and remove equipment and supplies, and erect and remove temporary structures on the land and to perform any other work necessary and incident to the construction of the Central Everglades Planning Project, together with the right to trim, cut, fell and remove therefrom all trees, underbrush, obstructions, and any other vegetation, structures, or obstacles within the limits of the right-of-way; reserving, however, to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject, however, to existing easements for public roads and highways, public utilities, railroads and pipelines

D.11 PROPOSED NON-STANDARD ESTATES-ALREADY OWNED BY SFWMD AND ACQUIRED FOR THE CENTRAL AND SOUTHERN FLORIDA PROJECT (C&SF) IN THE WATER CONSERVATION AREAS

D.11.1 Canal and Levee Easements from the State of Florida to SFWMD –owned by SFWMD and acquired and provided for C&SF Project

NOW, THEREFORE, to facilitate Central and Southern Florida Flood Control District in carrying out the purposes for which said district was created, the State of Florida, in the public interest and for the public convenience and welfare, and for the public benefit, have granted and conveyed unto Central and Southern Florida Flood Control District a perpetual easement for the right-of-way for the works of the district, the construction, operation and maintenance of same, over and across the lands hereinafter described, and grants the further right to said District to convey to the United States of America in connection with the District's purposes, the rights herein granted to said district by said Trustees.

D.11.2 Perpetual Easements from Private Parties to SFWMD –owned by SFWMD and acquired and provided for C&SF Project

The right, privilege, use and easement in and to the lands hereinafter described for any and all purposes necessary to the construction, maintenance and operation of any project in the interest of flood control, reclamation, conservation and allied purposes now or that may hereafter be conducted by the grantee herein, its successors or assigns, including the right to permanently or intermittently flood all or any part of the area covered hereby as a result of the said construction, maintenance, or operation, in carrying out the purposes and intents of the statutes of the State of Florida relating to the Central and Southern Florida Flood Control District presently existing or that may be enacted in the future pertaining hereto.

D.11.3 Perpetual Easements from the State of Florida to SFWMD –owned by SFWMD and acquired and provided for C&SF Project

The right, privilege, use and easement in and to the lands hereinafter described for any and all purposes necessary to the construction, maintenance and operation of any project in the interest of flood control, reclamation, conservation and allied purposes now or that may hereafter be conducted by the grantee herein, its successors or assigns, including the right to permanently or intermittently flood all or any part of the area covered hereby as a result of the said construction, maintenance, or operation, in carrying out the purposes and intents of the statutes of the State of Florida relating to the Central and Southern Florida Flood Control District presently existing or that may be enacted in the future pertaining hereto.

D.11.4 Surface Rights from State Board of Education of the State of Florida to SFWMD – owned by SFWMD and acquired and provided for C&SF Project

For the purposes for which the District was created, the surface rights to the lands hereinafter described, including the right to permanently or intermittently flood all or any part of said land within established water conservation areas, and to construct, operate and maintain works of flood control thereon.

D.11.5 Permitted Rights from Department of Interior, National Park Service – to be acquired by SFWMD for Old Tamiami Trail removal

The Department of Interior, National Park Service hereby grants to the South Florida Water Management District an irrevocable right to enter upon the lands hereinafter described at any time within a period of _______ (__) months from the date of this instrument, in order to remove the structures associated with the Old Tamiami Trail or any other type of improvements and to perform construction work of any nature. This permit includes the right of ingress and egress on other lands of the Department of Interior, National Park Service not described below, provided such ingress and egress is necessary and not otherwise conveniently available to the South Florida Water Management District. All tools, equipment, improvements, and other property taken upon and placed upon the land by the South Florida Water Management District shall remain the property of the South Florida Water Management District and may be removed by the South Florida Water Management District at any time within a reasonable period after the expiration of this permit or right-of-entry.

D.12 UNIFORM RELOCATION ASSISTANCE ACT, PL 91-646

The appropriate relocation benefits were included as part of the Talisman Exchange/acquisition agreement for the land in A-2 FEB and therefore these costs were not costed separately. Under PL 91-646, as amended, there are no additional residential relocations and no business relocations associated with the implementation of this Project.

The USACE prepared a General Design Memorandum (GDM) and EIS for MWD to ENP. The overall purpose of the MWD to ENP project is to restore natural hydrologic conditions in ENP, which were altered by the construction of roads, levees and canals. MWD is one of many foundation projects for CERP. The GDM/EIS was completed in 1992 and concluded that the raising of the Osceola Indian Camp to the levels above expected flood levels was determined to be the responsibility of the Department of Interior (DOI) since the camp is within the boundaries of the Everglades National Park Expansion Area.

As a result of the 2009 Omnibus Appropriations Act passed by Congress on March 10, 2009 (Public Law 111–8) Congress directed the National Park Service (NPS) "to immediately evaluate the feasibility of additional bridge length, beyond that to be constructed pursuant to the Modified Water Deliveries (MWD) to Everglades National Park Project (16 U.S.C. SS 410r-S), including a continuous bridge, or additional bridges or some combination thereof, for the Tamiami Trail (U.S. Highway 41) to restore more natural water flow to ENP and Florida Bay and for the purpose of restoring habitat within the Park and the ecological connectivity between the Park and the Water Conservation Areas."

DOI produced the Tamiami Trail Modifications: Next Steps Final Environmental Impact Statement November 2010, with a Record of Decision signed February 11, 2011

DOI selected Alternative 6e as the recommended plan. Alternative 6e includes 5.5 miles of bridges and the remaining highway raised to an elevation of 13.13 feet. The bridge configurations include: (1) a 2.60 mile bridge located between the Osceola Camp and the Airboat Association, (2) a 0.4 mile bridge located between the Airboat Association and the Tiger Tail Camp, (3) a 1.8 mile bridge located between the Tiger Tail Camp and the existing one-mile bridge, and (4) a 0.7 mile bridge located between the existing 1-mile bridge and the S-334 structure. The bridges would create a conveyance opening through Tamiami Trail by removing the sections of the existing highway and embankment. The bridges would be constructed approximately 50 feet south of the existing roadway ROW to maintain motor vehicle traffic during bridge construction and avoid impacts to infrastructure north of the project area. The remaining highway embankment would be reconstructed to raise the crown elevation to 13.13 feet.

Alternative 6e of the Tamiami Trail Modifications: Next Steps would require the Osceola Camp ground to be elevated to 12.5, with non-residential finished floor to 12.83 and residential finished floor to 13.17 feet NGVD. DOI will be responsible as part of the implementation of the Tamiami Trail Modifications: Next Steps to raise the Osceola Camp to the levels above expected flood levels.

D.13 NAVIGATIONAL SERVITUDE AND OTHER LANDS

The navigation servitude is not applicable to the Project.

D.14 ACCESS TO PROJECT AREAS

Adequate access to most of the project is available as set forth below. The only area where additional access may be required is to the A-2 FEB. This would be provided across other SFWMD lands and a temporary access easement has been valued in Table D-5 below.

NORTH OF THE REDLINE–FLOW EQUALIZATION BASIN -Access to this area is from US 27 utilizing the A-1 FEB access road that connects the northeast corner of the A-1 FEB to the recreation area by culverts. There is an existing east-west road "Central Agricultural Road" that could provide direct access to the A-2 FEB footprint, but this is projected to be degraded for the A-1 FEB project. If new haul roads are needed, they will have to divert from the nearest public road and will be limerock displacing the underlying peat materials.

SOUTH OF THE REDLINE–DIVERSION & CONVEYANCE-Access to this project area is primarily from US 27 along the existing L-5 northern access road westward to existing S-8, L-4 and Miami Canal. Access to L-6 is from US 27 along the existing S-7 complex and L-6 areas. Due to the remote nature of the Miami Canal, site access limitations could be a significant consideration for the CEPP project construction.

BLUELINE/GREENLINE/YELLOWLINE–DISTRIBUTION, CONVEYANCE & SEEPAGE MANAGEMENT-Access to the project site will be from US 41 (Tamiami Trail) by S-333 along L-67A, L-67C, L-29 and L-31N levees. Northern access into WCA 3B is from S-9 Pump Station or by Holliday Camp along the L67-A canal.

D.15 BORROW AND DISPOSAL SITES

NORTH OF THE REDLINE–FLOW EQUALIZATION BASIN-Cut and fill quantities will be completed during PED phase to balance the design as much as possible. Peat material will be utilized in backfilling the Miami Canal. Unsuitable material will be hauled to a certified land fill. If enough material is not available on site from the canal construction of C-624, C-624E, C-625E, C-625W, and C-626 to provide suitable levee construction material for L-624 and L-625, material will be brought from an approved commercial source for construction of the remainder of the levees.

SOUTH OF THE REDLINE–DIVERSION & CONVEYANCE-Cut and fill quantities will be completed during PED phase to balance the design as much as possible. Material from the construction of canal, from Miami Canal to L-4 and the L-5 improvements, not suitable to fill in the Miami Canal will be hauled to a certified land fill. Material from the L-28 levee will be utilized to fill the L-28 canal.

BLUELINE/GREENLINE/YELLOWLINE–DISTRIBUTION, CONVEYANCE & SEEPAGE MANAGEMENT-L-67 extension (ext.) and Old Tamiami Trail removal will place the material in the adjacent canals. L-67C material may be used in the construction of L-67D or may be stockpiled adjacent to the L-67C canal. L-67D will be completed with material from onsite degrades within the vicinity of the project area first, then from L-31N Spoil Mound, L-29 removal or from an approved commercial source. All peat material will be placed in either L-67 Ext. or Old Tamiami Trail canal. Unsuitable material will be hauled to a certified land fill.

It is the intent of the project to utilize all suitable materials for the project works, as described in Appendix A section A.5.1.4. The reference to offsite borrow as a source to obtain material is standard and not anticipated to be enacted. Therefore in line with the costing assumption of sufficient materials to construct features, there were no offsite borrow sources identified. They will not be identified in the PIR nor Appendix A. The disposal of unsuitable material offsite was desired as there are limited areas within the project footprint to store unsuitable material due to the footprint of the A-2 FEB of 13 features and recreation facilities. This was the agreed upon solution from ecological and construction communities.

D.16 TEMPORARY WORK AREAS

Lands within the Project footprint will be used for temporary work areas and for borrow material, as required. The estates, fee and perpetual easements, owned by SFWMD provide sufficient interest to allow for temporary work areas and borrow areas. Use of these land as temporary work areas and borrow areas are consistent with the rights owned by SFWMD.

D.17 INDUCED FLOODING

On December 11, 2000 the Water Resources Development Act of 2000 (WRDA 2000) was signed into law by the President of the United States (Public Law No. 106-541, of the 106th Congress). Section 601(h)(5) contains a Savings Clause that provides protection for existing legal sources of water that will be eliminated or transferred due to project implementation and no significant and adverse reduction in the level of service for flood protection that was in existence on the date of enactment and in accordance with applicable law.

The Programmatic Regulations for the Everglades (33 CFR §§ 385.5 and 385.35-37) require a programmatic guidance memorandum describing procedures for evaluating project effects on existing legal sources of water, and a determination of the pre-CERP baseline conditions, and procedures for evaluating project effects on "levels of service for flood protection ... in accordance with applicable law" existing on date of enactment of WRDA 2000.

To ensure the levels of service of flood protection will not be diminished by this Project, preliminary hydrologic and hydraulic analysis was performed using surface water and groundwater modeling. The results of the preliminary analysis indicate that the Project is not expected to result in increases in stages in canal systems or increases in flooding of private lands adjacent to the Project site; however, additional analysis will be undertaken during detailed design work to further identify Project features and operations necessary to ensure that the level of service of flood protection in areas adjacent to the Project site is maintained.

The purpose of CEPP is to increase flows in WCA 3A/3B and while this will be accomplished, no additional interests in lands in WCA 3A/3B will be required to allow the increase in flows. The estates held by the SFWMD for the C&SF project are sufficient to allow for increased flows. See paragraph D.11 above. A takings analysis determined that no lands outside the project boundaries will be affected by the Project. It was legally determined that SFWMD owns sufficient interests in the lands within the Water Conservation Areas that will have increased flows to allow the increase water elevations.

D.18 MINERAL AND TIMBER ACTIVITIES

There are no known present or anticipated mineral or subsurface mineral extraction activities within the land required for the CEPP Project that may affect construction, operation, or maintenance of the Project. There are currently no timber-harvesting activities. Since the basis for the construction of the Project is to restore the ecosystem within the CEPP Project Area, such activities will be restricted or prohibited. Under Florida Statutes 704.105, most of the rights of entry to conduct mining operations or remove any outstanding mineral interests have been extinguished. For those mineral interests that have not been extinguished by the Florida Statute set forth below, the REP will address the potential that no State or Federal regulatory permits would be issued to permit the mining. There are no outstanding rights reserved to remove timber from easement lands owned by SFWMD or the State.

D.19 NON-FEDERAL AUTHORITY TO PARTICIPATE IN THE PROJECT

The SFWMD was created by virtue of Florida Statutes, Chapter 373, Section 373.069 to further the State policy of flood damage prevention, preserve natural resources of the State including fish and wildlife and to assist in maintaining the navigability of rivers and harbors. (There are other enumerated purposes but they are not directly applicable to this Project.) The SFWMD is specifically empowered to

> *Cooperate with the United States in the manner provided by Congress for flood control, reclamation, conservation, and allied purposes in protecting the inhabitants, the land, and other property within the district from the effects of a surplus or a deficiency of water when the same may be beneficial to the public health, welfare, safety, and utility. (Section 373.103)*

To carry out the above purposes, the SFWMD is empowered to

> *...hold, control, and acquire by donation, lease, or purchase, or to condemn any land, public or private, needed for rights-of-way or other purposes, and may remove any building or other obstruction necessary for the construction, maintenance, and operation of the works; and to hold and have full control over the works and rights-of-way of the district.*

The term works of the district is defined by Section 373.019 to be

> *...those projects and works, including, but not limited to, structures, impoundments, wells, and other water courses, together with the appurtenant facilities and accompanying lands, which have been officially adopted by the governing board of the district as works of the district.*

Section 373.139 specifically empowers the SFWMD

> *...to acquire fee title to real property and easements therein by purchase, gift, devise, lease, eminent domain, or otherwise for flood control, water storage, water management, and*

preservation of wetlands, streams and lakes, except that eminent domain powers which may be used only for acquiring real property for flood control and water storage.

SFWMD has authority to act as the local sponsor for the CERP project pursuant to Florida Statutes Section 373.1501.

D.20 ZONING ORDINANCES

Preliminary investigation indicates that no enactments of zoning ordinances are proposed in lieu of, or to facilitate, acquisition in connection with the Project.

D.21 ACQUISITION SEQUENCING

Based upon the project implementation and sequencing information contained in Section 6.0 of the Project Implementation Report and after Congressional authorization of Project components, all construction activities will be on lands owned by the SFWMD and previously acquired for the C&SF project. A specific land acquisition schedule is premature. After Congressional authorization of the Project components, lands will be certified or recertified in the order of sequence below:

1. Portions of L-6 right-of-way; S-8 lands; and portions L-4 right-of-way.
2. Portions of L-5 right-of-way; and portions of Miami Canal right-of-way.
3. Portions of L-67C right-of-way; S-356 and adjacent lands; and S-333 and adjacent lands.
4. Portions of L-29 right-of-way; portions of L-67A and L-67C rights-of-way; and lands required for the Blue Shanty Levee.
5. Portions of the L-31N right-of-way.
6. The SFWMD will be required to provide the lands for the A-2 FEB and FEB Outflow Canal. The SFWMD already owns all of the lands required for construction of the A-2 FEB and FEB Outflow Canal, except for approximately 57.02 acres required for the FEB Outflow Canal, which is owned by the State of Florida; and the SFWMD will obtain and certify this remaining interest.
7. The lands underlying the Old Tamiami Trail, which are owned by the United States of America, National Park Service, will be required. These lands will be provided to SFWMD by Permit from the National Park Service.

D.22 FACILITY AND UTILITY RELOCATIONS

The utilities or facilities identified below are located within lands owned by the SFWMD or the U.S. Park Service. The SFWMD has issued permits that require removal or relocation at the cost of the permittee. The U.S. National Park Service has issued leases that require removal or relocation at the cost of the lessee. In the Real Estate MCACES Cost Estimate, Non-Federal and Federal administrative costs for termination of permits and termination of leases were estimated.

Preliminary Attorney's Opinions of Compensability have been completed and used for the purpose of completing this section. Final Attorney's Opinions of Compensability will be completed as required by Engineering Regulation 405-1-12, chapter 12, paragraph 12-22 prior to completion of the Project Partnership Agreement or 100 percent design of the project.

NORTH OF THE REDLINE–FLOW EQUALIZATION BASIN-Utility Relocations-Florida Power and Light lines will have to be relocated or abandoned from the center of the detention area. This property is owned in fee by the SFWMD and Florida Power and Light has a SFWMD permit for the powerline.

SOUTH OF THE REDLINE–DIVERSION & CONVEYANCE-There do not appear to be any utility relocations required in this area. Utility impacts, including potential relocations, will also need further assessment during the project design phase.

BLUELINE/GREENLINE/YELLOWLINE–DISTRIBUTION, CONVEYANCE & SEEPAGE MANAGEMENT-Utility Relocations-Florida Power and Light, and Quest Communications will have to be relocated where the L-29 is being removed. Both Florida Power and Light and Quest Communication have SFWMD permits. The removal of Old Tamiami Trail will require relocation of the Florida Power and Light line. Florida Power and Light has a easement from the U.S. National Park Service.

ANY CONCLUSION OR CATEGORIZATION CONTAINED IN THIS REPORT THAT AN ITEM IS A UTILITY OR FACILITY RELOCATION TO BE PERFORMED BY THE NON-FEDERAL SPONSOR AS PART OF ITS LERRD RESPONSIBILITIES IS PRELIMINARY ONLY. THE GOVERNMENT WILL MAKE A FINAL DETERMINATION OF THE RELOCATIONS NECESSARY FOR THE CONSTRUCTION, OPERATION, OR MAINTENANCE OF THE PROJECT AFTER FURTHER ANALYSIS AND COMPLETION AND APPROVAL OF FINAL ATTORNEY'S OPINIONS OF COMPENSABILITY FOR EACH OF THE IMPACTED UTILITIES AND FACILITIES."

D.23 HAZARDOUS TOXIC OR RADIOLOGICAL WASTE (HTRW)

The A-2 FEB is a 14,000 acre parcel of land. The land is presently dry and it is proposed to be inundated with water. SFWMD completed a draft Summary Environmental Report for the A-2 FEB, dated 21 August 2012. The Summary Environmental Report documents that all known point sources on the property have been addressed. The Florida Department of Environmental Protection (FDEP) has issued Site Rehabilitation Completion Orders (SRCO) for all known point sources within the project boundary. A copy of this report is included in **Annex F**.

To address the lack of sampling results for the cultivated areas of the A-2 parcel, the SFWMD conducted limited soil sampling in the winter/spring of 2013. With agreement of the USFWS, the sampling density was set at 10 percent of the 50 acre grids rather than the typical 30 to 50 percent typically specified per the *Protocol for Assessment, Remediation, and Post-Remediation Monitoring for Environmental Contamination on Everglades Restoration Projects* (the ERP Protocol), dated March 13, 2008 (A copy of this protocol is in **Annex F**). SFWMD analyzed 30 composite samples from the 14,000 acre site for pesticides, herbicides, total organic carbon and metals following a stratified random approach. The laboratory results indicate that some of the site soils have residual arsenic, barium, cadmium, chromium, copper, mercury, selenium, 2-4-D, atrazine, metribuzin, phorate, and dieldrin. The USFWS and FDEP have preliminarily determined that the residual agricultural chemicals found on the A-2 FEB lands do not present a risk to protected resources. Based on the results of the 2013 soil testing, the USFWS and FDEP are recommending that during the initial operations of the FEB, the SFWMD perform testing of water for several contaminants (2,4, D, atrazine, metribuzin, phorate, dieldrin, chromium, mercury, selenium, copper) as well as testing of periphyton and apple snails for copper. The FDEP also recommended the development of a soil management plan to address the fate of arsenic impacted soils during construction as well as the same start-up operations sampling program as provided by the USFWS. The FDEP and the USFWS both recommended that agrochemical best management practices be instituted during the continued cultivation of the lands.

The A-2 FEB lands will remain in agricultural production for several years until the A-2 project feature is set for construction at which time the agricultural leases will be terminated. Once farming has ceased on the project lands, an Exit Assessment will be performed to determine the presence of any new potential sources of HTRW since the completion of the previous Phase II ESA, and to verify the concentration of contaminants in the cultivated areas at selected locations. The results of these audits will be provided to the FDEP and USFWS for their review, comment, and concurrence regarding the need for remedial actions. The assessment of the project in relation to the CERP Residual Agricultural policy is included in **Appendix C.2.2**. Remediation of HTRW contamination is the responsibility of the SFWMD, the non-Federal Sponsor and is not a creditable cost to the project.

D.24 PROJECT SUPPORT

There is no known or anticipated opposition to the project by landowners in the project area or any known or anticipated landowner concerns related issues that could impact the acquisition process.

D.25 FEDERAL AGRICULTURE IMPROVEMENT AND REFORM ACT OF 1996 (FARM BILL)

On April 4, 1996, Congress enacted the Federal Agriculture Improvement and Reform Act of 1996 (Public Law 104-127, 110 Stat. 1022). The provisions of Section 390 of the Federal Agriculture Improvement and Reform Act of 1996, Section 390 gave the Secretary of Interior broad discretion in the expenditure of the initial $200,000,000 and more limited discretion in the expenditure of the additional $100,000,000 to be generated by the sale of excess or surplus Federal property. The Secretary of Interior could expend all the funds without assistance or could provide the funds to the Army Corps of Engineers, the State of Florida, or the South Florida Water Management District on such terms and conditions as was determined necessary.

On October 3, 1996, a Framework Agreement (Agreement) was executed by the United States Department of Interior (DOI), the United States Department of the Army (Army), the State of Florida, Department of Environmental Protection (FDEP) and the South Florida Water Management District (SFWMD). The Agreement was developed to provide a framework and procedures for the Secretary of Interior to provide Section 390 funds to the other parties for Everglades ecosystem restoration for the acquisition of real property or the construction of features that were intended to become part of existing or future Army projects. The Agreement specifically recognizes that Section 390 provided "the Secretary of the Interior with discretion to determine the use of Section 390 funds for restoration purposes and with the responsibility to ensure that Section 390 funds are used for restoration purposes." Article I states that "except as otherwise provided by law or agreed to by the Secretary of Interior, all Section 390 funds expended will be matched by non-Federal funds on a dollar-for-dollar basis." This Article also states: "Section 390 funds disbursed for the acquisition of real property or the construction of features shall count as Federal funds for cost sharing purposes for Army projects. Funds provided by the non-Federal parties to match Federal funds provided under Section 390 will be treated as non-Federal funds for cost-sharing purposes for Army projects.

The value of real estate acquired pursuant to this Article shall be the acquisition cost of such real property for credit purposes under applicable cost-sharing principles."

D.26 LAND VALUATION AND CREDITING

D.26.1 Land Valuation and Crediting Guidance

D.26.1.1 CECW-SAD Memorandum dated July 30, 2009; SUBJECT: CERP Land Valuation and Crediting

In accordance with CECW-SAD memorandum dated July 30, 2009 signed by the Director of Civil Works, U.S. Army Corps of Engineers the current guidance for the CERP, Land Valuation and Crediting as set forth in the referenced memorandum is as follows:

1. Background. The Comprehensive Everglades Restoration Plan (CERP) land valuation and crediting policy previously approved by the Assistant Secretary of the Army (Civil Works) (ASA(CW)) is based on actual costs. The South Florida Water Management District (SFWMD) requested application of the national U.S. Army Corps of Engineers (USACE) land crediting principles to future CERP projects and the ASA(CW) has agreed to SFWMD's request. The purpose of this memorandum is to provide general guidance on several additional issues as outlined in paragraph 2 below as well as to provide guidance on an issue related to credit for incidental acquisition costs as outlined in paragraph 3 below.

2. Land Valuation Issues for Lands Acquired Pre-PPA.

a. Consistent with long-standing USACE practice, and as supported by the unique land credit provision for CERP contained in Section 601 (e)(5)(A) of WRDA 2000, tracts acquired by the SFWMD that are acquired and provided in furtherance of a CERP project should be valued and credited as individual tracts regardless of whether the acquisition was prior to or after execution of the PPA for that project. This general principle would not apply where the SFWMD acquired contiguous tracts that are required for a CERP project but it acquired such tracts prior to the PPA for a reason and use other than for implementation of the CERP project. A determination that a tract was acquired "in furtherance of a CERP project" should be supported by documentation existing at the time of acquisition.

b. The unique statutory land credit provision for CERP projects is clear that the non-Federal sponsor will be afforded credit for the value of lands, or interests in lands, that it provides in accordance with a PIR "regardless of the date of acquisition." *See* Section 601 (e)(5)(A) of WRDA 2000. To effectuate the clear intent of Congress reflected in this credit provision, land use restrictions imposed in furtherance of a CERP project after acquisition of a tract by the SFWMD should not be considered in valuing that tract for crediting purposes.

c. For the same reasons as expressed in subparagraph b. above, demolition of improvements after a tract was acquired in furtherance of a CERP project should not change the approach to value from that applicable at the time of acquisition. Accordingly, the tract should be valued for crediting purposes as it was improved when acquired by the SFWMD. To accomplish this result, the contributory value of the improvements, as of the date of the SFWMD's acquisition, should be added to the market value of the land on the date it is provided for the project as appraised in accordance with its highest and best use on the date of acquisition.

3. Incidental Costs. The SFWMD has requested that it be afforded credit for the costs incurred by other non-Federal governmental entities incidental to acquisition of project lands by such entities. The wording of Section 601 (e)(5)(A) is clear that credit may be afforded only for "incidental costs for land acquired by a non-Federal sponsor." Credit may be afforded for traditional incidental acquisition costs that are incurred by SFWMD (such as appraisal costs, mapping costs, or relocation assistance benefits) as well as costs actually incurred by SFWMD in obtaining the required real property rights from other non-Federal governmental entities. However, to be eligible for credit to be afforded to the SFWMD for incidental acquisition costs, SFWMD must have, in fact, incurred those costs.

D.26.1.2 CERP Master Agreement Between the Department of the Army and the South Florida Water Management District for Cooperation in Constructing and Operating, Maintaining, Repairing, Replacing and Rehabilitating Authorized Projects under the Comprehensive Everglades Restoration Plan, dated August 13, 2009

In accordance with the terms and conditions of Article IV, paragraph A. no credit shall be afforded for those lands or real estate interests provided by the SFWMD as an item of local cooperation for another Federal project.

D.26.2 Talisman Exchange-SFWMD Lands

In March 1999, Department of Interior (DOI), SFWMD, The Nature Conservancy, United States Sugar Corporation, Okeelanta Corporation, South Florida Industries, Inc., Florida Crystals Corporation, Sugar Cane Growers Cooperative of Florida, Talisman Sugar Company and the St. Joe Company executed an "Exchange and Purchase and Sale Agreement" for the purpose of effecting transactions in which landowners in the EAA would sell lands to, or exchange lands with, other such landowners and the SFWMD so that the SFWMD would own contiguous parcels of land in the southern portion of the EAA for the purposes of Everglades restoration. The end result of the purchase and exchange was that the SFWMD obtained over 45,000 acres of land in the southern Everglades Agricultural Area. The DOI provided $99,434,312 in Federal Farm Bill funds for the acquisition of these lands and the SFWMD provided $12,939,906. As part of the Talisman Lands Exchange transaction, part of SFWMD funds that were contributed totaling $9,756,881.31 was to buy out the farming reservation held by the St. Joe Paper Company. As per the terms of the Cooperation Agreement between the SFWMD and the DOI, SFWMD elected to apply program income revenue towards the repayment of its contribution. SFWMD has received and applied program income revenue towards its contribution and land management costs which has or will cover all of the $9,756,881.31. SFWMD will continue to provide financial reports to the DOI until such time as program income revenue is no longer received for the grant lands. As part of the Talisman Exchange, DOI had the properties appraised, reviewed and approved the appraisals, and was instrumental in negotiating the Exchange and Purchase and Sale Agreement, as well as executing the agreement. Because DOI funds were expended for the purchase of the lands required for the majority of the A-2 FEB and 34.23 acres of the FEB Outflow Canal, the USACE will accept the land costs paid by both DOI and SFWMD and these will be credited to either the Federal government or the SFWMD without review and approval of appraisals or other documentation. Pursuant to both Section 601 (E)(3) of WRDA 2000, the Framework Agreement, and Article II., paragraph M.2., the DOI funds will be credited to the Federal share of the Project. As set forth in the Framework Agreement, the credit is the actual acquisition costs of the lands required for the Project.

In total, Compartment A, located between the Miami and North New River Canals, consists of 31,493.72 acres, with 30,507.42 acres having been acquired in the Talisman exchange/acquisition. The project footprint of the A-2 FEB and structures requires approximately 13,839.44 acres, which were acquired in the Talisman exchange. The FEB Outflow Canal requires approximately 34.23 acres in lands west of Compartment A, which were acquired in the Talisman exchange. The DOI contributed approximately $30,220,406 for the acquisition of the lands in the A-2 FEB and approximately $78,801 to the acquisition of the 34.23 acres required for the FEB Outflow Canal. Additionally, DOI contributed approximately $163,750 for a leasehold buyout. These amounts will be credited to the Federal share of the project cost. SFWMD contribution toward the acquisition of the A-2 FEB, which was not repaid by program income, totals approximately $1,366,352. SFWMD contribution toward the acquisition of the approximately 34.23 acres required for the FEB Outflow Canal, which was not repaid by program income, totals approximately $10,246. These amounts will be credited to the non-Federal share of the project cost. The SFWMD holds fee title to these lands.

D.26.3 Other SFWMD Lands Required for A-2 FEB

SFWMD acquired approximately 9.90 acres within the A-2 FEB with State funds. These lands were valued at $12,500 per acre for a total of $123,750. In accordance with Article IV, paragraph D.1.a. of the Master Agreement, the credit for lands acquired prior to the PPA shall be the fair market value of such real property interests as of the date the Non-Federal Sponsor provides the Government with authorization for entry thereto for construction.

D.26.4 State of Florida Lands

The State of Florida owns fee to that portion of Section 36, Township 46 South, Range 35 East where the remaining portion of the proposed FEB Outflow Canal from the Miami Canal to the A-2 FEB will be constructed, consisting of approximately 57.02 acres. These lands will be acquired by SFWMD, either through direct acquisition from the State or by Supplemental Agreement with the State, from the State prior to construction of the FEB Outflow Canal. If the lands are acquired prior to the execution of the PPA, the credit will be the fair market value as of the date the Non-Federal Sponsor provides the Government with authorization for entry thereto for construction. As set forth in Article IV.D.1. of the Master Agreement for the Central Everglades Restoration Project, if these lands are acquired after execution of the PPA; SFWMD will receive the fair market value of such real property interests at the time the interests are acquired. The value of these lands was estimated at $12,500 per acre for a total of $712,750.

D.26.5 WCA 3A/3B Lands

SFWMD owns a variety of different interests in WCA 3A/3B which were previously acquired and provided as an item of local cooperation for the original C&SF Project. SFWMD owns sufficient interests in these lands for the construction of CEPP features. Where SFWMD owns a perpetual easement, either the State of Florida or private parties own the underlying fee title. SFWMD will not receive credit for the provision of these lands unless a greater interest is required.

D.26.6 L-31N Lands

SFWMD owns fee title to the lands required along the L-31N which were previously acquired and provided as an item of local cooperation for the original C&SF Project. SFWMD will not receive credit for the provision of these lands.

D.27 BASELINE COST ESTIMATES AND MCACES COST ESTIMATES

Real estate cost estimates are based on the actual SFWMD acquisition costs and administrative costs provided by SFWMD and approved by Department of Interior and the estimated value of the State lands. **Table D-5** provides the Baseline Cost Estimate for Real Estate costs and Table D-6 provides the current MCACES cost estimate.

In the Water Conservation Areas, no interest was valued because SAJ Office of Counsel and SFWMD Office of Counsel both opined that in almost all instances, the easement interests and estates held by the SFWMD or the fee held by the SFWMD and both acquired and provided for the prior Federal project, Central and Southern Florida Flood Control Project, were sufficient for all CEPP purposes. Depending on the final location of certain project features determined during PED, there may be an instance that the current interests and estates held by SFWMD may have to be upgraded at a very minimal cost to the project. These potential costs were included in the Incremental Real Estate Costs in the Draft PIR, but have been included in the Real Estate costs below as a separate line item under Fee-Potential Upgrade of SFWMD lands from Perpetual Flowage Easement in WCA.

D.27.1 Administrative Costs

Non-Federal Administrative costs in the estimated amount of $350,000 for utility relocations are accounted for in Tables D-5 and D-6 below for the following: (1) for costs associated with termination of SFWMD permits for Florida Power and Light and Quest Communications located where the L-29 is being removed; (2) for costs associated with termination of permit for the abandonment of the Florida Power and Light lines from the center of the A-2 FEB area; and (3) for costs associated with coordination with Department of Interior on the termination of the easement to Florida Power and Light for the removal and relocation of the power line during removal of Old Tamiami Trail.

Future Non-Federal Administrative Costs in the estimated amount of $980,000 are accounted for in Tables D-5 and D-6 below for the following:. (1) $200,000 for Project Planning purposes; (2) $320,000 for future acquisitions; (3) $370,000 for future appraisals; (4) $70,000 for temporary permits/licenses/rights-of-entry; and (5) $20,000 for damage claims.

Future Federal Administrative costs in the estimated amount of $500,000 are accounted for in Tables D-5 and D-6 below for the following: (1) $310,000 for Project Planning purposes; (2) $30,000 for review of future acquisitions; (3) $65,000 for review of future appraisals; (4) $15,000 for review of temporary permits/licenses/rights-of-entry; (5) $35,000 for review of the Project Partnership Agreement; and (6) $45,000 for review and coordination of utility relocations.

In the acquisition of the Talisman property, the Department of Interior contributed $163,750 toward SFWMD administrative expenses which will be credited to the Federal Government. SFWMD expended $501,061 in State funds on administrative costs associated with the acquisition of the Talisman lands which will be credited to the Non-Federal (SFWMD) sponsor,

D.27.2 Risk Register

The risk register is a tool being used in the Pilot Planning Program as a means to identify, discuss and document issues early in the process. A risk register was developed by the study team to identify significant risks attributed to the shortened study period and to project success. In addition, a Cost and Schedule Risk Analysis was conducted specific to the project costs and schedule, that is separate from the study risk register and that results in contingency values that are applied to the project costs to set a total project cost. The risk analysis process for this study is intended to determine the probability of various cost outcomes and quantify the required contingency needed in the cost estimate to achieve the desired level of cost confidence. Two cost risk workshops were held to begin the process of Cost and Schedule Risk Analysis. The entire PDT participated in a risk analysis brainstorming session to identify risks associated with the recommended plan. The risks were listed in the risk register, which is a tool commonly used in project planning and risk analysis, and evaluated by the PDT. Assumptions were made as to the likelihood and impact of each risk item, as well as the probability of occurrence and magnitude of the impact if it were to occur. Separate risk models are also being developed for the initial construction and other co-main events using the Oracle Crystal Ball Risk Analysis software using the Monte Carlo Model in order to develop contingencies to apply to the project cost. The models were structured based on the CWWBS for the project and provide a contingency for each of the feature codes. The risk uncertainty for real estate was low. A contingency of 44% was determined to be applicable to cost not expended. For real estate, the contingency was applied on only $2,987,000 which included the following costs:
Fee-SFWMD acquired from Private Owner-$123,750
Fee-FEB Outflow Canal From the A-2 FEB West to the Miami Canal-TIIF Owned land.-$712,750.
Fee-Potential upgrade of title to lands with existing perpetual easements-$20,000
Temporary Access Easements-$150,000
Perpetual and Temporary Easements on Airboat Lands-$500,000
Future Federal Administrative costs-$500,000.
Future Non-Federal Administrative Costs-$980,500.

Total Contingency applied is $1,314,000

Table D-5: Baseline Cost Estimate

PROJECT: CENTRAL EVERGLADES PLANNING PROJECT						
DATE: February 2014						
LANDS AND DAMAGES:						
ESTATE	**PARCELS**	**ACRES**	**LAND COST**		**FEDERAL**	**SFWMD**
Fee-GrantT Federal Cost Shared-Acquired-DOI FARM BILL- A-2 FEB	7	13,839.44	$31,586,758		$30,220,406	$1,366,352
Fee-SFWMD Acquired from Private Party-A-2 FEB	1	9.9	$123,750			$123,750
Fee-FEB Outflow Canal from A-2 FEB West to Miami Canal-TIIF Owned	1	57.02	$712,750		$0	$712,750
Fee-FEB Outflow Canal from A-2 FEB West to Miami Canal-Federal Cost Shared-DOI FARM BILL	1	34.23	$89,047		$78,801	$10,246
Fee-Potential Upgrade of SFWMD lands from Perpetual Flowage Easement in WCA	10	400	$20,000			$20,000
Temporary Access Easement	2	40	$150,000			$150,000
Perpetual and Occasional Flowage Easements on Airboat Association lands	1	5	$500,000			$500,000
Fee-SFWMD-Acquired and Provided for Original C&SF PROJECT	733	134,280.95	$0			$0
Pepetual Flowage Easement owned by SFWMD- with Fee owned by State Acquired and Provided by SFWMD for Original C&SF PROJECT	525	300,343.52	$0			$0
Perpetual Flowage Easement owned by SFWMD- with Fee owned by Private PartiesS- Acquired and Provided by SFWMD for Original C&SF PROJECT	311	70,612.53	$0			$0
Perpetual Canal Easement owned by SFWMD- with Fee owned by STATE- Acquired and Provided by SFWMD for Original C&SF PROJECT	33	11,598.84	$0			$0
Surface Flowage Rights- Flowage Easement with Fee owned by STATE- Acquired and Provided by SFWMD for Original C&SF PROJECT	113	73,360.00	$0			$0
Fee for L-31N Lands Acquired and Provided by SFWMD for Original C&SF PROJECT	1	325.00	$0			$0
SUBTOTAL	1739	604,581.43	$33,182,305		$30,299,207	$2,883,098
IMPROVEMENTS	0		$0			$0
SEVERANCE:& MINERALS	0		$0			
TOTAL LANDS AND DAMAGES			**$33,182,305**		$30,299,207	$2,883,098
ACQ/ADMIN						
FUTURE FEDERAL			$500,000		$500,000	
FUTURE NON-FEDERAL			$980,500			$980,500
PRIOR FEDERAL-FARM BILL			$163,750		$163,750	$0
PRIOR NON-FEDERAL			$501,061			$501,061
PL 91-646 STATE			$0			$0
SUBTOTAL			$35,327,616		$30,962,957	$4,364,569
Contingency of 44% on $2,987,000			$1,314,000		$220,000	$1,094,280
TOTAL ESTIMATED RE COST			**$36.641,616**		**$31,182,957**	**$5,458,939**
TOTAL ESTIMATED RE COSTS (RD)			**$37,000,000**		**$31,000,000**	**$6,000,000**

Table D-6: MCACES Cost Estimate for Real Estate Costs

PROJECT: CENTRAL EVERGLADES PLANNING PROJECT					
DATE: **February 2014**					
	LANDS AND DAMAGES			FEDERAL	SFWMD
01AA	PROJECT PLANNING	BY GOVT	$310,000	$310,000	
		BY LS	$200,000		$200,000
01B--	ACQUISITIONS				
01B20	BY LOCAL SPONSOR (LS)-FUTURE		$320,500		$320,500
	BY LS-DOI FARM BILL		$163,750	$163,750	$0
	BY LS -PRIOR		$501,061		$501,061
01B40	REVIEW OF LS		$75,000	$75,000	
01C--	CONDEMNATIONS				
01C20	BY LS		$0		
01C40	REVIEW OF LS		$0		
01E--	APPRAISALS				
010E30	BY LS-FUTURE		$370,000		$370,000
010E50	REVIEW OF LS		$65,000	$65,000	
01F--	PL 91-646 ASSISTANCE				
01F20	BY LS		$0		
01F40	REVIEW OF LS		$0	$0	
01G--	TEMPORARY PERMITS /LICENCES/RIGHTS-OF-ENTRY				
01G20	BY LS		$70,000		$70,000
01G40	REVIEW OF LS		$15,000	$15,000	
01G60	DAMAGE CLAIMS		$20,000		$20,000
01M00	PROJECTED RELATED ADMINISTRATION				
	REAL ESTATE REVIEW OF PCA		$35,000	$35,000	
01R--	REAL ESTATE PAYMENTS				
01R1	LAND PAYMENTS				
01R1B	BY LS-STATE		$123,750		$123,750
	BY LS-FARM BILL		$31,675,805	$30,299,207	$1,376,598
	BY LS-FUTURE		$1,382,750	$0	$1,382,750
01R2	PL 91-646 ASSISTANCE PAYMENTS				
01R2B	BY LS-STATE		$0		$0
TOTAL REAL ESTATE COST W/O CONTINGENCY			$35,327,616	$30,962,957	$4,364,659
Contingency of 44% on $2,987,0000			$1,314,000	$220,000	$1,094,280
TOTAL PROJECT REAL ESTATE COST			**$36,641,616**	**$31,182,957**	**$5,458,939**
TOTAL PROJECT REAL ESTATE COST (RD)			**$37,000,000**	**$31,000,000**	**$6,000,000**

D.28 PROJECT MAPS

Figure D-7 is the SFWMD land acquisition map for the A-2 FEB and FEB Outflow Canal. **Figure D-8** is a map of the WCA 3A/3B affected by the Project.

Figure D-6: SFWMD FEB AND FEB OUTFLOW CANAL OWNERSHIP MAP

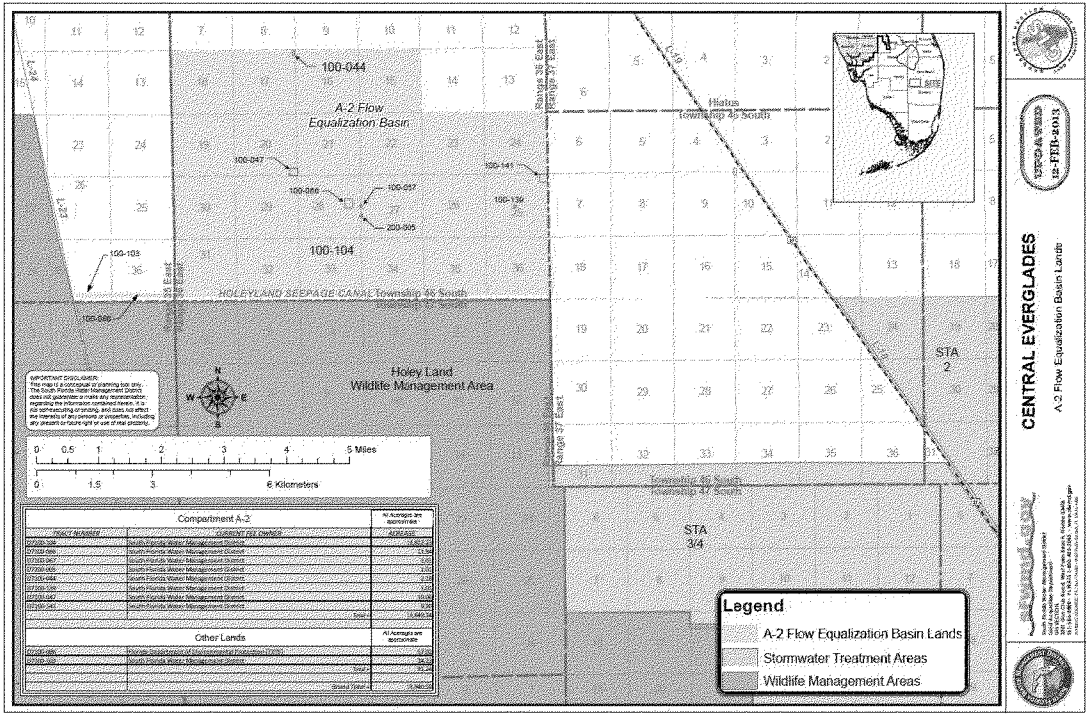


Figure D-7: WATER CONSERVATION AREA 3A/3B

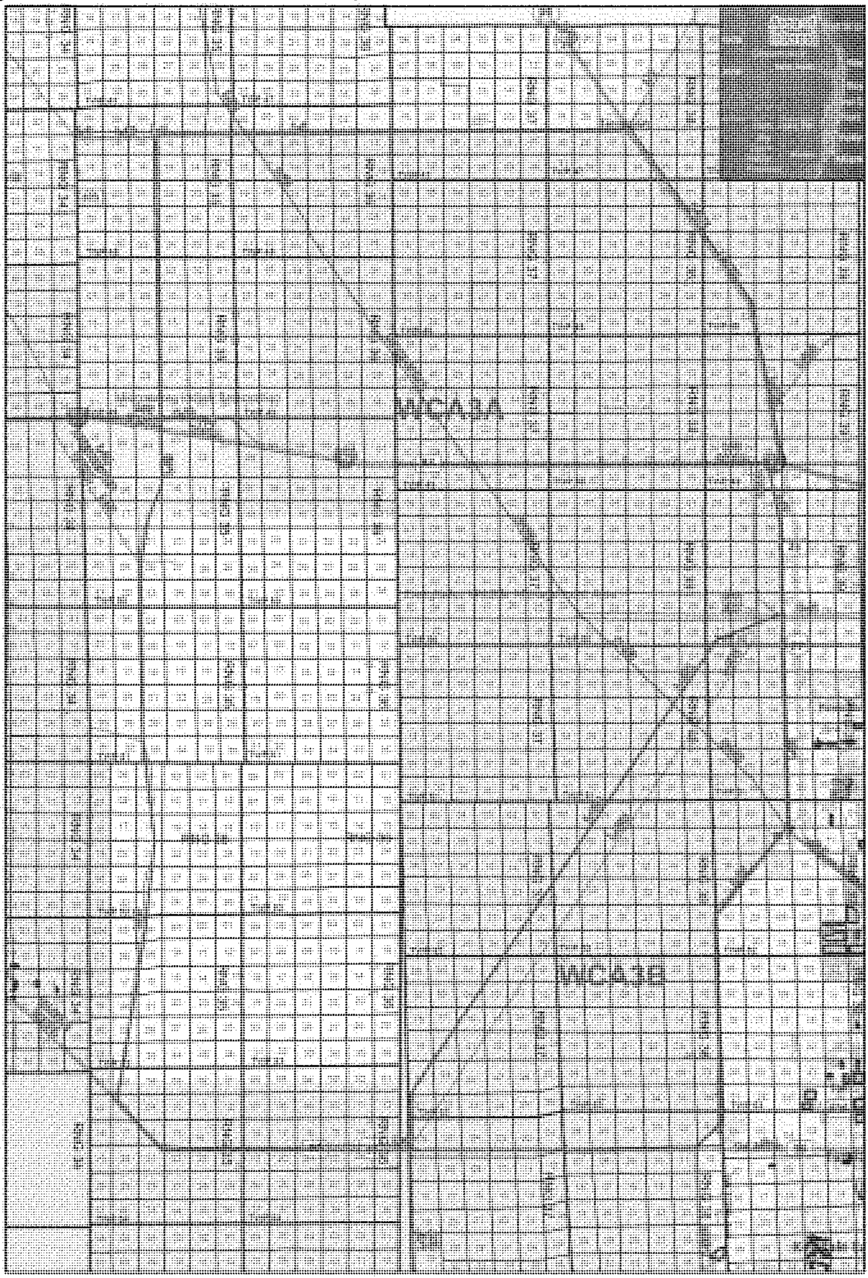


EXHIBIT C

CERP CENTAL EVERGLADES PLANNING PROJECT
ASSESSMENT OF NON-FEDERAL SPONSOR'S
REAL ESTATE ACQUISITION CAPABILITY

I. Legal Authority:

a. Does the sponsor have legal authority to acquire and hold title to real property for project purposes? **YES**

b. Does the sponsor have the power of eminent domain for this project? **YES**

c. Does the sponsor have "quick-take" authority for this project? YES

d. Are any of the lands/interests in land required for the project located outside the sponsor's political boundary? **NO**

e. Are any of the lands/interests in land required for the project owned by an entity whose property the sponsor cannot condemn? YES, Lands owned by the by the State of Florida will be provided by Supplemental Agreement in conformity with the terms of Article III-Lands, Easements, Rights-of-Way, Relocations and Compliance with Public Law 91-646, as Amended of the Master Agreement between the Department of the Army and South Florida Water Management District for Cooperation in Constructing and Operating, Maintaining, Repairing, Replacing and Rehabilitating Authorized Projects under the Comprehensive Everglades Restoration Plan, entered into on August 13, 2009.

II. Human Resource Requirements:

a. Will the sponsor's in-house staff require training to become familiar with the real estate requirements of Federal projects including P.L. 91-646, as amended? **NO**

b. If the answer to II.a. is "yes," has a reasonable plan been developed to provide such training? **N/A**

c. Does the sponsor's in-house staff have sufficient real estate acquisition experience to meet its responsibilities for the project? **YES**

d. Is the sponsor's projected in-house staffing level sufficient considering its other work load, if any, and the project schedule? **YES**

e. Can the sponsor obtain contractor support, if required in a timely fashion? **YES**

f. Will the sponsor likely request USACE assistance in acquiring real estate? **NO**

III. Other Project Variables:

a. Will the sponsor's staff be located within reasonable proximity to the project site? **YES**

b. Has the sponsor approved the project/real estate schedule/milestones? **YES**

IV. Overall Assessment:

a. Has the sponsor performed satisfactorily on other USACE projects? **YES**

b. With regard to this project, the sponsor is anticipated to be: highly capable/fully capable/moderately capable/marginally capable/insufficiently capable. **HIGHLY CAPABLE**

V. Coordination:

a. Has this assessment been coordinated with the sponsor? **YES**

b. Does the sponsor concur with this assessment? **YES**

Prepared by:

5-11-13
Date

Karl J. Nixon
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Deputy Chief
REAL ESTATE DIVISION
JACKSONVILLE DISTRICT

Reviewed and approved by:

13 May 2013
Date

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REAL ESTATE DIVISION
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APPENDIX E

PLAN FORMULATION SCREENING

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E PLAN FORMULATION SCREENING

This plan formulation appendix serves as supplemental supporting information to Section 3 of the main report. It addresses (1) storage and treatment north of the redline, (2) distribution and conveyance in northern WCA 3A, (3) distribution and conveyance in southern WCA 3A, WCA 3B, and ENP, and (4) seepage management.

E.1 STORAGE AND TREATMENT – NORTH OF THE REDLINE

This section provides supporting information regarding the identification of management measures, screening of management measures, formulation of options and the Multi-Criteria Decision Analysis (MCDA) and cost effectiveness results for storage and treatment components of CEPP north of the redline (**Figure E.1- 1**).

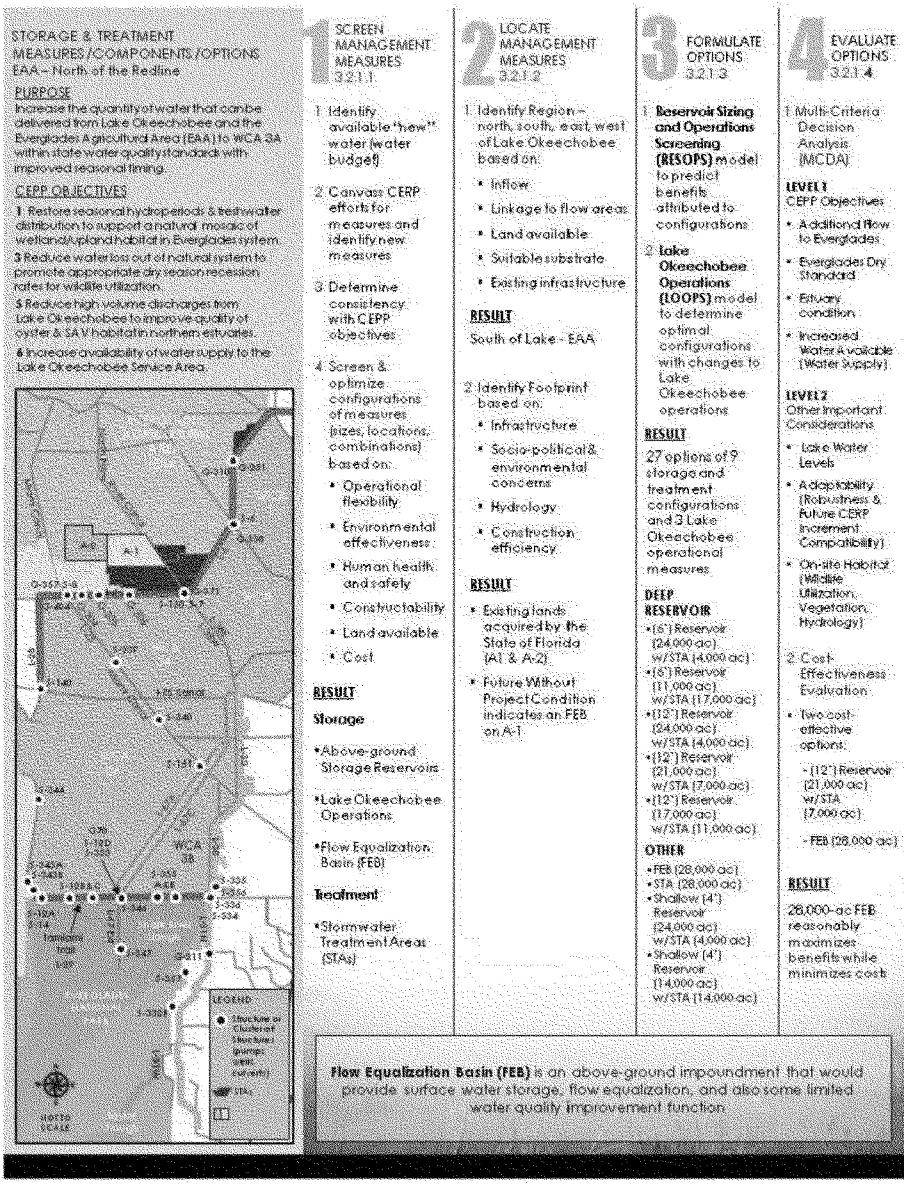


Figure E.1- 1. Overview of Storage and Treatment Screening

E.1.1 Storage and Treatment Management Measures

This section lists and describes major features and activities (i.e. management measures) and the rational for their inclusion or exclusion as the basis for alternative development. Management measures were compiled from previous CERP planning efforts and new measures were identified for CEPP. An array of 13 distinct management measures (9 storage measures and 4 treatment measures) was identified with multiple size and configuration potentials for each measure.

E.1.1.1 Storage Management Measures

Higher Lake Levels: Raising water levels within Lake Okeechobee would require substantial modifications to the Herbert Hoover Dike. The USACE is currently conducting a project to strengthen and secure the existing dike, and any increase in water levels above the design specifications of the current HHD rehabilitation would require a commensurate increase in the dike dimensions for human health and safety concerns.

Higher water levels within Lake Okeechobee could also cause significant impacts to the littoral zone. The lake's natural resources are dependent on the littoral zone since it provides nursery areas, spawning areas, foraging areas, and roosting areas required for the completion of aquatic fauna and higher trophic level (e.g., wading bird) life cycles. The frequency and duration of inundation of the lake littoral zone would increase with higher lake levels. High lake stages result in loss of beneficial littoral zone plant communities in favor of introduced exotics (e.g., torpedo grass) as well as impacts to wading birds and other water-dependent wildlife.

Operational Changes in Lake Okeechobee: Operational changes could be utilized to optimize timing and distribution of deliveries into and through Water Conservation Area 3. Excess flows that are normally discharged to the estuaries would be delivered south to the Everglades. Water quality treatment facilities will be necessary to treat additional flows. Operational changes in Lake Okeechobee will help achieve the objective of providing water supply, while being incidental to the objective of fulfilling the ecological needs of the South Florida ecosystem. Water retained in the Lake for delivery to the Everglades that is not identified for the natural system will be available for water supply. This can be considered excess water that would not be of beneficial use to the environment.

Partition Lake Okeechobee: Compared with simply holding the entire lake at a higher stage, compartmentalized storage within a partitioned lake would allow for greater storage capacity and more flexible control of regulatory releases to the estuaries and Water Conservation Areas. However, fragmentation of the lake would be a substantial ecological concern, restricting movement of the native aquatic animal species. Higher water levels within certain compartments would damage the littoral zone, disrupting natural cycles of native flora and fauna. Algal blooms would likely increase with the restricted water circulation. Navigation would also be disrupted within the Lake, and substantial visual aesthetic impacts would occur. Partitioning of Lake Okeechobee was previously considered in CERP and other C&SF studies, and eliminated as a measure due to the environmental criteria. Due to these factors, this measure has been eliminated from further consideration.

Dredging of Lake Okeechobee for Storage: This measure consists of dredging sediment from Lake Okeechobee and depositing it in an approved spoil site. Dredging of the Lake would allow for increased water storage capacity, decreasing the need for discharges to the estuaries and improving the timing and distribution of water deliveries to Water Conservation Area 3. Although this measure is feasible from an engineering perspective, the costs to dredge such a massive waterbody would be excessive. Additionally, disposal of the spoil material would require a massive containment area located near the

Lake for return water, creating environmental concerns with such a large discharge of fill material required. There may also be concerns regarding relocations and community displacement if such a large site were required to be constructed adjacent to the Lake. As such, this measure was eliminated from further consideration.

Above-Ground Storage Reservoir: Above-ground storage reservoirs would be utilized to capture and hold normal and peak flows. Water would then be discharged when flows are needed for the natural system. Water depths in above-ground reservoirs typically range from approximately 4-14 feet, with vegetation management and dam safety concerns being the limiting factors. Deep Storage reservoirs have relatively high construction costs when compared to shallow reservoirs due to additional dam safety requirements; however, both shallow and deep reservoirs are operationally flexible and offer the potential to improve the timing and distribution of water to the natural system. Storage reservoirs would experience dryouts during extended drought periods and do not offer substantial wildlife habitat value. Above-Ground Storage Reservoir was retained for consideration in alternative development.

Ecoreservoir: An Ecoreservoir could be utilized for water storage; however, it is predominantly designed and maintained to encourage habitat utilization and recreational opportunities. The secondary function of water storage limits the primary uses, which forces a trade-off for onsite habitat benefits, and leads to significantly increased costs per unit volume of water stored. Water levels are maintained at 4 feet or less to encourage the growth of vegetation. Embankment side slopes are shallow (12:1) and vegetated to promote wildlife use, making land requirements more extensive and increasing the risk of levee failure by including vegetation on the levee embankment and protection system. Construction and maintenance costs can be as much as 3 times higher than an above-ground storage reservoir with the same storage volume and as such is an inefficient means to store and deliver large quantities of water when creation of onsite habitats is not a primary objective. Operational flexibility is limited and hydraulic capabilities are inadequate to meet natural system flow quantity and timing demands. An ecoreservoir was considered and eliminated in the River of Grass study and, due to the factors mentioned above, was eliminated from consideration for the CEPP

Flowthrough Wetland (Flow Equalization Basin (FEB)): A Flowthrough Wetland, also known as a Flow Equalization Basin (FEB), is an above-ground, impoundment that would provide for surface water storage, flow equalization, and also some limited water quality improvement function. Levee design would be similar to that of a 4-foot Above-Ground Storage Reservoir; however, operations would be optimized for storage and wetland establishment. The Flowthrough Wetland would receive water flows from Lake Okeechobee and have a targeted depth of 1-3 feet to sustain the growth of hydrophytic vegetation, thereby limiting high water events and dry downs. A Flowthrough Wetland, in addition to providing water storage capacity for the natural system, would also help control the rate of water flow from Lake Okeechobee to the Stormwater Treatment Areas by minimizing hydraulic surges and providing more consistent flows. Additionally, some nutrient reduction will occur within the Flowthrough Wetland; however, unlike an STA, design and operation is not optimized for water retention times and nutrient retention. A Flowthrough Wetland would likely be forward compatible with future CERP projects, enabling conversion to a deep reservoir or STA with limited infrastructure removal. Consequently, a Flowthrough Wetland was retained for consideration in alternative development.

Dry/Wet Flow Way: A Flow Way measure is an above-ground, impoundment that would be operated like a flowing wetland system. Maximum water depths would be no higher than 4-feet with minimal engineering or alteration of land topography. Vegetation would be allowed to naturally recruit and would also be unmanaged except for exotic removal. Similar to an ecoreservoir, operational flexibility is limited and hydraulic capabilities are inadequate to meet natural system flow quantity and timing demands. Cost is similar to that of an ecoreservoir (12:1 embankment slopes), and with extremely limited storage and treatment capabilities is an inefficient means to meet the downstream objectives in the CEPP study area A Flow Way measure was considered and eliminated during the River of Grass study; and, due to the factors mentioned above, was eliminated from consideration for the CEPP.

Localized Aquifer Storage and Recovery (ASR): ASR is the storage of available water deep within the aquifer, and the recovery of that water for use when there are system demands. Preliminary results from the Pilot Study that is currently being finalized seem to indicate that ASR may be feasible in regards to toxicology, groundwater migration, etc. ASR must be used in combination with other water storage and water quality improvement management measures as it is not sufficient to meet any project objectives as a stand-alone measure. Due to the uncertainties that currently exist with ASR technologies, supplementing other storage measures with ASR storage is not being considered for this increment of CEPP. Future opportunity exists to incorporate ASR technology through other CERP efforts.

E.1.1.2 Water Quality Treatment Measures

Stormwater Treatment Areas: Stormwater Treatment Areas have been successfully utilized to reduce nutrients, mainly phosphorous, before discharging water into the natural system. Stormwater Treatment Areas are constructed and managed as shallow, above-ground impoundments and are vegetated to increase nutrient uptake. Most consist of flow paths that include upstream Emergent Vegetation Treatment Cells, and downstream Submerged Vegetation Treatment Cells. Water is directed through the treatment system through engineered hydraulics, maximizing water retention times to achieve nutrient retention. Optimal water levels are typically maintained to promote wetland vegetation survival and prevent exotic colonization and spread.

Chemical Precipitation: Chemical precipitation using ferric chloride, aluminum or other salts of iron can be utilized for phosphorous removal from water. Although the amount of land required for chemical precipitation is substantially less than an STA, there are some drawbacks to using this process to improve water quality. The chemicals required for chemical precipitation are expensive and would render the method non-cost effective due to the large volume of water to be treated and the corresponding massive scale of treatment required. Additionally, excessive sludge and waste products would require disposal, adding to the substantial costs and creating an environmental issue with sludge disposal. Although the excess waste product could potentially be utilized for fertilizer, it is likely that the nutrients would just re-enter the Everglades system if applied to the EAA or other areas surrounding the Lake. As such, due to the excessive costs and environmental concerns, this measure was eliminated from further consideration.

Dredging of Lake Okeechobee near Primary Canal Intakes: This measure would involve dredging sediment from Lake Okeechobee in the vicinity of canal intakes to the WCAs. The removal of the sediment should decrease the amount of residual nutrients that would be suspended in the water before flowing to the Water Conservation Areas. Although it is likely that this measure would have some success in nutrient removal, it would likely be on an extremely small scale, and substantial treatment would still be required before water could flow into the WCAs. Due to the relative inefficiency of this measure, it was eliminated from consideration.

***Hybrid Wetland Treatment Technology (HWTT)*:** HWTT systems employ chemical treatment systems for Phosphorus (P) removal and utilize wetland vegetation to the maximum extent possible to minimize chemical amendment use. Chemical coagulants are added, either continuously or intermittently, to the front end of the treatment system, which contains one or more deep zones to capture the resulting floc material. A fundamental concept of the HWTT technology is that the floc resulting from coagulant addition generally remains active and has the capability of additional P sorption. Both active and passive reuse of floc material is practiced in this technology. Passive re-use refers to the accumulation of viable flocs on plant roots and stems that are situated near the front-end and mid-regions of the systems. Active re-use refers to the mechanical resuspension of settled floc. HWTT systems in use in the Northern Everglades system have shown promising results with mean inflow TP concentration reduction ranging from 70 to 95%. Although HWTT has been shown to be cost effective for smaller watersheds and aquatic systems, there remains a high level of technological and cost uncertainty in applying HWTT to large watershed treatment efforts. For this reason, HWTT has not been considered for this increment of CEPP, but as further investigation of HWTT is gained through the Northern Everglades Watershed effort there may be a potential to adopt the technology in future increments of CEPP.

E.1.2 Screening of Storage and Treatment Management Measures

Table E.1-1 summarizes the results of the preliminary screening of management measures and identifies the four management measures that are retained: above ground storage reservoir, Lake Okeechobee operational changes, flow equalization basin, and stormwater treatment area. Measures not retained are marked with "x".

Table E.1-1. Summary of screening of management measures for storage and treatment

		Screening Criteria						
	Management Measure	Project Objectives	Operational Flexibility	Environmental Effects	Human Health and Safety	Constructability/ Technical Uncertainty	Land Requirement	Efficiency (Cost)
Storage Measures	Higher Lake Levels			x	x			
Storage Measures	Lake Okeechobee Operational Changes		Retained					
Storage Measures	Partition Lake Okeechobee			x		x		x
Storage Measures	Dredge Lake Okeechobee			x				x
Storage Measures	Above-Ground Reservoir		Retained					
Storage Measures	Ecoreservoir	x	x				x	x
Storage Measures	Flow Equalization Basin		Retained					
Storage Measures	ASR					x		
Storage Measures	Dry/Wet Flow Way	x	x				x	x
Treatment Measure	Chemical Precipitation	x		x				x
Treatment Measure	STA		Retained					
Treatment Measure	Dredging Canal Intakes	x						
Treatment Measure	HWTT	x				x		x

E.1.2.1 Siting of Storage and Treatment Components

Reservoirs, flow equalization basins, and stormwater treatment areas require large land areas to function. Several regional and local sites for these management measures were analyzed and screened or retained.

E.1.2.1.1 Regional Siting

***Storage North of Lake Okeechobee*:** Storage areas located north of Lake Okeechobee would be located on tributaries of the Kissimmee River (or other smaller basins) and not on the main channel. Much of the excess flow from the Upper Kissimmee River basin could not be collected with this arrangement. The storage areas would be able to make releases indirectly to the lake where it could be distributed to all downstream users and targets. Storage north of Lake Okeechobee could not store excess water from Lake Okeechobee, the Caloosahatchee River Basin, St. Lucie Canal basin, or the EAA basin. Storage north of the lake could meet the northern estuaries and seasonal hydroperiod objectives; however, due to the extended time to route water from a reservoir to the Water Conservation Areas, a northern reservoir would not be able to meet the rainfall responses, or timing, objectives. It is likely that this water, if passed through the Lake or through perimeter canals subject to agricultural runoff, may need to undergo additional water quality treatment to meet applicable standards. The increased conveyance and treatment time would greatly inhibit the ability to increase the effectiveness and efficiency of water deliveries to the Water Conservation Areas. Due to these factors, storage and treatment measures in this location for the CEPP was not further considered.

***Storage in the Caloosahatchee River Basin (West of Lake Okeechobee)*:** Storage in the Caloosahatchee River Basin could catch both excess basin flow and regulatory releases from Lake Okeechobee (and indirectly from the inflows to the lake). Once stored, the water could be used for meeting municipal and industrial (M&I) water supply and estuary flow targets; however, back pumping water into Lake Okeechobee would necessitate construction of STAs in addition to significant back pumping infrastructure (lifting water over two lock and dam structures). Excess water from the EAA basin would not be available as storage inflows. Due to these factors, for the CEPP, additional quantity/quality measure in this location over the C-43 West Basin Reservoir project was not further considered.

***Storage in the St. Lucie Basin (East of Lake Okeechobee)*:** The St. Lucie Canal (that runs from Lake Okeechobee to the St. Lucie estuary) does not follow a natural runoff basin, so the storage in the St. Lucie would typically receive regulatory releases from Lake Okeechobee (and indirectly from the inflows to the lake). Once there, the releases would most likely feed M&I water supply demands and estuary flow targets. Excess water from the EAA basin would not be available as storage inflows. Due to these factors, for the CEPP, additional storage and treatment measure in this location over the Indian River Lagoon project was not further considered.

***Storage in the EAA (South of Lake Okeechobee)*:** Storage areas within the EAA would have the advantage of being able to store excess water from within the EAA basin and upstream sources (i.e. Lake Okeechobee and its inflow sources). Because of the existing canal system in the EAA, storage located between the Miami River and North New River Canals would be strategically located to store excess runoff from significant portions of the EAA basin. Storage in the EAA could be used to meet Everglades and Florida Bay targets. Meeting the downstream water needs would require only a minimal amount of new outflow/delivery infrastructure. Due to these factors, storage and treatment measure in this location for the CEPP was considered further.

After considering the possible regional geographic areas, the location for the storage and treatment measures within the EAA was selected based upon the factors shown in **Table E.1-2.**

Table E.1-2. Regional Siting Criteria

Infrastructure
• Use of existing major canal networks (Miami Canal, Bolles & Cross Canal and North New River Canal) • Proximity to move water from water source (Lake Okeechobee) • Proximity to existing public works (STAs, existing pump stations, roads, minor canal networks)
Environmental
• Using previously impacted lands
Hydrology
• Reduce regulatory releases to the northern estuaries • Hydraulic connection to Lake Okeechobee with flexibility to manage high water levels • Improve the timing of environmental deliveries to the WCAs
Construction Efficiency
• Topography • Muck depths • Construction and maintenance access • Seepage Management • Availability of construction material

E.1.2.1.2 Local Siting Evaluation

It is unlikely that any other component of CERP has been modeled and evaluated more than the EAA Storage Reservoir. Siting of the EAA Reservoir was studied as part of the Reconnaissance Phase of ERP as well as in the Feasibility Phase of CERP. Additionally, the EAA Reservoir was authorized as part of WRDA 2000 and studied as part of the EAA Storage Reservoirs Phase 1, PIR. The EAA Storage Reservoir was also evaluated in the 2007 Reservoir Optimization study.

Findings from the Reconnaissance Study and continued evaluations during the CERP Feasibility Study were used to support the 1997 purchase of the 50,000 acre tract from the Talisman Sugar Corporation. The Department of the Interior and the State of Florida completed the $133.5 million transaction to help restore more natural flows of water through the southern parts of Florida and into Everglades National Park.

CERP confirmed the need for 360,000 ac-ft of storage or 60,000 acres (with a 6-foot depth) for the EAA Reservoir. CERP evaluated a great number of sizes associated with storage in the EAA. More than 100 screening model runs were completed to support the findings that between 40,000 and 60,000 acres, with a maximum of 6 feet deep, were needed. Additional special investigations were conducted using the SFWMM to evaluate four scenarios (where sizing ranged from zero acres to 80,000acres at 20,000acre intervals) of the EAA storage reservoir to support the recommended configuration and size of 60,000 acres of the CERP Recommended Plan.

The Reservoir Optimization study investigated if possible trade-offs could be used to find the most "efficient" reservoir configuration. It was noted that the EAA Storage Reservoir, because of its strategic location could replace the storage from several other planned storage areas. However, the report concluded that the CERP storage features are the most cost effective option to achieve the benefits of CERP, partially because no other storage areas could replace the 40,000 acres needed to capture

240,000 acre-feet of excess Lake Okeechobee water (water that is otherwise discharged to the Northern Estuaries).

The River of Grass (ROG) study, conducted by the SFWMD from 2008 to 2010, identified the need and availability of greater flows passing through the EAA than did the Restudy. Even assuming a greater than CERP amount of storage would be located north of the Lake (as identified in the Lake Okeechobee Phase II Technical Plan, 2008), ROG indicated the need for storage in the EAA to be far greater than the Restudy. A screening-level sensitivity analysis of water storage in the EAA supported an optimal storage range of between 800,000 and 1,200,000 ac-ft. Even assuming 12-foot maximum depths, this represented between 66,700 and 100,000 acres of land.

The CERP identified the need for 360,000 ac-ft of water storage in the EAA and incorporating knowledge gained from updated science demonstrates that the need for flows passing through the EAA is even higher than envisioned in the CERP. This suggests that storage greater than 360,000 ac-ft is likely needed if CERP goals and objectives are going to be fully achieved. Therefore, the storage and treatment management measures south of Lake Okeechobee are recommended to be located on and maximize the usage of the previously purchased A-1 and A-2 Compartments of the EAA land south of Lake Okeechobee that are owned by the State of Florida(**Figure E.1- 2**). The identified project lands are located between and adjacent to the North New River and Miami Canals, which reduces the need to construct any additional conveyance features to move water from Lake Okeechobee to the project features and the Water Conservation Areas. The project lands are adjacent to existing treatment facilities (STA 3/4 and STA 2) that are currently being used for environmental purposes, creating a unique ability to optimize C&SF operations.

A Flow Equalization Basin (FEB) on the A-1 compartment is being financed, constructed, and operated by the SFWMD, however the formulation of management measures assumed this could be modified and incorporated into the CEPP as long as project constraints were not violated. This feature is included in the Future Without Project condition (FWO).

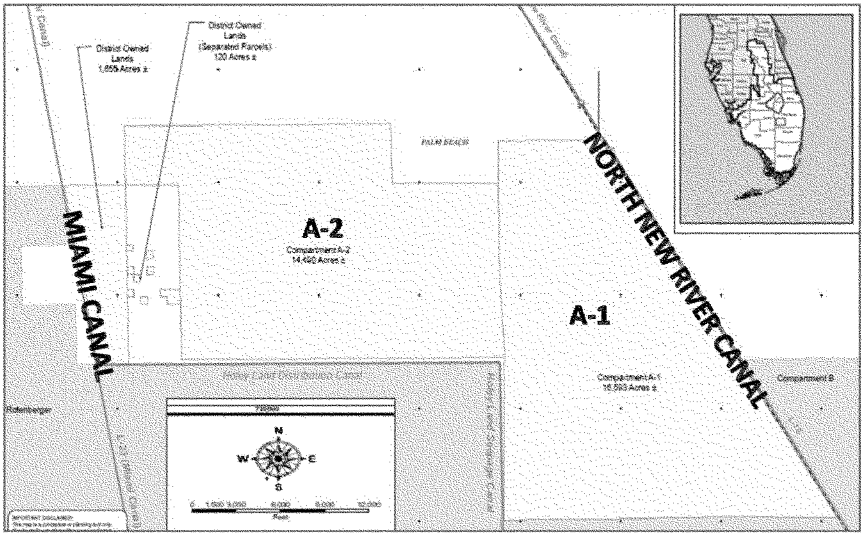


Figure E.1- 2. A-1 and A-2 Footprints within the EAA

E.1.3 Formulation of Storage and Treatment Options

The combinations of storage and treatment management measures included shallow reservoirs (4 foot depth), deep reservoirs (6 foot and 12 foot depth) and FEBs (4 ft depth emergent marsh storage) combined with existing and new stormwater treatment areas (STA), as well as standalone STAs on the identified EAA footprint. The Reservoir Sizing and Operations Screening (RESOPS) model was used to predict benefits attributed to thousands of iterations of management measure combinations. The RESOPS model is a screening model with batch processing capabilities, developed during the SFWMD Northern Everglades and River of Grass planning efforts that is useful to screen a large number of storage and treatment features. This tool is useful to assess performance of these measures and components using a large and flexible suite of evaluation criteria and considerations early in the plan formulation techniques. During batch processing, a computer program incorporates a large set of diverse data files as input, processes the data, and generates multiple sets of output data files. These outputs can be analyzed for trends in performance.

The result of the RESOPS modeling effort led to identification of nine highly functioning combinations of storage and treatment configurations to undergo further detailed analysis. These highly functioning combinations were selected by identifying the combined storage and treatment configurations on the EAA footprint that maximized water deliveries, timing of flow and reduction in discharge to the Northern Estuaries for each of the retained management measures. **Figure E.1- 3** contains an example of the RESOPS output.

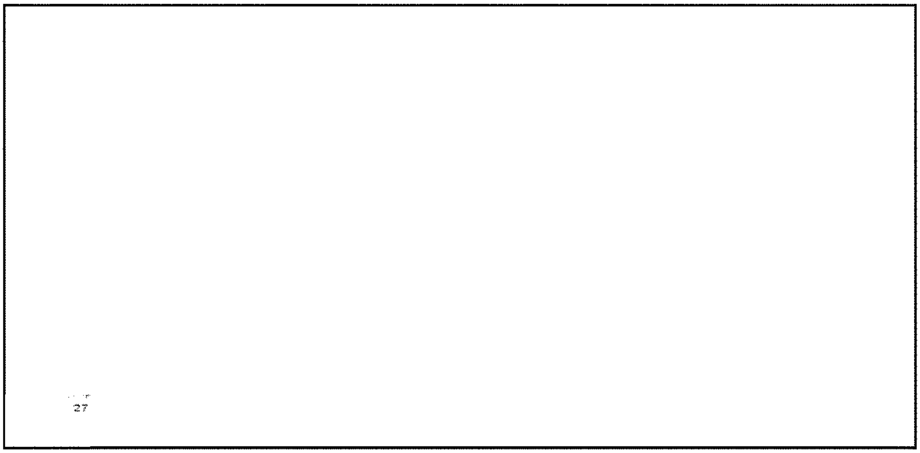


Figure E.1- 3. Performance curves for 4-foot storage and stormwater treatment area combinations on the Talisman property

In addition to determining the configuration of storage and treatment management measures, consideration was given to incorporating operational flexibility in Lake Okeechobee when additional storage capacity is available by using the Lake Okeechobee Operations Screening (LOOPS) model. Existing Lake Okeechobee regulatory release protocols balance multiple objectives for Lake Okeechobee and system management. Simply adding discharges to storage in addition to existing regulatory protocols may over-drain the Lake and impact system performance. Efficient Lake Okeechobee regulatory releases in concert with discharges to storage will maintain or enhance system performance.

The nine highly functioning combinations of storage and treatments measures were combined with three operational measures for Lake Okeechobee operations: water supply optimized, estuary performance optimized and Lake Okeechobee performance optimized. These 27 storage and treatment options (**Table E.1-** 3) were evaluated with the MCDA process and a subset was identified to be included in the final array of alternatives.

Table E.1- 3. Initial Storage and Treatment Options evaluated with MCDA

Storage and Treatment Configuration	Lake Okeechobee Operations
Flow-Through Wetland/FEB	Water Supply Optimized Estuarine Performance Optimized Lake Performance Optimized
28,000 acres	
4ft Shallow Storage & STA	
24,000 acre Res & 4,000 acre STA	
14,000 acre Res & 14,000 acre STA	
6ft Deep Storage & STA	
24,000 acre Res & 4,000 acre STA	
11,000 acre RES & 17,000 acre STA	
12 ft Deep Storage & STA	
24,000 acre Res & 4,000 acre STA	
21,000 acre Res & 7,000 acre STA	
17,000 acre Res & 11,000 acre STA	
STA	
28,000 acres	

E.1.4 Evaluation Criteria for Storage and Treatment Options

Performance of the 27 combinations of reservoirs, flow equalization basins, and stormwater treatment areas, and Lake Okeechobee operations were evaluated using seven screening criteria (**Table E.1-4**). Four of the criteria are directly related to primary objectives of the project (Level 1). Three of the seven criteria, while not directly addressing project objectives, describe effects important to the selection of storage and treatment options (Level 2). Methods of analysis and the results for the seven screening criteria are in the following sections.

Table E.1-4. Criteria used in the Storage and Treatment MCDA evaluation

Criteria	*Project Objectives*
Level 1	
Additional Flow to The Everglades	*Restore Natural Mosaic of Wetland and Upland Habitat*
Timing Of Flows to the Everglades	*Reduce Dry-downs and Over-Drainage*
Estuary Conditions	*Reduce High Volume Discharges to the Northern Estuaries*
Water Supply Cutbacks	*Increase Availability of Water Supply*
Level 2	
Lake Okeechobee Conditions	*N/A*
Adaptability	*N/A*
On-Site Habitat	*N/A*

E.1.4.1 Additional Flows to the Everglades (Level 1)

E.1.4.1.1 Criteria Description

This criterion was developed based on the set of CEPP project objectives related to restoring seasonal hydroperiods and freshwater distribution, and surface water depths within the project area. In the pre-drainage system, inundation patterns supported an expansive system of freshwater marshes including longer hydroperiod sawgrass "ridges" interspersed with open-water "sloughs", and higher elevation marl prairies. The depth, distribution and duration of surface flooding largely determined the vegetation patterns, as well as the distribution, abundance, seasonal movements, and reproductive dynamics of aquatic and terrestrial animals in the Everglades. Resumption of sheet flow and related patterns of hydroperiod and water depth will significantly help to restore and sustain the microtopography, directionality, and spatial extent of ridges and sloughs and improve the health of tree islands in the ridge and slough landscape.

The desired restoration condition for the Everglades ridge and slough landscape as it pertains to this criterion is to restore the natural patterns of flow volume characteristic of the pre-drainage Everglades.

E.1.4.1.2 Evaluation Tool Used

RESOPS was used to evaluate the options in terms of the increase in the *Total Volume of Additional Average Annual Flow* (1000-acre-feet or k-ac-ft) delivered across the "red line" from the EAA to WCA 3A, in excess of what would have been delivered by STA's 2, 3/4, 5 and 6, if CEPP was not implemented. This additional flow volume was made possible by reducing in-lake triggered high discharges to the northern estuaries and calculated for each year over the period of simulation (1965-2005), and averaged.

E.1.4.1.3 Scoring Methodology

Potential storage and treatment components which improved the volume of water delivered across the "red line" scored more favorably. Storage and treatment components were ranked on a scale of (1-4) to estimate the degree to which each project component performed. The Natural Systems Regional Simulation Model (NSRSM) version 3.3 predicts an average annual total flow volume across the "red line" of 2.1 million acre-feet. The range of *Total Volume of Additional Average Annual Flow* to the Everglades varied from 0 to 250 (k-ac-ft). A review of the data indicated that the majority of flow occurred within the 100 to 250 (k-ac-ft) range. A scale of (1-4) was used to best separate the performance of project components based on this existing range of additional flow. The scoring methodology is defined below.

4 (Best) – The project component received a score of 4 if the *Total Volume of Additional Average Annual Flow* fell within the high 200 to 250 (k-ac-ft) range, between 225-250.
3 (Good) – The project component received a score of 3 if the *Total Volume of Additional Average Annual Flow* fell within the low 200 to 250 (k-ac-ft) range, between 200 and 225.
2 (Fair) – The project component received a score of 2 if the *Total Volume of Additional Average Annual Flow* fell within the high 150 to 200 (k-ac-ft) range.
1 (Worst) – The project component received a score of 1 if the *Total Volume of Additional Average Annual Flow* fell within the high 100 to 150 (k-ac-ft).

E.1.4.1.4 Criteria Results

Results are presented in **Table E.1-5**.

Table E.1-5. Additional flows to the Everglades results

Storage and Treatment Component	Additional Flows	Rating
Flow-Through Wetland/FEB 28,000	L (200-250)	3
4ft Shallow Storage & STA 24,000 Res & 4,000 STA 14,000 Res & 14,000 STA	H (150-200) H (150-200)	2 2
6ft Deep Storage & STA 24,000 Res & 4,000 STA 11,000 Res & 17,000 STA	H (150-200) M (150-200)	2 2
12ft Deep Storage & STA 24,000 Res & 4,000 STA 21,500 Res & 6,500 STA 17,000 Res & 11,000 STA	H (100-150) H (200-250) H (200-250)	1 4 3
STA 28,000 STA	M (100-150)	1

E.1.4.2 Everglades Dry Standard Score (Level 1)

E.1.4.2.1 Criteria Description

The Everglades Standard Scoring methodology was developed during the River of Grass (ROG) planning efforts to measure how well a RESOPS simulation matches the magnitude and timing of a defined Everglades Demand Target. The RESOPS simulates monthly flows for a 41 year simulation period (1965-2005). A spreadsheet model was developed to compare the monthly flows to target flow (NSRSM v3.3) discharging into the Everglades at the red line.

The NSRSMv3.3 is a natural system Regional Simulation Model (RSM) used to simulate flows across the red-line boundary along the northern edges of the Everglades in a fully decompartmentalized future system (an ROG type scenario). The NSRSM v3.3 has an estimated average of 2.1 million acre-feet/yr across the red line, whereas existing flows are estimated at 1.4 million acre-feet/yr. A plot of the estimated average monthly flows for the 41 year simulation period for the target flows vs. existing flows is shown in **Figure E.1- 4**. The gray line represents the target flows at the redline (NSRSM v3.3), the red line represents existing conditions, and the green line represents an alternative flow scenario that moves from existing conditions towards the NSRSM target.

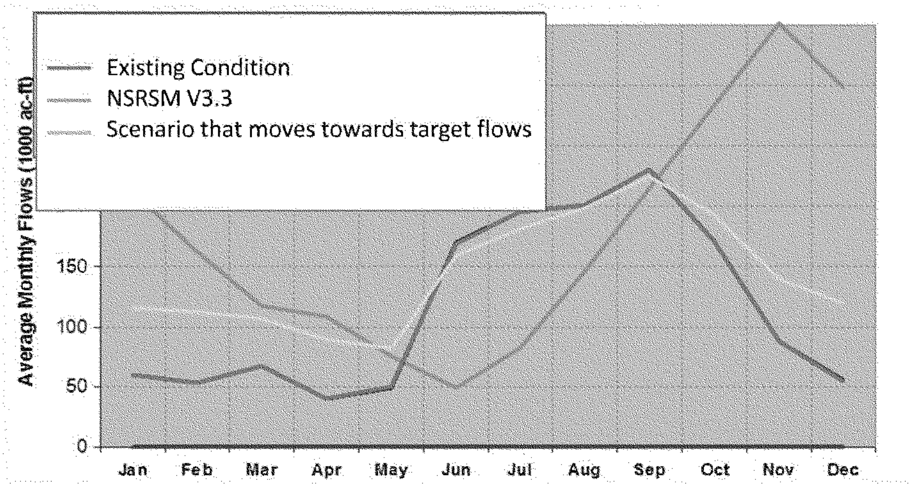


Figure E.1- 4. Seasonality of Flows to the Everglades: The red line represents the existing conditions, the gray line is the natural system target flow and the green line shows an alternative that moves towards target flows

The Everglades Dry Standard Score was developed to provide a measure on how well alternatives are meeting target flows during the dryer portion of the year when there are limited discharges to the Everglades. From reviewing existing real time data at the S-8 pump station it was determined that the current system provides most of the discharge at the peak of the wet season, and that deliveries typically diminish starting in the October time frame. The deliveries further diminish with the approaching dry season, and only event driven deliveries are made during the dry season. The S-8 usually starts wet season discharges in the June time frame, providing more regular discharges, normally peaking in August or September. This is illustrated in a plot of the measured S-8 discharge for the time period between May 2003 and January 2005 (**Figure E.1- 5**). During 2003 and 2004 the wet season discharges started in June and extended through about mid October.

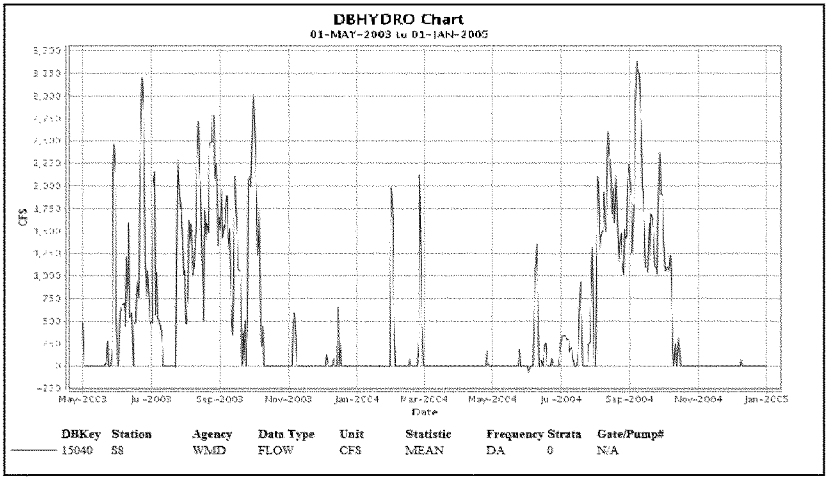


Figure E.1- 5. S-8 Pump Station plot of the measured S-8 discharge for the time period between May 2003 and January 2005

The Everglades Dry Standard Score provides a score of 0 to 100 based upon how well each alternative performs relative to the target during the dryer months (October through May). Monthly flows of each alternative run are compared to the target flows to determine the shortfall of inflow volumes relative to the target for each month of the simulation period (starting on January 1, 1964 through December 1, 2005). An accumulating penalty is calculated based on relative divergence from the target. The Dry Standard Score calculates shortfall during months between October and May and provides a score that weights later dry season months as more critical based upon the following relationship:

$$ESS_D = 100 - [\frac{\sum_{i=1}^{n}(Shortfall_i * \omega_m)}{n}]$$

where:
ESS_D = Everglades Standard Score $_{Dry}$ (between 0 and 100),
i = Time step in months
n = Number of months simulated (in this case n=41*12)
Shortfall = Percentage of relative shortfall volume delivered to Everglades compared to desired target inflow (limited to between 0% and 100%) defined as:

$$\frac{(Target\ Inflow_i - Glades\ Inflow_i)}{Target\ Inflow_i}$$

ω_m = Normalized monthly weighting factor:

The normalized weight factor (**Table E.1-6**) was generated based on providing higher weights to later dry season months, and zero weight to wet months June through September. Providing supplemental flows during the mid to later wet season is ecologically important to reverse the current adverse effects of marsh dry out during the dry months. February has a weight factor of 1, April has the highest weight factor of 1.5, and October has the lowest weight factor of 0.65 signifying that it is more than twice as important to meet the target flows in April than it is in October to avoid dry outs.

Table E.1-6. Normalized weighting factor used in the Dry Standard Score

Month	ω_m	Month	ω_m
Jan	0.875	**Jul**	0
Feb	1.0	**Aug**	0
Mar	1.25	**Sep**	0
Apr	1.5	**Oct**	0.625
May	1.25	**Nov**	0.75
Jun	0	**Dec**	0.75

The weight factors were developed based on the primary goal of avoiding dry outs in the Everglades. The importance of restoring flow amplitude and shifting the peak discharge from September to November was a secondary goal. The green line alternative shown on the Seasonality of Flows to the Everglades. **Figure E.1- 4** represents a 77% Dry Season Standard Score, the existing conditions red line represents a 62% score and the target NSRSM v3.3 gray line has a score of 100%.

E.1.4.2.2 Evaluation Tool Used

This methodology measures how well a spreadsheet simulation model (RESOPS) matches the magnitude and timing of a defined Everglades Demand Target. The RESOPS simulates monthly flows for a 41 year simulation period (1965-2005) and provides the ability to compare monthly flows to target flow (NSRSM v3.3) discharging into the Everglades at the red line.

E.1.4.2.3 Scoring Methodology

The Everglades Dry Standard Score provides a score of 0 to 100 based upon how well each alternative performs relative to the target during the dryer months (October through May). Monthly flows of each alternative run are compared to the target flows to determine the shortfall of inflow volumes relative to the target for each month of the simulation period (starting on January 1, 1964 through December 1, 2005).

To get a better understanding of what the scores mean as we move from an existing degraded system towards restoration flows, a spread sheet was created to generate hypothetical test runs to ensure that the weights generated were appropriate and that interpretations were ecological based and fit the descriptions of the scores as provided below.

"Best" Narrative (DSS Score ≥90) – rating = 4. The "best" portion of the DSS score is the top fraction of the possible range of conditions that corresponds to flow conditions that has all the characteristic restoration value needed to prevent soil oxidation and peat fires, while creating hydrology needed to enhance habitat microtopography. At this DSS score, long term average water depths will likely match long term average pre-drainage water depths (ca. 3 feet at the end of the wet season, ca. 1 foot at the end of the dry season); water surfaces will fall in response to seasonal and interannual climatic variability; and hydrologic conditions will sustain the elevation differences between sloughs, sawgrass ridges and tree islands. The average water depths are such that even during the driest of years associated with the natural, weather-driven interannual variability, the peat soils never, or extremely rarely, dry out to the point of significant oxidation. Instead, the water depths, including the interannual variability in depths, are such that the populations of larger, multi-yeared fish can persist. At this DSS score the potential for persistence of outflows from the Everglades into Florida Bay to prevent hypersalinity and sustain submerged aquatic vegetation is extremely high.

"Good" Narrative (75≥DSS Score<90) – rating = 3. The "good" portion of the DSS score is the top fraction of the possible range of conditions that corresponds to flow conditions that has most of the characteristic restoration value needed to prevent soil oxidation and peat fires, while creating hydrology needed to sustain habitat microtopography. This condition might be referred to as the sub-optimal but "sustainable" condition. Note that the definition is somewhat complex. If the Ridge and Slough landscape is ecologically and geomorphologically in "Best" condition, then "Good" hydrologic conditions are defined as those that are able to sustain the landscape in this "Best" ecological condition. That is, the hydrologic conditions can be somewhat reduced from "Best" hydrologic conditions, but reduced only to the extent that they are still able to sustain an existing "Best" ecological condition. This differs from "Fair" in that it does not set the landscape on a trajectory toward "Worst." If the landscape is already ecologically and geomorphologically somewhat diminished from "Best" conditions, then "Good" hydrological conditions may still be able to maintain the ecological status quo, but these hydrological conditions will not be able to move the landscape upward back toward "Best".

"Fair" Narrative (60>DSS Score<75) – rating = 2. The "fair" portion of the DSS score is the bottom fraction of the possible range of conditions that corresponds to flow conditions that have minimal restoration value, especially in terms of soil oxidation, peat fires, and is likely not to be able to prevent loss of habitat microtopography. This condition might be referred to as continued "degrading" condition. Ecologically, the landscape shows some of the aspects described under "Worst." It differs from the "Worst" condition described above in that the Ridge and Slough landscape would not yet have completely arrived at all the ecological worst endpoints. However the "Fair" condition is by definition the set of hydrologic conditions that keeps the Ridge and Slough landscape on a trajectory toward the "Worst" endpoint. If hydrologic conditions remain in the "Fair" condition, the landscape will over time degrade into the ecological "Worst" condition.

"Worst" Narrative (DSS Score ≤ 60)- rating = 1. The "worst" portion of the DSS score is the bottom fraction of the possible range of conditions that corresponds to flow conditions that have no restoration value or make conditions worse, especially in terms of soil oxidation, peat fires, and continued loss of habitat microtopography. At this DSS score, water depths are low enough that sloughs are, on average, dry (surface water absent) for more than three months of the year. These hydrologic conditions spell the end of the Everglades as a wetland. Populations of larger, multi-year fish are eliminated and populations of smaller fish (e.g., mosquito fish) are greatly reduced if not eliminated. Water lilies disappear and sloughs are invaded by sawgrass. Tree islands and ridges are invaded by dryland species. Elevation differences between sawgrass ridges and sloughs will continue to disappear; tree island peats will oxidize or burn and the full landscape will become microtopographically "flattened."

E.1.4.2.4 Criteria Results
Results are presented in **Table E.1-7**.

Table E.1-7. Everglades Dry Standard Score Results

Storage and Treatment Component	DSS Score	Rating
Flow-Through Wetland/FEB 28,000	(73-76)	2
4ft Shallow Storage & STA 24,000 Res & 4,000 STA 14,000 Res & 14,000 STA	 (73-76) (73-76)	 2 2

6ft Deep Storage & STA		
24,000 Res & 4,000 STA	(73-76)	2
11,000 Res & 17,000 STA	(73-76)	2
12ft Deep Storage & STA		
24,000 Res & 4,000 STA	(76-79)	3
21,500 Res & 6,500 STA	(76-79)	3
17,000 Res & 11,000 STA	(76-79)	3
STA		
28,000 STA	(67-70)	2

E.1.4.3 Estuary Performance (Level 1)

E.1.4.3.1 Criteria Description

The benefits to the St. Lucie and Caloosahatchee Estuaries are predicted to be a reduction in high flows. Two high flow indicators for each estuary were used to evaluate the alternatives. A 41 year period of daily discharges to the two estuaries was reduced to a times series of mean monthly flows (n=492 months). The number of mean monthly flows greater than 2800 and 4500 cfs at S-79 were used to evaluate alternatives for the Caloosahatchee (**Table E.1-8**). Total flows greater than 2000 cfs and greater than 3000 cfs were used to evaluate alternatives for the St. Lucie (**Table E.1-9**). Total flow was calculated as the sum of discharge from a time series at S-80 (located on C-44) and a time series containing discharge from sources other than the C-44 canal.

Table E.1-8. Mean monthly flows at S-79 *

Caloosahatchee (S79)		Number of Months in Five Flow Ranges				
MEAN MONTHLY FLOWS		**<450**	**450-2800**	**2801-4500**	**>2800**	**>4500**
WSE + C43 RES		68	340	39	84	45
LORS08 + C43 RES		38	375	38	79	41
ADP + C43 RES		24	382	39	86	47
LOW + LOKOPT + C43RES		75	344	30	73	43
LOW + WSOPT + C43RES		81	342	28	69	41
LOW + ESTOPT + C43 RES		66	352	37	74	37
MED + LOKOPT + C43RES		78	340	31	74	43
MED + WSOPT + C43RES		82	343	27	67	40
MED + ESTOPT + C43 RES		82	342	36	68	32
HIGH + LOKOPT + C43RES		86	355	32	71	39
HIGH + WSOPT + C43RES		82	343	27	65	38
HIGH + ESTOPT + C43 RES		74	348	36	70	34

Located at the head of the Caloosahatchee Estuary in various flow classes. The >2800 cfs and >4500 classes were used as indicators. N=492 months.

Table E.1-9. Total mean monthly flows to the St. Lucie Estuary*

St. Lucie (S80+SLETRIB)		Number of Months in Five Flow Ranges				
MEAN MONTHLY FLOWS		**<350**	**350-2000**	**2001 - 3000**	**>2000**	**>3000**
WSE + C43 RES		140	279	38	73	35

LORS08 + C43 RES		120	300	39	72	33
ADP + C43 RES		136	283	38	73	35
LOW + LOKOPT + C43RES		148	274	36	70	34
LOW + WSOPT + C43RES		148	276	32	68	36
LOW + ESTOPT + C43 RES		138	289	35	65	30
MED + LOKOPT + C43RES		150	272	37	70	33
MED + WSOPT + C43RES		149	277	31	66	35
MED + ESTOPT + C43 RES		149	280	39	63	24
HIGH + LOKOPT + C43RES		151	276	34	65	31
HIGH + WSOPT + C43RES		150	277	34	65	31
HIGH + ESTOPT + C43 RES		144	286	34	62	28

**Data displayed in various flow classes. The >2000 cfs and >3000 classes were used as indicators. N=492 months.*

E.1.4.3.2 Evaluation Tool Used

RESOPS was used as a preliminary screening tool used to compare monthly flows to target flow at the S-79 and S-80 structures. Further analysis was conducted using the LOOPs model in combination with a C-43 model. LOOPS is a hydrologic routing screening model that simulates Lake Okeechobee stages and discharges through the primary outlets as prescribed by a user-defined regulation schedule. The C-43 model is a hydrologic routing model that simulates the effects of the C-43 reservoir, which can alter flows observed at S-79.

E.1.4.3.3 Scoring Methodology

Rather than assign alternatives to quartiles, this initial screening sought to identify trends by ranking alternatives. For each estuary, alternatives were ranked by each of the two indicators (n=2 ranks/alternative). These were averaged to derive a single ranking of alternatives for each estuary (**Table E.1-10**). A final ranking, considering both estuaries was derived by averaging the ranks for each estuary. Ranking was from 1 to 12 with 1 being the best and 12 being worst with respect to reduction of high flows.

E.1.4.3.4 Criteria Results

Results are presented in **Table E.1-10.** Ranking of Options on Estuary Performance*

- When both estuaries are considered together from a high flow perspective, all nine of the options ranked higher than the three base cases, but all ranked similarly.
- Within each range of water delivery (Low, Medium, High), the alternatives optimized for estuarine performance ranked highest for estuary performance.

Table E.1-10. Ranking of Options on Estuary Performance*

	St. Lucie Estuary				Caloosahatchee Estuary				
	>2000	>3000	Rank		>2800	>4500	Rank		FINAL
WSE + C43 RES	11.5	10	10.75		11	11	11		10.9
LORS08 + C43 RES	10	6.5	8.25		10	7.5	8.75		8.5
ADP + C43 RES	11.5	10	10.75		12	12	12		11.4

LOW + LOKOPT + C43RES	8.5	8	8.25		7	9.5	8.25		8.3
LOW + WSOPT + C43RES	7	12	9.5		4	7.5	5.75		7.6
LOW + ESTOPT + C43 RES	4	3	3.5		8.5	3	5.75		4.6
MED + LOKOPT + C43RES	8.5	6.5	7.5		8.5	9.5	9		8.3
MED + WSOPT + C43RES	6	10	8		2	6	4		6.0
MED + ESTOPT + C43 RES	2	1	1.5		3	1	2		1.8
HIGH + LOKOPT + C43RES	4	4.5	4.25		6	5	5.5		4.9
HIGH+ WSOPT + C43RES	4	4.5	4.25		1	4	2.5		3.4
HIGH+ ESTOPT + C43 RES	1	2	1.5		5	2	3.5		2.5

**For each estuary, alternatives were ranked by each of two high flow indicators. These were averaged to produce a single ranking of alternatives for each estuary. Ranks for the two estuaries were averaged to provide a final ranking of alternative. The top highest ranking alternatives are identified by shading (1= most benefit, 12=least benefit).*

E.1.4.4 Water Supply (Level 1)

E.1.4.4.1 Criteria Description

During droughts Lake Okeechobee levels can fall below the Water Shortage Trigger. When this occurs, a reduced volume of water is delivered to meet demands, otherwise described as "demands not met" or "cutback volume" (**Figure E.1-6**). Water supply performance for LOSA will be measured by calculating the total cutback volumes (water demand not met) for the eight worst drought years during the 41-year period of analysis.

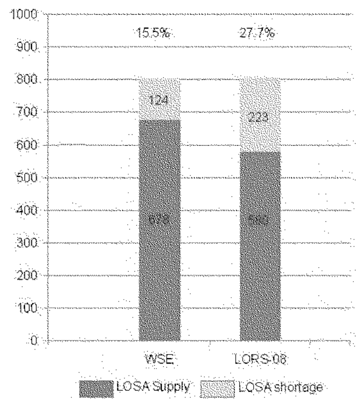


Figure E.1-6. Baseline water supply cutbacks

E.1.4.4.2 Evaluation Tool Used

LOOPS is a hydrologic routing screening model that simulates Lake Okeechobee stages and discharges through the primary outlets as prescribed by a user-defined regulation schedule. LOOPS was the model used to consider the volumes of water delivered to be "fixed" and the model would be used to identify Lake Okeechobee operations that take advantage of the flexibility within LORS to provide better deliveries to the estuaries (less high flows, more detail on time series of deliveries), evaluate Lake Okeechobee stage through time, and improve water supply for the Lake Okeechobee Service Area (reduced water supply cutbacks) for each of the flow volumes selected from the Tier 1 modeling.

E.1.4.4.3 Scoring Methodology

Water supply performance of the various options were rated by assigning scores relating to four categories of outcome, with a score of one being the worst, and four being the best.

The existing condition (LORS 08) is considered to be unacceptable by agricultural interests in the Lake Okeechobee Service Area. The current operations yield LOSA water shortage cutbacks occurring more frequently than 1-in-10 years, for longer durations, and at increased severities leading to economic damages. The water control plan that existed prior to the implementation of LORS 08, the WSE (2000 LORS-Water Supply/Environment) provided a higher level of service by limiting water restrictions imposed on agricultural permit holders. WSE has been identified as the target for the water supply performance. The intermediate categories are an equal proportion of the volume between WSE and LORS 08.

The average LOSA demand for the 8 drought years (1968, 73, 74, 81, 82, 89, 90, 01) is approximately 803,000 ac-ft. The percentage of water demands not delivered on average increased noticeably from WSE (15.5%) to LORS 2008 (27.7%). This average percentage cutback represents an average volume of 124,000 ac-ft and 223,000 ac-ft respectively. Converting this average volume into total volume, the total WSE cutbacks for the eight worst drought years totaling 992,000 ac-ft and the total cutback volume for LORS08 is 1,784,000 ac-ft.

4 - Total volume of cutbacks less than 992,000 ac-ft for eight worst drought years.
3 – Total volume of cutbacks between 992,000 ac-ft and 1,392,000 ac-ft for eight worst drought years.
2 – Total volume of cutbacks between 1,392,000 ac-ft and 1,784,000 ac-ft for eight worst drought years.
1 – Total volume of cutbacks is greater than 1,784,000 ac-ft for eight worst drought years.

E.1.4.4.4 Criteria Results

Results are presented in **Figure E.1- 7**. The highest performing scenarios (140-WS and 190-WS) improve water supply by reducing cutbacks over LORS 08 (~25%), and over Adaptive Protocols (AP) 5.50 (~20%) (**Table E.1-11**). Lake Okeechobee operations optimized for estuarine performance yield no water supply benefits. The high flow scenario provides less benefit for water supply than either the low or medium flow scenarios.

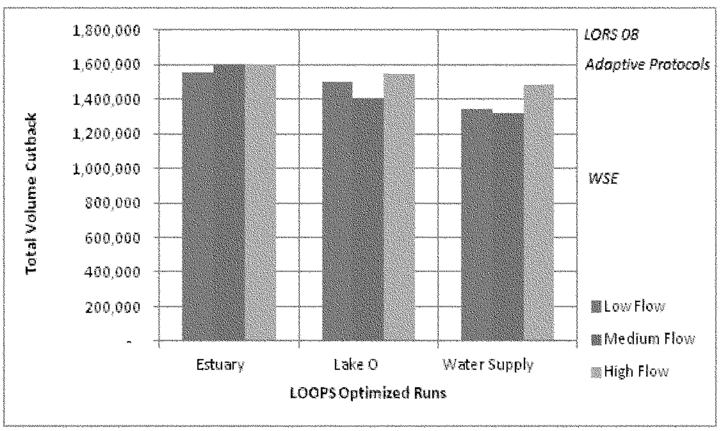


Figure E.1- 7. Water Supply Cutbacks by Lake Okeechobee Operation for each of the flow projections

Table E.1-11. Cutback percentages of flow options compared to baseline water supply cutbacks

	Baselines		
	WSE	LORS08	AP5.50
Cutback %	15.5%	27.7%	24.9%
Low Flow	LOKOPT	WSOPT	ESTOPT
Cutback %	23.3%	20.9%	24.2%
Med. Flow	LOKOPT	WSOPT	ESTOPT
Cutback %	21.9%	20.5%	24.9%
High Flow	LOKOPT	WSOPT	ESTOPT
Cutback %	24.1%	23.1%	24.9%

Table E.1-12. Cutback volume of flow options compared to baseline water supply cutbacks

140-Est	1,553,834	2
140-LO	1,496,046	2
140-WS	1,341,947	3
190-Est	1,598,779	1
190-LO	1,406,155	2
190-WS	1,316,264	3
240-Est	1,598,779	1
240-LO	1,547,413	2
240-WS	1,483,205	2

E.1.4.5 Lake Okeechobee (Level 2)

E.1.4.5.1 Explanation of the Criterion

Although there are currently four RECOVER approved Lake Okeechobee performance measures, the challenge in using them to evaluate and rank alternatives using hydrologic model output is typically that differences between the various alternatives tend to be small, and there has been no formal way of balancing the importance of each performance measure against the others and treating them as a meaningful group. The performance measures include the standard score above 17 feet NGVD, standard score below 10 feet NGVD, standard score above stage envelope and standard score below stage envelope.

E.1.4.5.2 Evaluation Tool Used

LOOPS is a hydrologic routing screening model that simulates Lake Okeechobee stages and discharges through the primary outlets as prescribed by a user-defined regulation schedule. LOOPS was the model used to consider the volumes of water delivered to be "fixed" and the model would be used to identify Lake Okeechobee operations that take advantage of the flexibility within LORS to provide better deliveries to the estuaries (less high flows, more detail on time series of deliveries), evaluate Lake Okeechobee stage through time, and improve water supply for the Lake Okeechobee Service Area (reduced water supply cutbacks) for each of the flow volumes selected from the Tier 1 modeling.

E.1.4.5.3 Scoring Methodology

In the case of evaluating Lake Okeechobee model output for CEPP screening above the red line, it was decided to assign relative weights to each of the four performance measures, which themselves are all normalized to a scale of 0 to 100%, and then to combine the weighted scores to obtain a Lake Okeechobee total value for each screening alternative. The weighting factors used were as follows: standard score above 17 feet NGVD 50%, standard score below 10 feet NGVD 25%, standard score above stage envelope 15% and standard score below stage envelope 10%. The assignment of weighting factors was based on nearly 20 years of Lake Okeechobee data which generally indicate that the most significant factor affecting Lake ecological health are stages above 17feet NGVD which tend to have devastating and cascading effects on lake vegetation and their associated faunal communities. Following stages over 17 feet NGVD, the most important ecological factors in descending order are then considered to be stages under10 feet NGVD which dry out the entire littoral zone, and deviations above and below the stage envelope which, though ecologically sub-optimal do not necessarily mediate against a viable vegetation community although the relative ratio and distribution of terrestrial, emergent wetland, and submerged vegetation may vary over a wide geographic range.

The decision to sum the resultant performance measure weighted values to obtain a cumulative score for each alternative was based on the assumption that total Lake ecological performance is based on the combined effect of the key hydrologic conditions reflected by the performance measures as they are distributed over the course of the period of record (POR). Rather than using a descriptive narrative approach to establishing quartile rankings for Lake Okeechobee, it was decided to use a series of ranges and thresholds of cumulatively weighted scores instead. This decision was based on the difficulty of establishing sufficiently quantitative narrative descriptions that adequately reflected the interactions between the key hydrologic factors represented by the Lake Okeechobee RECOVER performance measures and could still be directly used to evaluate the scores generated by the alternative ranking process. The quartile ranges (**Table E.1-13**) and thresholds (below) were developed based on model output for the most recent best performing and worst performing Lake Okeechobee operating schedules; LORS 2008 (Lake Okeechobee Regulation Schedule 2008) plus Adaptive Protocols and WSE (Water Supply and Environment) respectively.

Table E.1-13. Quartile scoring for Lake Okeechobee performance

Quartile	Cumulative Score	Best
4	>90%	
3	80%-90%	to
2	70%-80%	
1	< 70%	Worst

E.1.4.5.4 Criteria Results

Adaptive Protocols yielded a cumulative score above the mid 80% range (**Table E.1-14**). While Adaptive Protocols is probably the best recent schedule and resolves a large portion of the Lake's over 17 feet NGVD issues, it also results in more frequent events below 10 feet NGVD, which while potentially damaging, are less so than extreme high lake stage events. It also has relatively modest scores for time within the stage envelope (standard score above and standard score below the envelope) which could stand significant improvement. Therefore Quartile 3 was set to encompass the range characterized by the Adaptive Protocols run and considering that improving low Lake Stage events and the time within the Lake stage envelope would result in additional improvements in lake performance the threshold for the transition to Quartile 4 was set at 90%. Using a similar approach, the WSE base run yielded a score in the mid 70% range (**Table E.1-14**). WSE results in too many excessively high, potentially ecologically damaging, lake stages and also has relatively modest scores within the stage envelope (with a tendency for excursions to be in the less preferred above rather than below the envelope range) which could likewise stand significant improvement). Hence the range for Quartile 2 was set to encompass the performance of WSE. Anything with performance markedly worse than WSE would most likely have dire consequences for lake ecology, so the threshold for a descent into Quartile 1 was set at 70%.

Using the method described, all the results, except for the WSE base run fall into Quartile 3 (**Table E.1-14**). Within Quartile 3, the best performer is Adaptive Protocols and the worst performer is the estuarine optimization for medium everglades flow. The medium everglades flow Lake Okeechobee optimization run score is nearly the same as the Adaptive Protocols score which makes it the preferred option from the perspective of Lake Okeechobee ecology. However, there are several options that are either as good as, nearly as good as, or slightly better than LORS 08, which despite its tendency to cause more low lake stage events than Adaptive Protocols, is an acceptable schedule from a Lake ecology perspective. These runs include the Lake Okeechobee optimization for low everglades flow, the water supply optimization for medium everglades flow, and the Lake Okeechobee optimization for high everglades flow. It should be noted that none of the estuarine optimization runs performed as well as LORS 08, primarily because they appear to both remove some degree of protection from events above 17 feet NGVD while at the same time increasing the occurrence of events below 10 feet NGVD; indicating an operating schedule with more excursions into both the upper and lower ranges of potentially ecologically damaging Lake stage.

Table E.1-14. Lake Okeechobee results

	Baselines			Low Everglades Flow			Medium Everglades Flow			High Everglades Flow		
Lake Operation	WSE	LORS08	AP5.50	LOKOPT	WSOPT	ESTOPT	LOKOPT	WSOPT	ESTOPT	LOKOPT	WSOPT	ESTOPT
SSA	51.3	81.0	76.3	67.8	61.2	67.2	71.1	63.5	66.9	69.3	66.7	69.9
SSB	70.0	30.7	41.4	48.9	56.3	47.0	50.5	57.4	45.2	47.9	50.8	45.5
SS>17	78.6	99.1	98.7	97.5	95.7	96.1	97.6	95.9	95.6	97.3	96.6	96.2
SS<10	95.7	86.1	90.3	90.4	92.3	90.0	91.0	92.1	89.2	89.7	89.8	89.3
Weighted SS	77.9	86.3	87.5	86.4	85.7	85.3	87.3	86.3	84.7	86.2	85.8	85.5

E.1.4.6 Adaptability (Level 2)

E.1.4.6.1 Criteria Description

Adaptability was composed of three sub-criteria.

- Flexibility: Speed, ease, efficiency of moving water to adjust to changing conditions such as storms or other real-time needs.
- Robustness: Ability to function effectively in the face of variability and uncertainty of future events (NRC 2007). Ability to perform under broad shifts, such as climate change.
- Future compatibility: Efficiency of using this configuration to complement future CEPP increments.

E.1.4.6.2 Evaluation Tool Used

There was no specific model used to evaluate the adaptability of storage and treatment options, but a rigorous examination of the option's conceptual design was conducted by an interdisciplinary team of scientists, engineers and planners to identify expected trends and use best professional judgment to score options. The following parameters were used to help guide ratings.

- Greater degree of storage → more flexibility and robustness.
- Greater degree of STAs → Less flexibility and robustness.
- FEB or shallow storage → Easier to retrofit.
- STA → Difficult to retrofit

E.1.4.6.3 Scoring Methodology

Components and operations easy and most efficient to adjust = 4
Components and operations are moderately simple to adjust = 3
Components and operations adjustment is expensive and time consuming = 2
Components and operations difficult or slow to adjust = 1

E.1.4.6.4 Criteria Results

Results are presented in **Table E.1-15**.

Table E.1-15. Results of adaptability analysis

		Flexibility of Operations	Robustness	Future compatibility	Average Rating
4' Reservoir	24000 Res & 4000 STA	2	2	4	3
	14000 RES & 14000 STA	2	2	3	2
6' Reservoir	24000 Res & 4000 STA	3	3	3	3
	11000 RES & 17000 STA	2	2	2	2
12' Reservoir	24000 Res & 4000 STA	4	4	3	4
	21500 Res & 6500 STA	4	4	3	4
	17000 Res and 11000 STA	3	3	2	3
FEB	All FEB	1	2	4	2
STA	All STA	1	1	2	1

E.1.4.7 On-site Habitat (Level 2)

E.1.4.7.1 Criteria Description

Measure of the potential for wetland and aquatic wildlife within the footprint of the storage and treatment components.

- Based on Florida regulatory methodologies
- Not to be utilized to compare to natural areas within the Everglades (WCA 3, ENP, etc.)
- 3 sub-criteria:
  - Wildlife Utilization
  - Vegetation
  - Hydrology
- Descriptions are specific to the component types

E.1.4.7.2 Evaluation Tool Used

There was no specific model used to evaluate the on-site habitat for storage and treatment options, but an evaluation was conducted by an interdisciplinary team of scientists and planners to rate each storage and treatment feature (STA, FEB, 4 ft reservoir, 6' reservoir and 12' reservoir) based on Florida regulatory methodologies for vegetation, hydrology and wildlife utilization as described below (**Table E.1- 16**). The scores were averaged to give one on-site habitat score for each storage and treatment option. Those scores were then used to calculate a score for each storage and treatment combination based upon the acreage for each feature (**Table E.1- 17**)

E.1.4.7.3 Scoring Methodology

Performance of the various options were rated by assigning scores relating to four categories of outcome, with a score of one being the worst, and four being the best.

A. Vegetation:

4 – Desirable species and cover/ no dense cattail; healthy vegetation, strong natural recruitment; <10% exotic
3 – Moderate vegetative cover/some dense cattail; healthy with sufficient natural recruitment; <25% exotics
2 – Limited vegetative cover/large areas of dense cattail; vegetation stressed, little natural recruitment (plantings necessary); <50% exotics or undesirable species
1 – Little or no vegetative cover/dense cattail throughout; unhealthy vegetation, no natural recruitment, plantings difficult to establish; >50% exotics or undesirable species

B. Hydrology

4 – Supports favorable habitat; fish, aquatic species populations flourishing; no dry downs or dryouts; optimal dissolved oxygen levels.
3 – Adequate support of habitat; fish, aquatic species sustained; dry downs and/or dryouts during droughts only; sufficient dissolved oxygen.
2 – Highly fluctuating or poorly maintained water levels; sparse populations of fish and aquatic species; intermittent dry downs and/or dryouts; reduced dissolved oxygen.
1 – Water levels inadequate to sustain habitat; fish and amphibian mortality evident; frequent and/or severe dry downs and/or dryouts; insufficient dissolved oxygen.

C. Wildlife Utilization

4 – Substantial avian and reptile utilization; abundant cover and food; ample foraging and nesting; fish, macroinvertebrate and amphibian populations thriving.
3 – Some avian and small to medium-sized reptile utilization; adequate cover and food; sufficient foraging and nesting; fish, macroinvertebrate and amphibian populations sustainable.
2 – Minimal wildlife utilization; sparse cover and inadequate food; limited foraging and nesting; poor maintenance of fish, macroinvertebrate and amphibian populations.
1 – No wildlife utilization; little/no cover or food; foraging and nesting areas absent; deficient fish, macroinvertebrate and amphibian populations.

E.1.4.7.4 Criteria Results

A. Vegetation

STA Rating: 3 Moderate vegetative cover with some dense areas of cattail (area not managed for cattail reduction); Most vegetation healthy with substantial natural recruitment and sustained growth occurring.
FEB Rating: 3 Moderate vegetative cover with some dense areas of cattail (area not managed for cattail reduction); Most vegetation healthy with substantial natural recruitment and sustained growth occurring.
4' Reservoir rating: 1 Little to no vegetative cover due to substantially fluctuating water levels throughout; Any vegetation becoming established unhealthy; plantings unable to become established.
6' Reservoir rating: 1 Little to no vegetative cover due to substantially fluctuating water levels throughout; Any vegetation becoming established unhealthy; plantings unable to become established.
12' Reservoir Rating: * Not rated. This area would not be able to maintain vegetation.

B. Hydrology

STA Rating: 4 STA would remain hydrated with water levels supporting favorable habitat; no dry downs or dryouts; aquatic organisms would flourish.
FEB Rating: 4 FTW would remain hydrated with water levels supporting favorable habitat; no dry downs or dryouts would occur; aquatic organisms would flourish.
4' Reservoir rating: 2 Highly fluctuating water levels with frequent dry downs and dryouts during drought periods; reduced DO levels due to shallowness; sparse populations of fish and aquatic species poorly maintained.
6' Reservoir rating: 2 Highly fluctuating water levels with frequent dry downs and dryouts during drought periods; reduced DO levels due to shallowness; sparse populations of fish and aquatic species poorly maintained.
12' Reservoir rating: 3 Adequate water levels some fluctuation; dry downs and dryouts during drought periods; sufficient DO levels when flooded; fish and aquatic species populations sustainable.

C. Wildlife Utilization

STA Rating: 4 Substantial utilization by numerous avian species and reptiles; abundant cover and food sources for migratory animals; ample foraging and nesting areas for resident species.
FEB Rating: 4 Substantial utilization by numerous avian species and reptiles; abundant cover and food sources for migratory animals; ample foraging and nesting areas for resident species.
4' Reservoir rating: 2 Poor wildlife utilization with food sources becoming established only during wet periods; Foraging areas mainly absent; Minimal fish, macroinvertebrate and amphibian populations with significant mortality during droughts.
6' Reservoir rating: 2 Poor wildlife utilization with food sources becoming established only during wet periods; Foraging areas mainly absent; Minimal fish, macroinvertebrate and amphibian populations with significant mortality during droughts.
12' Reservoir rating: 2 Poor wildlife utilization with food sources becoming established only during wet periods; Foraging areas mainly absent; Minimal fish, macroinvertebrate and amphibian populations with significant mortality during droughts.

Table E.1- 16. Rating for each feature for vegetation, hydrology and wildlife utilization.

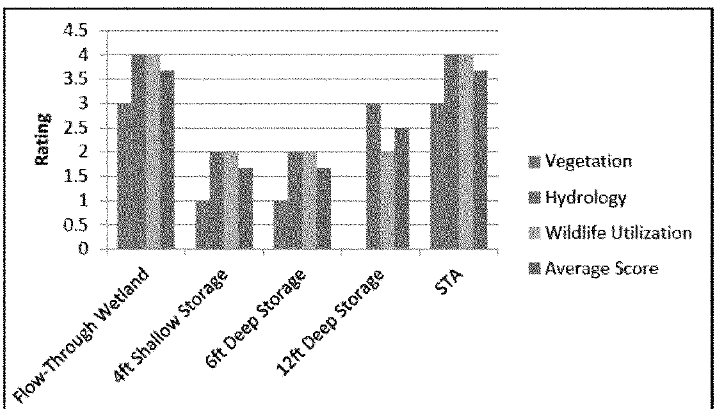


Table E.1- 17. Onsite Habitat Ratings

Storage and Treatment Combination	Vegetation Acreage (combined ranking factor*acreage)	Hydrology Acreage (combined ranking factor*acreage)	Wildlife Utilization Acreage (combined ranking factor*acreage)	Onsite Habitat Total (average of the three)	Onsite Habitat Rating (average of the three based on % of acreage)
4ft Shallow Storage & STA					
24000 Res & 4000 STA	9000	16000	16000	**13667**	**2**
14000 RES & 14000 STA	14000	21000	21000	**18667**	**3**
12 ft Deep Storage & STA					
24000 Res & 4000 STA		22000	16000	**19000**	**3**
21000 Res & 7000 STA		22750	17500	**20125**	**3**
17000 Res and 11000 STA		23750	19500	**21625**	**3**
6ft Deep Storage & STA					
24000 Res & 4000 STA	9000	16000	16000	**13667**	**2**
11000 RES & 17000 STA	15500	22500	22500	**20167**	**3**
Flow-Through Wetland/FEB					
28000	21000	28000	28000	**25667**	**4**
STA					
28000 STA	21000	28000	28000	**25667**	**4**

E.1.5 Storage and Treatment Options – MCDA and Cost Effective Results

The screening effort resulted in 2 cost-effective measures with wide differences in costs. The results of the level 2 criteria supported the Level 1 analysis, and did not lead to the identification of further options to be considered for inclusion in the final array of alternatives. **Table E.1-18** provides sums of the scores from **Tables E.1-5, E.1-7, E.1-12, E.1-15, and E.1-17.** There are two cost effective options that were identified. These options performed best in the MCDA analysis for the lowest comparative cost. The two alternatives are as follows:

- A 28,000 acre Flow Equalization Basin (FEB) with Lake Okeechobee operations optimized for water supply is the least cost option at an expected cost range of $700-900 million. This option is estimated to provide approximately 200,000 ac/ft of additional water annually to the Everglades system.
- A 12ft Deep Reservoir, also optimized with Lake Okeechobee operations focused on water supply, provides the greatest benefits to the everglades. This reservoir is sized at 21,000 acres with an additional 7,000 acre STA to handle the water stored that would exceed the limitations of the existing STA system. The expected cost is $1.8-2.0 billion.

Table E.1-18. Results of scoring for all storage and treatment criteria

Management Measure Configuration			Level 1 Objectives Sub Total	Level 1 + Level 2 Total Score	Total Cost (Capital and O&M)
Flow-Through Wetland/FEB					
FEB	Reservoir	LO Ops			
28000		190-Est	6	12	700 - 900
		190-WS	8	14	700 - 900
		190-LO	7	13	700 - 900
4ft Shallow Storage & STA					
STA	Reservoir	LO Ops			
4000	24000	190-Est	5	9	770 - 970
		190-LO	6	10	770 - 970
		190-WS	7	11	770 - 970
14000	14000	190-Est	5	10	950 - 1050
		190-LO	6	11	950 - 1050
		190-WS	7	12	950 - 1050
6ft Deep Storage & STA					
STA	Reservoir	LO Ops			
4000	24000	190-Est	5	10	1020 - 1220
		190-WS	7	12	1020 - 1220
		190-LO	6	11	1020 - 1220
17000	11000	190-Est	5	10	1144 - 1344
		190-WS	7	12	1144 - 1344
		190-LO	6	11	1144 - 1344
12 ft Deep Storage & STA					
STA	Reservoir	LO Ops			
4000	24000	140-Est	6	13	1765 - 1915
		140-WS	7	14	1765 - 1915
		140-LO	6	13	1765 - 1915
7000	21000	240-Est	8	15	1820 - 1960
		240-WS	9	16	1820 - 1960
		240-LO	9	16	1820 - 1960
11000	17000	190-Est	7	13	1900 - 2030
		190-WS	9	15	1900 - 2030
		190-LO	8	14	1900 - 2030
STA					
STA	Reservoir	LO Ops			
28000		140-Est	5	11	1020 - 1120
		140-WS	6	12	1020 - 1120
		140-LO	5	11	1020 - 1120

E.2 DISTRIBUTION AND CONVEYANCE – NORTHERN WCA 3A

CEPP considered previously conducted plan formulation, screening and modeling data from the Decomp Study effort, which helped provide a basis for identification of the initial array of options to be analyzed through the CEPP formulation process. This initial array utilized the existing water budget entering WCA 3A, and while providing invaluable insight and information, further modification and evaluation of these options was needed when considering the additional water provided by the FEB and Lake Okeechobee operational refinements. **Sections E.2.3, E.2.4 and E.2.5** describe the process and results of the previous screening and modeling using the existing water budget. **Section E.2.6** contains details of the analysis used to build upon and modify the conclusions drawn from the preliminary modeling and screening effort.

E.2.1 Northern Distribution and Conveyance Management Measures

E.2.1.1 Northern Distribution Management Measures

Spreader Canal: A Spreader Canal along the L-5 levee could be utilized to distribute freshwater flows more effectively and promote hydropattern development and restoration. The spreader canal would need an appropriately-sized pump station to deliver flows into the segment of canal. The C-111 Spreader Canal Design Test demonstrated that a Spreader Canal feature can be extremely effective in reducing water recession rates during the dry season, which would promote the restoration of seasonal hydroperiods, improve surface water depths and durations, and also contribute to timing improvements for water deliveries by encouraging a more natural distribution of water across the EAA/WCA 3A boundary. A spreader canal was retained for further consideration in alternative development.

Levee Removal: Levees such as the L-67A would be completely removed in order to re-establish water flows. The removal of the levees would restore the sheet flow directionality and improve hydroperiods by ensuring a more consistent distribution of water. Additionally, the removal of these barriers would eliminate substantial fragmentation that inhibits animal movement and decreases habitat value. Material would be disposed of onsite through the incorporation into other features or may need to be transported offsite, which would increase project costs. Levee removal, with significant potential benefits, was retained as a measure for possible inclusion into components and alternatives.

Levee Gaps: Levees such as the L-67A would be degraded in certain areas to allow water flows from WCA 3A to WCA 3B. The levee gaps may have control structures for operational control to prevent water flows into WCA 3B during extreme high water events. Some improvements in habitat value would occur with the increased water flows from this measure, with reduced fragmentation leading to a healthier ecosystem. This measure would likely be less costly when compared to complete levee removal if the material is not needed for related management measure construction; however, there would be more likelihood that some hydropattern restoration may be impeded by remaining portions of the levees. As such, levee gaps, although not quite as effective as levee removal but with possible cost savings, was retained as a management measure.

Pump Stations: Pump stations could be constructed to introduce water at additional locations along the L-5 and provide greater distribution of water into WCA 3. Additionally, pump stations may be necessary to supplement some components such as spreader or collection canals. This measure was retained for further consideration.

Levee/Berm Construction: The construction of levees/berms within the WCAs could be utilized to guide surface water along preferential flow paths for distribution. Certain portions of WCA 3 may be situated in an area where additional structures are necessary to steer water flows into the area. The strategic placement of these levees/berms could reduce ponding in some areas while diverting surface flows to other areas that are typically dry. Additionally, levee/berm construction could direct water away from the eastern levees, reducing the possible need for seepage control with increased flows into the WCAs. This measure was retained.

Flow-through Wetlonds (Restored Wetlands): A Flow-through is a measure that is similar to the Flow Way feature that was evaluated as a water storage measure. A Flow-through would be used primarily for the distribution of freshwater, promoting the restoration of seasonal hydroperiods within the remnant Everglades areas in the EAA. A Flow-through would not be utilized within the areas identified for the quantity/quality measures. Areas that could be utilized as a Flow-through include the Holey Land and other possible large tracts of land.

Conveyance Canal Modifications (L-5 and L-6): The L-5 and L-6 canals would be widened to allow for the benefits diversion of treated water from STA 2 into Northern WCA 3A, in lieu of being discharged into WCA 2A. This would entail potential excavation of the canals and the construction of control structures to ensure proper routing of water. This measure would provide needed water to WCA 3A and prevent further exaceration of ponding issues in WCA 2.

E.2.1.1.1 Holey Land Flow-through Wetland Screening

The desire to integrate restoration of Holey Land into the Central Everglades Planning Project was brought up by many stakeholders both during the scoping phase and during the formulation phase. The Holey Land Wildlife Management Area consists of approximately 35,336 acres situated directly south of the A2 parcel considered for CEPP treatment and storage features. Although Holey Land restoration was not a specific goal of CEPP it was recognized that utilizing Holey Land as a flow through system could potentially provide additional added benefits to WCA 3A deliveries by providing additional storage and potentially improved deliveries.

Preservation and restoration efforts for Holey Lands have been ongoing since the early 1970's when the State of Florida Board of Trustees purchased much of the land in the Holey Lands and Rotenberger tracts. The initial restoration plans were formalized in 1983 when Florida Fish and Wildlife Conservation Commission (FWC formerly GFC), Florida Department of Environmental Protection (FDEP formerly DER) and South Florida Water Management District entered into a Memorandum of Understanding (MOU) for the Holey Land and Rotenberger Project. The MOU established a general agreement about how the State would proceed with restoration of the Holey Land and Rotenberger tracts and provided a funding source for the project. In 1984 FDEP issued a permit (06 and 50-0809209) to "restore natural vegetation and characteristics to Holey Land." Permit authorized construction of a 50 cfs pump station, levees and 3 outflow structures, and included monitoring requirements for vegetation surveys and water quality sampling.

Project construction was completed by 1992 and operations of the 750 cfs G 200A pump station started operations in November 1992. The initial operations were implemented according to a water regulation schedule of 11.5' to 13.5' NGVD to establish a maximum intended inundation depth of 2 feet as part of an "Initial Operational Plan" that was formalized in 1990. Based upon monitoring, better understanding of the topography and observation of the system response the Fish and Wildlife Commission recommended modifying the Initial Operational Plan, some of which was implemented to address high water concerns. The inability to get water out of Holey Land was part of the part of the recognized problem as the outflow structures were located along the higher grounds along the south project boundary. The new operations were never formalized. In 2005, hurricane Wilma damages the G 200A pump station beyond repairs, and the project has not been operational since then.

When considering integrating restoration of the Holey Land into CEPP we tried to build on what we had learned from the past, and we used the following Fish and Wildlife Conservation Commission's (FWC) recommended goals for Holey Land to aid in designing a restoration plan:

- The average depth of the interior of the marsh that ranges from:
  0.75 to 1.0 ft above average ground elevation for Holey Land WMA. The maximum depth should not exceed 1.5 ft and the minimum depth should not fall below -0.5 ft.
- The hydroperiod should range from 80-90% annually over at least 50% of Holey Land WMA.
- Recession rates: Average 0.05 ft/week from January 1 to June 1.
- Ascension rates: Average 0.05 – 0.10 ft/week from June 1 to October 1; not exceed 0.25ft/wk.
- Water quality should not exceed 40ppb.
- Water flow patterns should be consistent with that of the topography.
- Holey Land WMA should be a flow-through system.

A preliminary Holey Land Alternative was developed as part of the RESOPS modeling effort that was carried out north of the Red Line. For these preliminary runs we assumed replacement of G-200A pump station at the northeast corner (3 units-250 cfs each), and 3 outflow control structures similar to G204, G205 and G206 (3 structures - 250 cfs outflow each), located along the lower ground elevations at the east side of the Holey Land parcel. The estimated cost for the infrastructure was $16 million (compared to preliminary relative cost of $175 million for the FEB).

A method for determining water depths at the center of Holey Land was developed to help determine how the system could be operated using the proposed infrastructure (Predicting Water Levels at the center of Holey Land Report, May 2012). It was concluded that the FWC goals of having a flow through system with maximum water depth of 1.5 feet could be achieved by operating the inflow and outflow structures in a pulse like manner. In order not to stage up too high on the downstream side (east side of Holey Land parcel), the engineer found that you must limit deliveries to 7 days at 750 cfs, then shut down for 7 days before you start pumping again (7 days on/off to avoid higher ponding along east side) . This meant that maximum inflows are 21,000 acre-feet/month.

Refined RESOPS modeling was done to determine how much addition benefits could be derived based upon Level 1 screening criteria. Specifically additional flows and dry season score were calculated to ensure that the proposed design refinements would meet the overall project objectives of improving deliveries to the Everglades. Refinements to RESOPS were done by placing Holey lands downstream of the Reservoir (FEB) feature and upstream of the STA. If water was available in the reservoir and was not needed for the STAs and Everglades deliveries, RESOPS was modified to allow deliveries to Holey Land. The refined RESOPS runs predicted that ~31 kac-ft of water on an average annual basis could be sent to Holey Land. Provisional outcomes of DMSTA indicated that when considering FEB hydraulic constraints, a smaller amount of ~ 21 kac-ft could be passed into Holey Land and under the assumption that no additional treatment is provided, this would raise the average annual "mixed" outflow concentration by about 0.5 ppb. This would still keep us under the WQBEL annual average target of 13.0 ppb.

In the end the consideration of integrating restoration of Holey Land by allowing discharges from the proposed new FEB to be redirected to the Holey Land as described above by the proposed new infrastructure, was eliminated from consideration due to water quality concerns raised by environmental stakeholder groups (Florida Wildlife Federation and others). The stakeholder groups felt that there was not sufficient treatment in the FEB and that we should not consider discharging water into Holey Land that does not first come through one of the Everglades Stormwater Treatment Areas (STAs), where higher treatment can be achieved to meet the discharge requirements that are protective of the Everglades Protection Area marsh (13 ppb WQBEL). Holey Land is not part of the Everglades where the long term 10 ppb standard applies, however, Holey Land is an Outstanding Florida Waters where special consideration is given to water quality and that the project is clearly in the public interest. Since there was not broad public support for the proposed Holey Land Alternative, this alternative was eliminated from consideration.

E.2.1.2 Northern WCA 3A Conveyance Management Measures

Plug Canal to Marsh Grade: A series of large, earthen plugs or others of acceptable material would be constructed within strategic segments of the Miami Canal in order to eliminate canal flow, promote natural hydropatterns and reduce any drainage effects that may be occurring. Some recreational opportunities such as fishing may be diminished as a result of the reductions and possible elimination of open canal area. Modeling for the Decomp PIR planning effort demonstrated that some plug configurations may be nearly as hydrologically effective as some partial backfill configurations. As such, plugging of the canal to marsh grade was retained as a potential measure.

Backfill Canal to Marsh Grade: Portions or entire lengths of the existing Miami Canal could be completely backfilled with clean fill material to marsh grade. Backfill of the canal would promote sheet flow and eliminate any drainage effects and alteration of hydropatterns that are occurring. It would also restore the ecological connectivity of WCA 3. Some recreational opportunities such as fishing may be diminished as a result of the reduction in open canal area. Backfilling of the Miami Canal was demonstrated to be effective during a previous modeling effort conducted for the Decomp PIR planning effort. As such, backfilling of the canal to marsh grade was retained as a potential measure.

Spoil Mound or Berm Removal: The Miami Canal traverses approximately 26 miles within WCA 3A, running in a southeasterly direction until it reaches the L-67 A/C system at S-151. Excavated material from the canal construction was placed alongside the canal as spoil mounds or berms. A number of these have been planted with native vegetation by the Florida Fish and Wildlife Conservation Commission (FWC) and differ from natural tree islands by vegetation communities present, soil composition, elevation gradients, and shape; some have also been colonized by exotic vegetation. With this measure, existing spoil mounds or portions of the berms would be removed to promote improved sheet flow and improve freshwater distribution. FWC planted areas could be retained and/or reshaped to promote habitat utilization. Spoil would either be utilized for other project purposes such as backfill or would be transported offsite for proper disposal. Spoil mound or berm removal and reshaping was retained as a measure.

Above- or In-Ground Pipeline: Pipelines would be constructed to convey water down the Miami Canal to the South Dade Conveyance System. Substantial backfill would be required to augment a pipeline. Pipelines would allow for the re-establishment of surface landscapes, promoting re-vegetation and sheet flow characteristics. Although pipelines may be effective in routing water and allowing restoration above those areas, there would likely be excessive construction and maintenance costs. For an in-ground pipeline, there may be some hindrance of lateral groundwater movement on a local scale.

Secondary effects would likely occur as a result of the construction, particularly if any significant excavation and/or blasting are required. Also, water entering the pipeline would likely be of relatively poorer quality than water that currently exists in well fields and canals in the area where the pipe would discharge. Water discharging from the pipeline would need to be treated for nutrients, and other water quality concerns such as dissolved oxygen. Water discharged from the pipeline would also not receive the benefits of natural treatment through ground and surface water interactions with the surrounding marsh.

For an Above-Ground Pipeline, although maintenance and construction costs could likely be minimized, there would be a tremendous aesthetic impact on the Everglades system. A visible pipeline constructed through the central part of the historical River of Grass would be an extremely detrimental effect on a cultural resource. Due to the factors documented above, both an in-ground and above-ground pipeline were eliminated from consideration.

Shallowing of Canals: Canals would be partially filled to elevations slightly less than marsh grade. Conveyance capacity of the canal would be reduced, lessening the drainage effects and improving local hydrology. The shallowed canal may allow for some "spillage" into the surrounding marsh. Although there would likely be some short-term improvement in flows some distance from the canal, wetland and riverine systems have shown tendencies to either return to historical patterns or develop new, unpredictable flow paths. As such, it is extremely unlikely that the shallowing measure would be highly effective, and may actually disrupt the formation of natural hydropatterns once surface water depths have been restored. Recreational opportunities such as fishing may be diminished.

In addition, modeling was conducted during the Decomp PIR effort to examine the efficacy of a shallowing measure by testing a reduced canal conveyance (50% backfill) capacity of the Miami Canal. Modeling results indicated that overall performance of the reduced canal conveyance simulation was almost identical to no backfill simulation. Shallowing the canal did not remove the drainage effects of the existing canal on the adjacent landscape. As such, this measure was eliminated from further consideration.

Cap Canals: A concrete slab could be constructed across the canal and covered with clean fill material to marsh grade. Water could still be delivered within the existing canal while sheet flow would still occur across the capped portion. This measure would be difficult to maintain as any work within the canal would require removal of the surface material and cap from a flooded marsh. Additionally, the cost for maintenance would be extremely high given the time required and other issues such as possible dewatering for surface cap removal. Additionally, there would still likely be hydraulic effects associated with the canal, and a system would be created where groundwater flows were not consistent with surface water directionality. As such, due to concerns with groundwater uncertainties and high maintenance with associated costs, this measure has been eliminated from further consideration.

E.2.2 Screening of Distribution and Conveyance Management Measures

These distribution and Conveyance measures were screened using the following criteria:

Effectiveness: ability to meet objectives and avoid constraints
Environmental Effects: avoidance of substantial negative impacts
Maintenance: avoid measures that are difficult / costly to manage and maintain

Screening results are presented in **Table E.1-19**. Measures not retained are marked with "x". Management Measures such as littoral shelves in canals, creation of tree islands, exotic removal along levees, etc., were not evaluated in the initial screening process as those features would generally not influence modeling outcome or affect comparison of alternatives; however, they will be considered during design of the final array of alternatives as there may be associated costs and construction requirements with these minor features.

Table E.1-19. Northern WCA 3A Management Measure Screening Results

	Screening Criteria		
	Effectiveness/ Project Objectives	**Maintenance Considerations**	**Environmental & Secondary Effects**
DISTRIBUTION (Across WCA 3A) – Hydropattern Restoration Features			
Spreader Canal	Retained		
Levee Removal	Retained		
Levee Degradation/Gaps	Retained		
New Pump Station/Pump Station Modifications	Retained		
Levee/Berm Construction	x		
Flow-through Wetland (Holey Land WMA)			x
Conveyance Canal Modifications (L-5 and L-6)	Retained		
CONVEYANCE (To/Within WCA 3A) - Miami Canal Features			
Plug Miami Canal to Marsh Grade	Retained		
Backfill Miami Canal to Marsh Grade	Retained		
Spoil Mound Removal along Miami Canal	Retained		
Above/In-Ground Pipeline		x	x
Shallowing of Miami Canal	x		x
Cap Miami Canal		x	

E.2.2.1 Preliminary Formulation of Distribution Components

E.2.2.1.1 Siting of Distribution Components

Northern WCA 3A contains three primary conveyance canals that were identified as an efficient means to locate distribution measures:

- L-4 (west of the Miami Canal),
- L-5 (between the North New River Canal and the Miami Canal),
- Remnant L-5 (South of STA 3/4 the L-5 Canal).

Three reaches were established that correspond to these three canals to systematically identify the most efficient locations to distribute water across Northern WCA 3A. Two additional reaches were established which essentially bisect the Northern extent of WCA 3A and were included as management measure locations. Six Hydropattern Restoration Features (HRF) locations were identified from the physical characteristics of Northern WCA 3A and the existing canal system to evaluate locations to distribute water across Northern WCA 3A. Hydropattern Restoration Features are management measures along the northern boundary of WCA 3A that provide a means for distributing treated STA discharges into northern WCA 3A in a manner that will aid in restoration of natural sheetflow from the northern boundary of WCA 3A to the south

All combined HRF alternative configurations were initially developed to maintain the current design capacity of approximately 4,200 cfs. The existing inflows to northern and eastern WCA 3A are through the S-8 pump station (design capacity of 4,170 cfs), the S-7 pump station (design capacity of 2,490 cfs) via the S-11 structures, and S-150 (design capacity of 1000 cfs) (**Figure E.1- 8**).

Three configurations were established that essentially trisect Northern WCA 3A

- East (remnant L-5 from the STA3/4 outlet canal to S-7)
- West (West of S-8): L-4 canal from L-28 intersection to S-8
- Mid (L-5 Canal from S-8 to the STA 3/4 outlet canal)

Two configurations sub-divide Northern WCA 3A

- West of G-205 (western half of Northern WCA 3A)
- East of G-205 (eastern half of Northern WCA 3A)

One distributes water across the entire Northern WCA 3A boundary

- Full (L-4/L-3 intersection to S-150)

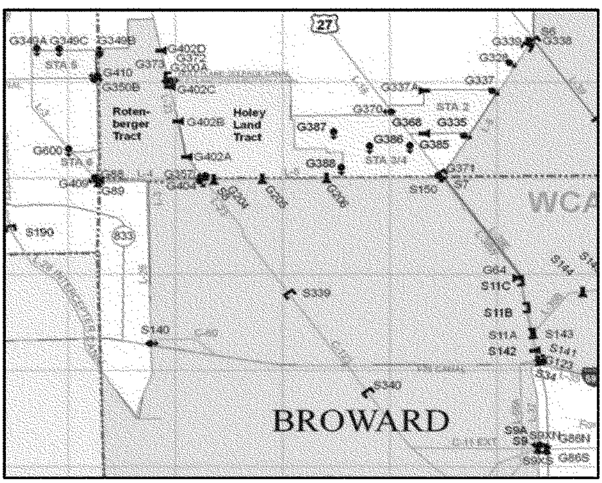


Figure E.1- 8. WCA 3 Structures Map

E.2.2.1.2 Initial Distribution Screening Criteria

Screening criteria were developed to further reduce the initial list of HRF management measures. The screening criteria include 1) flexibility to move water where most needed, 2) promotes longer flow path through WCA 3A (connectivity), 3) maximizes sheetflow objectives (overall distribution – includes minimizing short-circuiting along eastern and western boundaries), 4) minimizes likelihood to increase phosphorus movement from impacted areas, 5) best addresses dry-outs in over-drained areas, 6) maximizes potential to restore and sustain ridge and slough pattern and tree islands where desired, 7) improves conditions for wading birds (foraging/nesting), 8) maximizes spatial extent, and are further described below:

1) Flexibility to move water where most needed

The northwest area of WCA 3A is subject to prolonged dry-outs causing loss of peat soils through oxidation and fires which alters the historical water depth to soil elevation gradients in this region. This has contributed to encroachment of undesirable vegetation such as cattail and willow that are replacing the sawgrass and wet prairie communities. Rehydrating this part of the Everglades will require adaptive management of the flow regimes and water depths over an extended period of time to both stimulate vegetation pattern changes and to allow time for the plant communities to adjust to new conditions. Accordingly, alternatives that provide the greatest flexibility in distributing water flows to meet environmental objectives are more desirable than options with less flexibility. In addition, the quantity of treated water generated by the regional STAs (principally STA 3/4 and STA 5/STA 6/Compartment C; Compartment C is assumed operational for the future without project condition) varies significantly on a seasonal basis (historical STA treatment volumes are provided in **Table E.1-20**.

Table E.1-20. Quantity of Treated Water from STA 3/4.

STA-3/4			
Water Year	Treatment Area (acres)	Inflow Flow (acre ft)	Outflow Flow (acre ft)
2004	6,500	23,303	27,708
2005	12,059	671,442	648,872
2006	14,253	697,161	749,092
2007	16,161	388,471	355,423
2008	16,543	302,539	294,621
Total	13,703	2,082,916	2,075,716
Avg (exce. 1st yr)	14,754	514,903	512,002

Features that provide more capability to utilize different sources of treated water promote efficiency in delivering treated water to the marsh and allow the sheetflow objectives to be optimized over the greatest areal extent of the marsh while reducing point source deliveries. Options would be implemented to optimally use the maximum volume of treated water made available annually and distribute this volume as needed to meet specific objectives within the marsh. The current water distribution to WCA 3A relies on point-source inputs along the north border of WCA 3A via S-8 and S-150 or along the eastern border through S-7 (into WCA-2A) and subsequently through the S-11 structures. Depending on hydrologic conditions, in some years, more water may be needed to hydrate the area below the L-4 levee with less water needed on the east side below the remnant L-5 canal near S-150. Options which minimize the volume of water delivered through the existing point source locations and distribute water in the form of sheetflow across the northern boundary of WCA 3A, along the L-4, L-5 Levee and canal system are preferred. This requires integration of the existing infrastructure, to the maximum extent practicable, together with any newly-proposed structures associated with a specific alternative.

2) Promotes longer flow path through WCA 3A (connectivity)

This criterion was selected with the understanding that not all alternatives or management measures have the same potential for system scale restoration. The existing landscape has natural surface contours which promote related flows through the Greater Everglades marshes. The predominant topography slopes from the northwest (NW) to southeast (SE), roughly paralleling the Miami Canal (**Figure E.1- 9**). Historically, once flow reached the SE corner of the current WCA 3, water then turned to the south and west through Northeast Shark River Slough. Currently, flow generally stops at the L-67A Levee and moves south and west (entering ENP through the S-333 and the S-12 structures). The flow path from the NW to the SE is the longest flow path in the northern portion of the Everglades system. Flows entering the NW edge of WCA 3A have the greatest potential for hydrating maximum acreage if only a portion of the HRF is constructed. The flow path measurements, estimated below, correspond to the current system configuration.

EMAPS Estimates (GIS/Mapping tool)
S-8 to L-67A: Straight line – 27.47 miles (15.38 miles to I-75); Topographic - 35 miles (when accounting for contours and change in flow direction approaching L-67A)
Mid/Central HRF to L-67A: Straight line – 25 miles
Eastern HRF to L-67A: Straight line – 20.87 miles

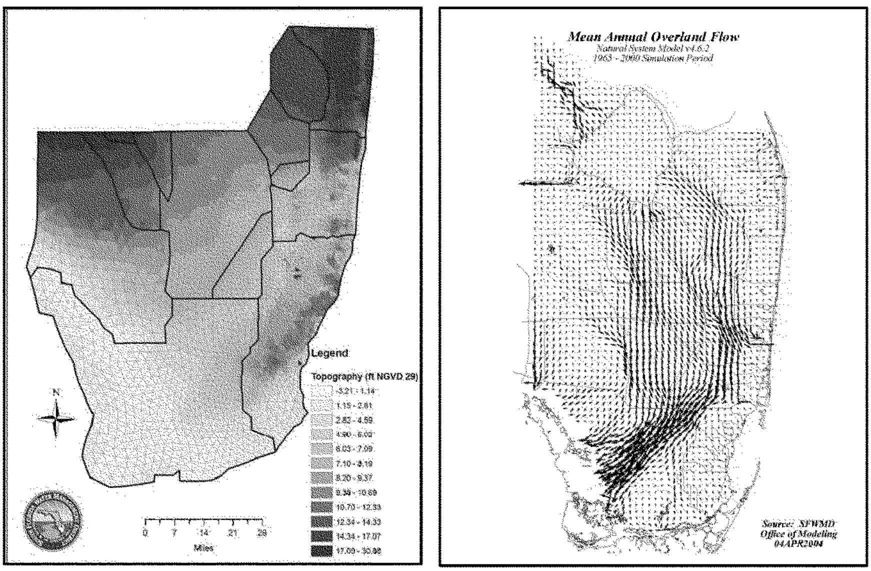


Figure E.1- 9. RSM Topography Contour Map and Mean Annual Overland Flow Map from Natural Systems Model (Version 4.6.2)

3) Maximizes sheetflow objectives (overall distribution – includes minimizing short-circuiting along eastern and western boundaries)

In order to maximize sheetflow objectives, management measures and related options should maximize the timing, distribution and continuity of sheetflow across WCA 3A. Sheetflow is generally defined as overland flow or down-gradient movement of water taking the form of a shallow, continuous layer over relatively smooth soil or rock surfaces, not concentrated within large channels. The direction of sheetflow in the pre-drainage Everglades as modeled by the Natural Systems Model (NSM) Version 4.6.2) can also be noted in **Figure E.1- 9**. Miami Canal backfill and the HRF components must function in concert and must function within the existing managed C&SF regional system. Interactions of flows may not always be beneficial under the varying configurations of each management measure. If water from the spreader canal feature immediately re-enters the Miami Canal (for example, in partial fill alternatives), the benefit of the spreader is reduced or negated via short-circuiting due to the canal. Flows down the eastern edge of WCA 3A may interact with S-11 flows leading to unfavorable ponding in northeast WCA. Additionally, alternatives that primarily focus inflows along the eastern boundary of WCA 3A would reduce the spatial extent of the marsh that historically served as a quasi-source area for surface and ground water flows from higher topographic areas (notably northwest WCA 3A) during the normal annual dry down cycle.

4) Minimizes likelihood to increase phosphorus movement from impacted areas (large volume inflow in small area)

This criterion is based upon the observation that medium to high flows through high phosphorus cattail regions will transport this phosphorus to downstream communities as a pollutant. There are high density regions of cattail along the Miami Canal, especially along its eastern border. A high density region of cattail can also be found in the eastern region of northern WCA 3A. The cattail-rich eastern region developed due to overdrained soils creating high phosphorus concentrations as a result of soil oxidation processes. Rehydration of this eastern region with water meeting state water quality standards is expected to decrease cattail expansion. With most inflows having TP concentrations of 10 ppb, project alternatives that change the way the water enters and flows through the wetlands reduced the overall water quality risk from phosphorus in most situations compared to the FWO. While there may be some resuspension of phosphorus from peat soil rewetting that could lead to some areas experiencing an increase in cattail, this did not appear to increase the eutrophication risk in the wetlands as a whole. Any resuspension of phosphorus from soils would likely be taken up quickly by phosphorus-limiting periphyton species and cycle through the peatland system processes; even if water column measurements indicate phosphorus concentrations are at natural background concentrations.

5) Best addresses dry-outs in over-drained areas

This criterion is based on the fact that northern WCA 3A is overdrained and its natural hydroperiods have been shortened. Reducing dryouts in this area will reduce the loss of peat due to peat fires and oxidation, and allow the accumulation of peat to resume. This, in turn, may shift vegetative communities from cattail back to sawgrass, through the mechanisms of restoring the ridge and slough microtopography (peat accumulation on the ridges) and the ability of inundated peat soils to sequester phosphorus. Rehydrating northern WCA 3A has the potential to increase wildlife diversity and abundance with the restoration of the aquatic food web.

6) Maximizes potential to restore and sustain ridge and slough pattern and tree islands where desired

Similar to the *maximizing sheetflow* objectives, this criterion is focused on sheetflow and the timing, distribution (including spatial extent) and depth of flows. Project components with the greatest capacity to deliver water across the full extent of the northern WCA 3A boundary are most likely to sustain and restore ridge and slough habitat. Additionally, flexibility in the location and timing of deliveries will facilitate adaptive management activities and achievement of stated project goals and objectives. This criterion differs from others in several ways-it *promotes longer flow path through WCA 3A* and is specific to topography and the existing surface slopes of the system (physical aspects affecting flow). *Promotes longer flow path through WCA 3A* is focused on maximizing the spatial extent of sheetflow benefit by getting the water where it is needed (while recognizing the constraints associated with specific management measures/partial spreader). The *Maximizes sheetflow objectives* is focused on understanding the interaction of components that may disrupt the normal pathway of water flow through the marsh and associated functions of transport. *Maximum potential to restore and sustain ridge and slough pattern and tree islands where desired* is focused not only on the physical aspects of topography and the interaction of flows but also specific needs associated with ridge and slough maintenance and restoration. This includes depth, timing, and flow components of hydroperiod that may distribute the required nutrients (particulate and dissolved constituents) as well as meeting the physiological water needs of the plant communities necessary to restore the ridge and slough landscape. Specific areas of northern WCA 3A have been identified where the potential to maintain or restore a mosaic of desired vegetation could be achieved with one or more rehydration management measures. The timing and distribution of reintroducing water flow could change as the marsh begins to adapt to new flow conditions. Alternatives or management measures that increase the flexibility to target the particular geographic areas for restoration and allow adaptive changes to the flow distribution are more desirable.

7) Improves conditions for wading birds (foraging/nesting)

This criterion is focused on the landscape heterogeneity and its ability to support fish refugia and a diverse depth pattern so wading birds can forage for longer periods, early in the dry season, and over large areas. It is also focused upon where wading birds currently feed during droughts and floods. During floods, the eastern sections of northern WCA 3A remain too deep for wading bird foraging, but the western region, with its remnant ridge and slough landscape and its higher topography, can support fish production and wading bird foraging with hydropattern restoration even during floods. During droughts, the water depths in eastern sections of northern WCA 3A are too shallow, but can support fish with hydropattern restoration.

8) Maximizes Spatial extent

This criterion is based upon the ability of the project components to provide sheetflow and hydropattern over the largest spatial extent. This criterion will review the removal of discontinuities and barriers to sheet flow. The performance measure target will be restoration of the project footprint.

E.2.2.1.3 Preliminary Evaluation of Distribution Components

The preceding criteria were applied to each HRF location; a qualitative value scale was given separately to each screening criterion. The relative qualitative value scales were assigned scores of Low, Medium or High, which correspond to the rankings of 1, 2 or 3 respectively. The standards of Low, Medium and High were selected as evaluation scores to reflect the degree of success each HRF location was expected to achieve with respect to each given criterion relative to the other locations. Explanations of scores are as follows:

High	Medium	Low
• High probability of success with a low uncertainty in achieving the desired outcome of the criterion. There is also a high degree of relevance to accomplishing project objectives.	• There is a moderate likelihood of achieving the desired target of the criterion.	• There is a lower probability of success of achieving the desired outcome of the given criterion, in relation to other alternatives. There is a high degree of uncertainty whether the objectives would be accomplished.

The following matrix (**Table E.1- 21**) summarizes the ranking and scoring of the hydropattern restoration feature locations:

Table E.1- 21. Evaluation of Distribution (HRF) Configurations

Criteria	Full		West of G-205		East of G-205		West		Mid		East	
Flexibility to move water where most needed	High	3	Medium	2	Medium	2	Low	1	Low	1	Low	1
Promotes longer flow path through WCA 3A (connectivity)	High	3	High	3	Medium	2	Medium	2	Low	1	Low	1
Maximizes sheetflow objectives (overall distribution- includes minimizing shortcircuiting along eastern and western boundaries)	High	3	Medium	2	Medium	2	Low	1	Low	1	Low	1
Minimizes likelihood to increase P movement from impacted areas (large volume inflow in small area)	High	3	Medium	2	Medium	2	Low	1	Low	1	Low	1
Best addresses dry outs in over-drained areas	High	3	Medium	2	Medium	2	Medium	2	Medium	2	Medium	2
Improves conditions for wading birds (foraging/nesting)	High	3	Medium	2	Medium	2	Low	1	Low	1	Medium	2
Maximum potential to restore and sustain ridge and slough pattern and tree islands where desired	High	3	Medium	2	Medium	2	Medium	2	Low	1	Low	1
Maximizes spatial extent	High	3	Medium	2	Medium	2	Low	1	Low	1	Low	1
Total Score		24		17		16		11		9		10
Average Score		3.0		2.125		2		1.4		1.1		1.3
Overall Value	HIGH		MEDIUM		MEDIUM		LOW		LOW		LOW	

E.2.2.2 Preliminary Formulation of Conveyance Components

E.2.2.2.1 Siting of Formulation Components

The formulation of conveyance components focuses on determining the best locations for placement of backfill and plugs in the Miami Canal in order to minimize negative effects caused by the canal and restore more natural hydropatterns in WCA 3A. To aid in incrementally building Miami Canal configurations (the entire Miami Canal 27.65 miles from S-8 to S-151), the Miami Canal was divided into three segments for initial quantitative screening using hydrologic modeling tools. The reasons for splitting the canal into segments are listed below:

- *Hydrologic response*: The North segment is the driest, the Central segment has the steepest gradient topography, and the South segment tends to pond more than the North and Central segments.
- *Cost and available fill factors*: Depending on the acreage of the Miami Canal to be filled, there may not be enough on-site spoil mound material to completely backfill the Miami Canal from S-8 to S-151.
- *Infrastructure*: There are two water control structures that essentially divide the Miami Canal into three equal lengths.

The following are the three Miami Canal sections as defined by the existing water control structures:

- NORTH only: 9.45 miles (S-8 to S-339);
- CENTRAL only: 8.45 miles (S-339 to S-340);
- SOUTH only: 9.75 miles (S-340 to S-151);

To assist with the determination of optimal Miami Canal plug length and spacing, RMA-2 modeling was used to evaluate varying lengths and spacing of plugs along the Miami Canal. Further details of the RMA analysis integrated into CEPP from the CERP Decomp project formulation effort, including limitations and assumptions can be found in Appendix A – Engineering, Annex A-2 – Hydrologic Modeling.

Results of Evaluation of the Conceptual Components for the Miami Canal:

- Reduced dryouts will be achieved in the Northern segment with backfill or plug, and the improvement in dryouts will be limited to the northwestern area of WCA 3A.
- Ponding is reduced in eastern WCA 3A with the backfilling or plugging of the Southern segment, possibly due to the redistribution of flows.
- Redistribution of sheetflow throughout northern WCA 3A is most closely achieved through backfilling/plugging the Northern segment.
- Backfilling/plugging the full extent of the Miami Canal encompasses all of the above effects observed for the individual segment backfill.
- Benefits from backfilling/plugging the Miami Canal will be localized.
- RMA-2 modeling shows that removing the spoil mounds alone can improve sheetflow to a limited degree; the RMA-2 model application, while useful as a screening tool, does not represent ground water interaction
- RMA-2 also revealed that certain plug length and spacing combinations were comparable to the observed hydrologic performance of the full backfill scenario. A 4,000 ft plug with 2,000 ft spacing provided performance most comparable to the complete backfill scenario with an allowance for additional imported fill.

An array of 23 Miami canal components was developed by incorporating the results of the conceptual Miami canal components in conjunction with the three identified reaches (**Table E.1- 22**). Each of these combinations incorporates spoil mound removal, however the exact location and extent of the spoil removal was not identified until the evaluation of the final array, as there is stakeholder concern over impacts to upland refuge and upland restoration sites on the spoil mounds

Table E.1- 22. Miami Canal Components

Miami Canal Component	Description
1	Spreader canal West of S-8 with complete backfill of the Northern canal. Remove spoil mounds along the entire length of the canal except for those portions which contain FWC plantings.
2	Complete backfill of northern segment, plug the Central segment and Southern segment with the remaining fill. Preserve FWC plantings
3	Spreader canal on L-4 levee. Plug Northern and Southern sections of the canal leaving Central section as is. The northern and southern levees east and west of the canal will be used to make the plugs in the respective areas.
4	Evenly spaced plugs between S-8 and S-151: with 800 feet spacing between plugs. The plug length is based on available fill (~1,100 ft plugs). The spoil mounds will be utilized for the plug material. Plug length will be adjusted based on fill material available. Remove FWC plantings.
5	Evenly spaced plugs between S-8 and S-151: with 1,500 feet spacing between plugs. The plug length is based on available fill (~2,100 ft plugs). The spoil mounds will be utilized for the plug material. Plug length will be adjusted based on fill material available. Remove FWC plantings.
6	Evenly spaced plugs between S-8 and S-151: with 3,000 feet spacing between plugs. The plug length is based on available fill (~4,300 ft plugs). The spoil mounds will be utilized for the plug material. Plug length will be adjusted based on fill material available. Remove FWC plantings.
7	Complete backfill of Northern and Southern sections of the Miami Canal. Remove all spoil mounds (levee) along the Miami Canal. Remove FWC plantings.
8	Complete backfill (S-8 to S-151) of the entire canal and remove all spoil mounds (levees).
9	Only degrade non-enhanced spoil mounds and create tree islands with the levee material.
10	Complete backfill (S-8 to S-151) and create tree islands.
11	Spreader canal 2 – 3 miles south of S-8, extends across WCA 3A with low berm (0.5 feet) allowing for shallow ponding north of spreader. Full backfill from spreader south to S-151 using spoil material and spreader canal excavations as fill. Imported fill is necessary.
12	Backfill from S-8 to I-75 leaving south of I-75 as is. Remove spoil mounds north of I-75.
13	Complete backfill of Central and South regions, removing the adjacent spoil mounds.
14	Complete backfill of North and Central regions using spoil mounds from the entire length of the Miami Canal. Leave FWC plantings.
15	Spreader south of S-8 to accommodate get-away capacity needs,beyond that backfill the canal as far as available fill material allows. Fill material will come from spoil mounds. No imported fill
16	Plug the entire Miami Canal with plugs that are 4,000 feet and spacing 2,000 feet. S-8 Spreader Canal. Import additional fill. Preserve FWC plantings.
17	Plug the North and South regions with plugs that are 4,000 feet and spacing 2,000 feet. S-8 spreader canal. Import additional fill. Preserve FWC plantings.
18	Plug the North, Central, and South (S-340 to C-11, only) regions with plugs that are 4,000 feet and spacing 2,000 feet. Import additional fill. Preserve FWC plantings.
19	Plug the North and South (C-11 to S-151, only) regions with plugs that are 4,000 feet and spacing 2,000 feet. S-8 spreader canal. Import additional fill. Preserve FWC plantings.
20	Plug the entire Miami Canal with 1,000 feet plugs and spacing 3,000 feet (increase length to use of all available fill). Use on-site spoil mounds only. Preserve FWC plantings.

Miami Canal Component	Description
21	Plug the North and South regions with plugs that are 1,000 feet and spacing 3,000 feet (increase length to use of all available fill). Use on-site spoil mounds only. Preserve FWC plantings.
22	Plug the North, Central, and S-340 to C-11, 1,000 feet plugs and spacing 3,000 feet (increase length to for use of all available fill).Use on-site spoil mounds only. Preserve FWC plantings.
23	Plug the North and C-11 to S-151, with 1,000ft plugs spaced 3,000 feet (vary length to use of all available fill). S-8 spreader canal. Use on-site spoil mounds only. Preserve FWC plantings.

E.2.2.2.2 Initial Evaluation of Conveyance (Miami Canal) Components

Table E.1- 23 includes the criteria used to evaluate the Miami Canal components. All preliminary options were assumed to include, at minimum, a spreader canal feature at S-8 that would be sized consistent with savings clause design criteria agreed to by the USACE and SFWMD.

Table E.1- 23. Criteria for Miami Canal Configurations

Risk and Uncertainty
Objectives: No associated project objectives **Explanation:** This deals with the implementability of an alternative, including constructability, public perception, and risks associated with planning constraints (water quality, savings clause, etc). There is a degree of uncertainty associated with our ability to predict potential ecological impacts and benefits (sheetflow/ reducing dryouts/ spatial connectivity). This poses risks to achieving goals and objectives (benefits). **Target:** The risks associated with building, planning constraints, and special interest groups are minimal. The benefits and impacts of the alternative are relatively certain compared to other alternatives **Metric:** 1 would be assigned to each alternative for each type of risk and uncertainty. The alternatives would be put in sequential order based on the total number of risks, from the most risk (highest number) to the lowest risk (lowest number or zero) and divided into thirds (highest third, middle third, lowest third). Scoring: -1 for highest third; 0 for middle third; 1 for lowest third.
Reduce Dryouts in Northern WCA 3A
Objectives addressed: -Improve sheetflow and hydropatterns, reducing dryouts, and peat loss in northern WCA 3A by removal of Miami Canal and water conveyance capacity. -Increase the abundance of forage fish and crayfish populations in WCA 3A. -Increase spatial extent and restore vegetative composition, habitat function, and ridge and slough patterning. **Explanation:** Due to presence of canals and levees, the north end of WCA 3A is overdrained and its natural hydroperiod has been shortened. By reducing dryouts in this area, vegetative communities are expected to shift from cattail to sawgrass, peat fires will be reduced, peat will accumulate, ridge and slough landscapes will return, phosphorus will be buried (leading to a more oligotrophic system), and wildlife diversity and abundance will increase as aquatic food webs are restored. The small marsh fishes and macroinvertebrates (crayfish, apple snails) help form the link between the algal and detrital food web bases of the Everglades and the larger fishes, alligators and wading birds that feed upon them. In the freshwater Everglades, population densities of marsh fishes are directly proportional to the duration of uninterrupted flooding. Reducing drought in northern WCA 3A may restore wildlife diversity and abundance.

Target: Reduction in dry conditions in northern WCA 3A. Reduce the amount of time the water table is below ground surface and therefore increase hydroperiods in northern WCA 3A.

Metric: Use best professional judgment and available model output to determine which alternatives may reduce dry conditions in northern WCA 3A. Alternatives that are expected to distribute water in a way that reduces dry conditions will score positively.

Scoring:
+2 Positive Net Effect
0 No Net Effect
-2 Negative Net Effect

Reduce Ponding in Southeastern/ Central WCA 3A

Objectives addressed:
- -Improve sheetflow and hydropatterns, reducing ponding in WCA 3A by removal of Miami Canal and water conveyance capacity.
- -Improve hydrology and hydrologic recession rates to increase wading bird foraging and nesting success.
- -Increase spatial extent and restore vegetative composition, habitat function, and ridge and slough patterning, including tree islands.

Explanation: The southeastern portion of WCA 3A is affected by high water and prolonged periods of inundation created by impoundment structures. Open water sloughs have replaced sawgrass habitat and negatively impacted tree islands. Prolonged deep water may kill and prevent woody growth that wading birds use as nesting substrate as well as disrupt a wading bird's foraging ability through loss of shallow feeding habitat and changes of fish species composition. This ponding effect may thwart the alligator's ability to lay eggs at nest elevations that would not be flooded in the wet season, thus drowning nests.

Target: Relieve ponding in eastern WCA 3A. Decrease frequency and duration of extreme high events in the vicinity of Indicator Regions 118 and 119. Reduce the amount of time water depths are above 2.5 feet.

Metric: Use best professional judgment and available model output to determine which alternatives may relieve ponding in southeastern WCA 3A. Alternatives that will redistribute water from the southeastern corner of WCA 3A (in a northeast to southwest direction) will score positively.

Scoring:
+2 Positive Net Effect
0 No Net Effect
-2 Negative Net Effect-

Water Quality

Objectives addressed:
- -Restore vegetative composition and habitat function
- -Increase the abundance of forage fish populations in WCA 3A

Explanation: Water quality determines the vegetative composition of WCA 3A. Areas of high phosphorus are dominated by cattail, which is undesirable habitat. High phosphorus in the water column can affect algal species composition as well as other water quality parameters (dissolved oxygen, turbidity, etc) which can adversely affect forage fish populations.

Target: No net effect, or net positive effect, on water column concentration, load, soil concentration, and flora. The primary focus will be on nutrients (phosphorus and nitrogen), but other constituents can be examined as appropriate (sulfur, mercury, etc.)

Metric: Use best professional judgment and model output to assess anticipated flow paths, changes in water distribution, distribution and timing of nutrient loads, dry-out potential, impacted and un-impacted wetland areas, and areas of special concern (e.g. sawgrass stands). Evaluators should consider each major component within an alternative (spreader canal, canal plug, etc.) in order to assess the overall impact. Alternatives that have a net positive effect on water column concentrations, loads, soil concentrations and flora will score positively.
Scoring:
+2 Positive Net Effect
0 No Net Effect
-2 Negative Net Effect

Degree of Increased Sheetflow

Objectives Addressed:
-Improve sheetflow and hydropatterns, reducing ponding in WCA 3A.
-Improve hydrology and hydrologic recession rates to increase wading bird foraging and nesting success.
-Increase spatial extent and restore vegetative composition, habitat function, and ridge and slough patterning, including tree islands.

Explanation: Sheetflow is one of the defining characteristics of the Everglades. The broad distribution of water across the landscape encourages the development of a peat-based ecosystem. Sheetflow also distributes nutrients broadly across the landscape which is a condition for oligotrophy. This is opposed to channeling and/or concentrating water along levees and canals. This measure is an indication of uninterrupted flow patterns caused by discontinuities in the system.

Target: This target is defined by maximizing the correlation of flow velocities within and outside of the canal footprint, specifically:

Metric: Rank alternatives/measures by effectiveness of establishing the sheetflow target. Then score the alternatives relative to their ranking.
A qualitative approach was used for application of this criterion.

Spatial Extent of Ecologic and Hydrologic Connectivity

Objectives addressed:
- Remove/reduce effects of landscape discontinuities and remove barriers to sheet flow related to the Miami Canal
- Increase fish and wildlife connectivity in WCA 3A
- Increase spatial extent of wetland habitats within the Miami Canal corridor.

Explanation:
The intent of this criterion is to screen those alternatives that do not significantly remove barriers to natural hydropatterns (depth, duration, and spatial extent).

Target: complete restoration of the project footprint ~ 989 acres (145,964 x 295 ft / 43,560). Scores from each alternative will be normalized with 100 being equal to 989 acres.

Metric: Area of wetland previously occupied by the Miami Canal and associated spoil mounds was calculated by multiplying the average width of canal and spoil mound by the linear length of canal and spoil removed. A rough GIS analysis provided the following average value for combined width of canal and spoil:

Total Canal Length = 145,964 ft; Canal Width = 75 ft; Average Spoil Width = 220 ft

The screening criteria evaluation led to the components being ranked from 1 to 23 in a multi-agency exercise. Implementation cost estimates were used to distinguish between similarly ranked components. The following assumptions regarding cost were made:

- A lower cost alternative is more desirable, hence an alternative that provides about the same predicted performance (for the selected screening criteria) as another, but costs less, should rank higher;
- Importing fill is more costly than using only on-site fill;
- Filling individual segments (North, Central, or South) would be less expensive than filling the entire extent of the canal;
- Using only one staging area (for example, only filling the canal from the North, rather than from both North and South) would be less costly than using two staging areas;
- The more plugs used, the more costly the alternative (this was used to distinguish between alternatives that were similar in all aspects apart from the number of plugs, plug length, and plug spacing).

The results of the technical working group application of the screening criteria are listed in **Table E.1- 24**, below. The table illustrates the ranking of the configurations from 1 to 23, 1 being the best configuration.

Table E.1- 24. Ranking of Conveyance Components

Miami Canal Component	Description	Rank Order
8 and 10	Complete backfill (S-8 to S-151) of the entire canal and remove all spoil mounds (levees). Spreader canal.	1
18	Import additional fill. Plug the North, Central, and South (S-340 to C-11, only) regions with plugs that are 4,000 feet and spacing 2,000 feet. S-8 spreader canal.	2
14	Complete backfill of North and Central regions using spoil mounds from the entire length of the Miami Canal. Leave FWC plantings.	3
2	Complete backfill of Northern segment, plug the Central segment and Southern segment with the remaining fill. Preserve FWC plantings	4
22	Use on-site spoil mounds only. Plug the North, Central, and South (S-340 to C-11, only) regions with plugs that are 1,000 feet and spacing 3,000 feet (increase length to accommodate for use of all available fill). S-8 spreader canal.	5
12	Backfill from S-8 to I-75 leaving south of I-75 as is. Remove spoil mounds north of I-75.	6
16	Import additional fill. Plug the entire Miami Canal with plugs that are 4,000 feet and spacing 2,000 feet. S-8 Spreader Canal.	7
7	Complete backfill of Northern and Southern sections of the Miami Canal. Remove all spoil mounds (levee) along the Miami Canal. Remove FWC plantings.	8

Miami Canal Component	Description	Rank Order
15	Spreader of S-8 to accommodate get-away capacity needs. Beyond that point, backfill the canal as far south as available fill material allows. Fill material will come from spoil mounds. Do not import.	9
20	Use on-site spoil mounds only. Plug the entire Miami Canal with plugs that are 1,000 feet and spacing 3,000 feet (increase length to accommodate for use of all available fill). S-8 spreader canal.	10
4	Evenly spaced plugs between S-8 and S-151: with 800 feet spacing between plugs. The plug length is based on available fill (~1,100 ft plugs). The spoil mounds will be utilized for the plug material. Plug length will be adjusted based on fill material available	12
11	Spreader canal 2 – 3 miles south of S-8, extends across WCA 3A with low berm (0.5 feet) allowing for shallow ponding north of spreader. Full backfill from spreader south to S-151 using spoil material and spreader canal excavations as fill. Imported fill	13
21	Use on-site spoil mounds only. Plug the North and South regions with plugs that are 1,000 feet and spacing 3,000 feet (increase length to accommodate for use of all available fill). S-8 spreader canal.	14
5	Evenly spaced plugs between S-8 and S-151: with 1,500 feet spacing between plugs. The plug length is based on available fill (~2,100 ft plugs). The spoil mounds will be utilized for the plug material. Plug length will be adjusted based on fill material available.	15
1	Spreader canal West of S-8 with complete backfill of the Northern canal. Remove spoil mounds (levees) along the entire length of the canal except for those portions which contain FWC plantings.	16
17	Import additional fill. Plug the North and South regions with plugs that are 4,000 feet and spacing 2,000 feet. S-8 spreader canal.	17
6	Evenly spaced plugs between S-8 and S-151: with 3,000 feet spacing between plugs. The plug length is based on available fill (~4,300 ft plugs). The spoil mounds will be utilized for the plug material. Plug length will be adjusted based on fill material available.	18
23	Use on-site spoil mounds only. Plug the North and South (C-11 to S-151, only) regions with plugs that are 1,000 feet and spacing 3,000 feet (increase length to accommodate for use of all available fill). S-8 spreader canal.	19
3	Spreader canal on L-4 levee. Plug Northern and Southern sections of the canal leaving Central section as is. The northern and southern levees east and west of the canal will be used to make the plugs in the respective areas.	20
19	Import additional fill. Plug the North and South (C-11 to S-151, only) regions with plugs that are 4,000 feet and spacing 2,000 feet. S-8 spreader canal.	21
13	Complete backfill of Central and South regions, removing the adjacent spoil mounds. Leave the Northern region as is.	22
9	Leave Miami Canal as is. Degrade non-enhanced spoil mounds and create tree islands with the levee material.	23

E.2.2.2.3 Formulation of Conveyance (Miami Canal) Components

From this ranking, four discrete conveyance configurations were developed. The following general assumptions were made for the Miami Canal backfill components: a) treat FWC plantings consistently across alternatives, b) treat S-8 get-away spreader consistently across alternatives; the spreader canal will be for mitigation purposes only and the location and design will be optimized by the design team (note: this assumption was prior to integration of the HRF component into the PIR 1 project scope), and c) backfill and plugs will be designed to fill to surrounding marsh grade, accounting for material compaction following initial placement. The description and intent of each of the final four Miami Canal backfill configurations are provided below.

Miami Canal backfill North, plug Central and South (Component 2)

Complete backfill of North section. Plug Central and South (entire southern reach), with 1,000ft plug and 3,000ft spacing. If necessary, the size of the plug may be larger in order to utilize all available on-site fill material.

Best Combination of Complete Fill and Plugging: This component represents a combination of backfill and plug configurations. 2x2 model output suggests that backfilling the Northern segment produces benefits of reducing dry-outs in northern WCA 3A. By using full backfill in this segment, uncertainties associated with plugs are reduced. Plugging the remainder of the Miami Canal potentially allows for the additive benefits of a full extent backfill to be achieved at a lower cost than full backfill of the entire canal). The RMA-2 modeling results identified the overall optimal plug length/spacing ratio to be 4,000:2,000, when fill is not limited to the project spoil mound material on site and 1,000:3,000 as the optimal plug/spacing combinations, when fill material is limited to that available on the project site.

Miami Canal Component backfill North, Central and South (Component 8/10)

Complete backfill of all three sections (S-8 to S-151) using all available on-site fill material and importing additional fill that is required. This component matches the Yellow Book version for filling the Miami Canal and removing its effects from the system.

Miami Canal Component backfill North and Central (Component 14)

Complete backfill of North section and Central section (S-8 to S-340) using all available on-site fill material and importing additional fill that is required.

This component ranked the highest for the midsize components to complete the full range of components, as required by USACE and NEPA planning guidance. This component focuses on the high priority north (for the purposes of reducing dryouts in northern WCA 3A) and with the backfill of the reach between S-339 and S-340, further contributes to project objectives of increased spatial extent of wetlands and removal of barriers to sheetflow. It also ranked third highest overall in the initial screening analysis for Miami Canal components.

Miami Canal Component plug North, Central and South from S-340 to C-11 (Component 18)

Plug the North, Central, and South (S-340 to C-11 extension) sections: would be initiated from the north and south terminus of the Miami Canal proceeding symmetrically from both ends until need to shift to smaller 1,000ft plugs and 3,000ft spacing based on available fill. Use all available on-site fill material. No additional fill will be imported.

Best Complete Plug Using Available Fill: This component is a hybrid modification of previous components. The North and South (S-340 to C-11 extension) sections proved to be the best areas to backfill in order to reduce dryouts and ponding respectively from the 2x2 modeling of conceptual alternatives. The RMA-2 modeling results identified the overall optimal plug length/spacing ratio to be 4,000:2,000, when fill is not limited to the project spoil mound material on site. 1,000:3,000 was the optimal plug/spacing combination, when fill material is limited to that available on the project site. Further design will determine the break points in the North and South for using 4,000:2,000 plug length/spacing with available fill, and then transitioning to using 1,000:3,000 plug length/spacing in the Central section. Due to water quality issues at S-9, the Southern section starts where the C-11 extension meets the Miami Canal.

E.2.3 Formulation of Distribution and Conveyance Options- Northern WCA 3A

The initial array of options for distribution and conveyance were developed by combining the retained Miami Canal backfill features of the conveyance screening and the retained hydropattern restoration features of the distribution screening. Fifteen possible combinations (three HRF and five Miami Canal backfill) of remaining HRF locations and Miami Canal backfill options were organized into a matrix to identify options that were candidates for further detailed modeling. Of the fifteen combinations, a subset of seven of these were identified to undergo further modeling with the Regional Simulation Model (RSM) based on a sequencing strategy developed to maximize the amount of information learned with each successive round of modeling runs simulated. As part of the modeling strategy, this subset was not considered absolute as refinements and modifications to the options remaining to be modeled were expected as initial modeling results were analyzed.

All "no action" options for the HRF were eliminated from further consideration. The Regional Simulation Model Glades and Lower East Coast Service Area (RSM-GL) simulations suggest that implementing Miami Canal backfill without a HRF would provide only limited benefits. Without a HRF, water would continue to be introduced into northern WCA 3A as a point source, which does not contribute to the project objective of increasing sheetflow in the marsh. The North and Central configurations of the Miami Canal were not identified to be modeled in the preliminary array because it is reasonable to assume that comparing an option for the North segment backfilled to one with the Full Miami Canal backfilled will provide sufficient information to infer whether a North plus Central combination should be further examined. Additionally, only one plugging scenario is needed to determine if plugging performs as well as backfilling while reducing costs.

As a result of the modeling strategy, seven combinations of options were identified for to be brought forward for detailed RSM modeling ("**No**" denotes no further action, "**Yes**" indicates a recommendation for further consideration). The matrix below (**Table E.1-25**) identifies the options resulting from the modeling strategy analysis.

Table E.1-25. HRF and Miami Canal combinations modeled in RSM-GL.

	Miami Canal Components				
HRF Component	**Full Backfill**	**Full Plug**	**North and Central**	**North**	**No Action**
Full HRF	Yes, A	Yes, C	No	Yes, B	Yes, F
HRF West of G-205	Yes, D	No	Yes, G	Yes, E	No
No HRF	No	No	No	No	No

Seven options identified to be further evaluated:

A. Full HRF and Complete Backfill of Miami Canal (S-8 to S-151)
B. Full HRF and North Backfill of Miami Canal (S-8 to S-339)
C. Full HRF and Plugging of Miami Canal (S-8 to S-151) with 4,000 ft plug with 2,000 ft spacing (Optimal Plug/Spacing Configuration – RMA-2)
D. West of G-205 HRF and Complete Backfill of Miami Canal (S-8 to S-151)
E. West of G-205 HRF and North Backfill of Miami Canal (S-8 to S-339)
F. Full HRF Only
G. West of G-205 HRF and I-75 Backfill of Miami Canal (S-8 to I-75)

E.2.4 Evaluation Criteria for Distribution and Conveyance Options - Northern WCA 3A

There were two levels of criteria evaluated. Level 1 corresponded to the primary objectives of CEPP and Level 2 assessment was used to ensure other ecologically significant considerations and other stakeholder concerns were included in determination of what options were carried forward. Level 1 criteria include project performance measures and hydrologic mapping results. Level 2 criteria include excessive ponding, adaptability, ecologic connectivity, and recreational impacts.

E.2.4.1 Project Performance Measures (Level 1)

Project performance measures (PMs) were developed to quantify ecological benefits within the Greater Everglades Region and were used to evaluate the degree to which proposed project configurations were likely to meet restoration objectives. To make the correlation between hydrologic output and ecosystem functions, the project team utilized PMs developed from the Greater Everglades Ridge and Slough Conceptual Ecological Model (CEM) which is used in CERP as a non-quantitative planning tool that identifies 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. PMs utilized to evaluate project configurations are briefly described below. Each PM may contain one or more sub-metrics.

PM 1.0 Inundation Duration in the Ridge and Slough Landscape – Provides a measure of the percent period of record of inundation.

- PM 1.1 – Percent Period of Record of Inundation (PPOR) Inundated

PM 2.0 Sheetflow in the Ridge and Slough Landscape – Provides a measure of the timing, distribution, and continuity of sheetflow across the landscape.

- PM 2.1 – Timing of Sheetflow
- PM 2.2 –Continuity of Sheetflow
- PM 2.3 –Distribution of Sheetflow

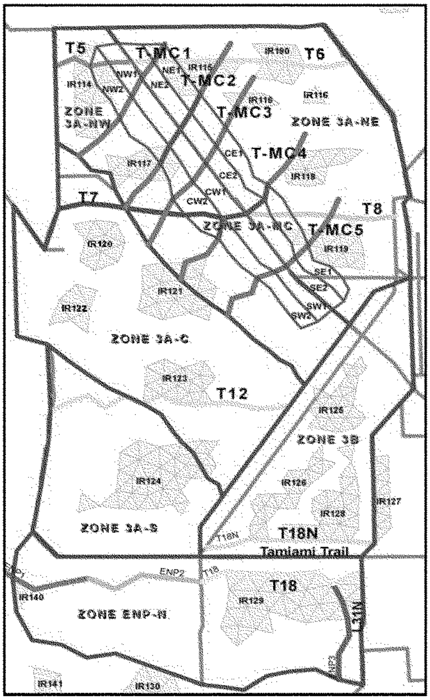
PM 3.0 Hydrologic Surrogate for Soil Oxidation – Provides a measure of cumulative drought intensity to reduce exposure of peat to oxidation.

- PM 3.1 – Drought Intensity Index

PM 5.0 Slough Vegetation Suitability – Provides a measure to evaluate the hydrologic suitability for slough vegetation.

- PM 5.1 – Hydroperiod
- PM 5.2 – Dry down
- PM 5.3 – Dry Season Depth
- PM 5.4 – Wet Season Depth

The analysis for CEPP was restricted to portions of northern WCA 3A (Zones 3A-NW, 3A-NE, and 3A-MC) as hydrologic improvements were not apparent in the southern portions of WCA 3A, 3B, and ENP (Zones 3A-C, 3A-S, 3B, ENP-N) as a result of the evaluation of the project configurations. Zones 3A-NW, 3A-NE, 3A-MC, 3A-C, 3A-S, 3B, and ENP-N were identified during plan formulation efforts to evaluate the spatial extent of the project's effects within the Greater Everglades. Hydrologic model output for each of the PM sub-metrics was produced by the Regional Simulation Model version 2.3.1 Glades-LECSA Implementation (RSMGL) for indicator regions and/or transects within each of these project zones (**Figure E.1- 10**). For this analysis, PM sub-metrics 2.1 and 5.3 were not used, as there was little differentiation in PM sub-metric scores between project configurations.



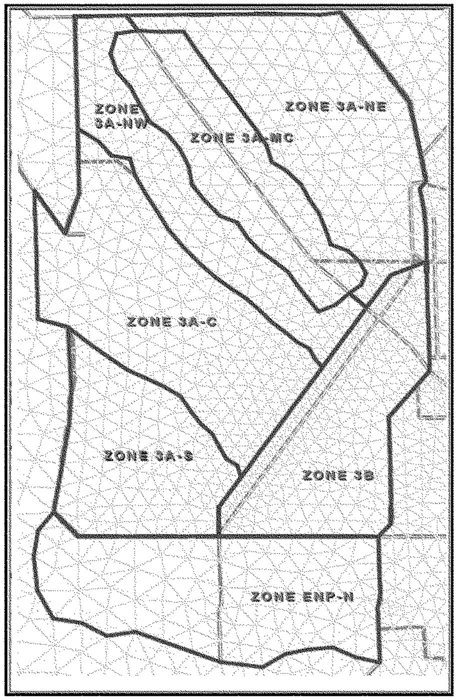


Figure E.1- 10. Indicator Regions, Transects, and Zones Within RSMGL Model Mesh

In order to establish what constitutes the minimum rating (*i.e.* rating = 1) on the 1-4 rating scale, reference degraded sites within the existing RSMGL model mesh were chosen based on output from the Existing Conditions Baseline (ECB). The ECB was used to set the minimum rating (1) for each PM sub-metric. The ECB provided the best available RSMGL representation of current habitat quality within the project area. The reference degraded sites (*i.e* indicator regions and/or transects within the RSMGL model mesh), are fully degraded as a result of the existing hydrologic conditions and are all located in northern WCA 3A.

The target for each PM sub-metric was used to set the maximum rating (*i.e.* rating = 4) on the 1-4 rating scale. Even quartiles were then calculated based on the range of values between the ECB and target for each PM sub-metric. Values in the top 25% of the range were assigned a quartile rating of 4; the next 25% were assigned a rating of 3, and so forth. This was repeated for each of the PM sub-metrics within zones 3A-NE, 3A-NW, and 3A-MC for each of the project configurations modeled.

The following example is provided for PM sub-metric 1.1 in Zone 3A-NE (**Table E.1-26**). The ECB score at the reference degraded site for PM 1.1 is equal to 70 Percent Period of Record of (PPOR) of Inundation. The target score for Zone 3A-NE for PM 1.1 is equal to 90.0 PPOR of Inundation. The score for Zone 3A-NE for PM 1.1 for project configuration A is equal to 89.4 PPOR. Configuration A received a rating of 4 based on the calculation of even quartiles.

Table E.1-26. Example Ratings (1-4) Scale for Zone 3A-NE for PM 1.1 Percent Period of Record Inundated

PM Sub-Metric Score	Rating	PM-Sub-Metric Score
70 (ECB Value at Reference Degraded Site)	< Rating 1 (Worst) ≤	75.0
75.0	< Rating 2 (Fair) ≤	80.0
80.0	< Rating 3 (Good) <	85.0
85.0	< Rating 4 (Best) ≤	90.0 (Target Value)

Ratings for each PM sub-metric were then averaged across the three zones (Zones 3A-NW, 3A-NE, and 3A-MC) for each project configuration. If a PM had more than one sub-metric (i.e. PM 2.0 and PM 5.0), sub-metric ratings were first averaged within each zone before being averaged across zones. Ratings were then sub-totaled to determine the configuration rank (**Table E.1-27**).

Table E.1-27. Level 1 Screening Criteria: Performance Measure Results

Configuration			Performance Measures				
	HRF	Miami Canal	PM 1.1 Inundation Duration	PM 2.2, 2.3Distribution/ Continuity of Sheetflow	PM 3.1 Soil Oxidation	PM 5.1, 5.2, 5.4 Slough Vegetation	Subtotal
E	West G-205	North S-339	3.7	2.4	3.7	2.7	12.4
G	West G-205	North I-75	4.0	3.0	4.0	2.8	13.8
D	West G-205	Full	4.0	3.0	4.0	2.8	13.8
B	Full	North S-339	3.7	2.4	3.3	2.7	12.0
A	Full	Full	4.0	3.0	4.0	2.7	13.7
C	Full	Plug Full	4.0	3.0	4.0	2.7	13.7
F	Full	None	3.0	1.4	2.7	2.3	9.4

Overall the top tier of project configurations include A, C, D, and G. Configurations with moderate performance include Band E. Configuration F was the weakest performing.

Hydrologic improvements were apparent in northern WCA 3A with implementation of each project configuration. Hydrologic improvements primarily occur north of I-75 with "existing" flow volumes. Implementation of a HRF and full backfill of the Miami Canal offer more hydrologic improvement in comparison to the HRF and backfill of northern Miami Canal (to S-339) or HRF only. Filling north of I-75 provides more hydrologic improvement in comparison to options filling only north of S-339.

E.2.4.2 Hydrologic Mapping Results (Level 1)

Additional RSMGL (Version 2.3.1) output was utilized to evaluate project configurations in addition to PM results including hydroperiod distribution maps, ponding depth maps, and overland flow vector maps. Maps for the project area were used that depicted average annual calculations for the 36-year period of record as well as calculations for a wet year (1995), dry year (1989) and an average year (1978). Performance of each project configuration for each of the six project objectives was compared to the Future Without (FWO) project condition as well as the performance of each configuration relative to the performance of the remaining configurations. A rating of (1-4) was used to best separate the performance of project configurations. Best professional judgment was used to apply each rating. A rating of 1 showed marginal to no improvement over the FWO. A rating of 2 showed the next least amount of improvement over the FWO. A rating of 3 showed intermediate improvement over the FWO and a rating of 4 showed the greatest improvement over the FWO.). Overall the top tier of performing configurations are A, C, D, and G. Project configurations with moderate performance are B and E. Configuration F was the weakest performing.

Project configurations were also rated on a scale of (1-4) by calculating the amount of average annual overland flow (1000-acre-feet or k-ac-ft) each configuration delivered across a set of transects in WCA 3A. Hydrologic model output for each of the transects was produced by RSMGL. Transect locations and flows are depicted in **Figure E.1- 11**. The analysis for CEPP was restricted to portions of northern WCA 3A (Transects 5, 6, 7, and 8) as hydrologic improvements were not apparent in the southern portions of WCA 3A, 3B, and ENP (Transect 12) as a result of the evaluation of the project configurations. Project configurations which improved the total volume of overland flow across transects 5, 6, 7, and 8 scored more favorably. The maximum amount of flow for configuration A was used to set the maximum rating (*i.e.* rating = 4). The minimum amount of overland flow for configuration G was used to set the minimum rating (*i.e.* rating = 1). Even quartiles were then calculated based on the range of values between the minimum and maximum. Values in the top 25% of the range were assigned a rating of 4; the next 25% were assigned a rating of 3, and so forth. The rating methodology is defined in **Table E.1-28**.

Table E.1-28. Rating (1-4) Scale for Average Annual Overland Flow (1000 Acre Feet)

Total Average Annual Overland Flow (1000 Acre Feet)	Ratings	Total Average Annual Overland Flow (1000 Acre Feet)
969	< Rating 1 (Worst) ≤	1085
1085	< Rating 2 (Fair) ≤	1201
1201	< Rating 3 (Good) <	1316
1316	< Rating 4 (Best) ≤	1432

The range of average annual overland flow varied from 969 to 1432 (k-ac-ft). Results are shown in **Figure E.1- 11**. Ratings for the hydrologic maps (hydroperiod distribution maps, ponding depth maps, and overland flow vector maps) and average annual overland flow are shown in **Table E.1-29.**

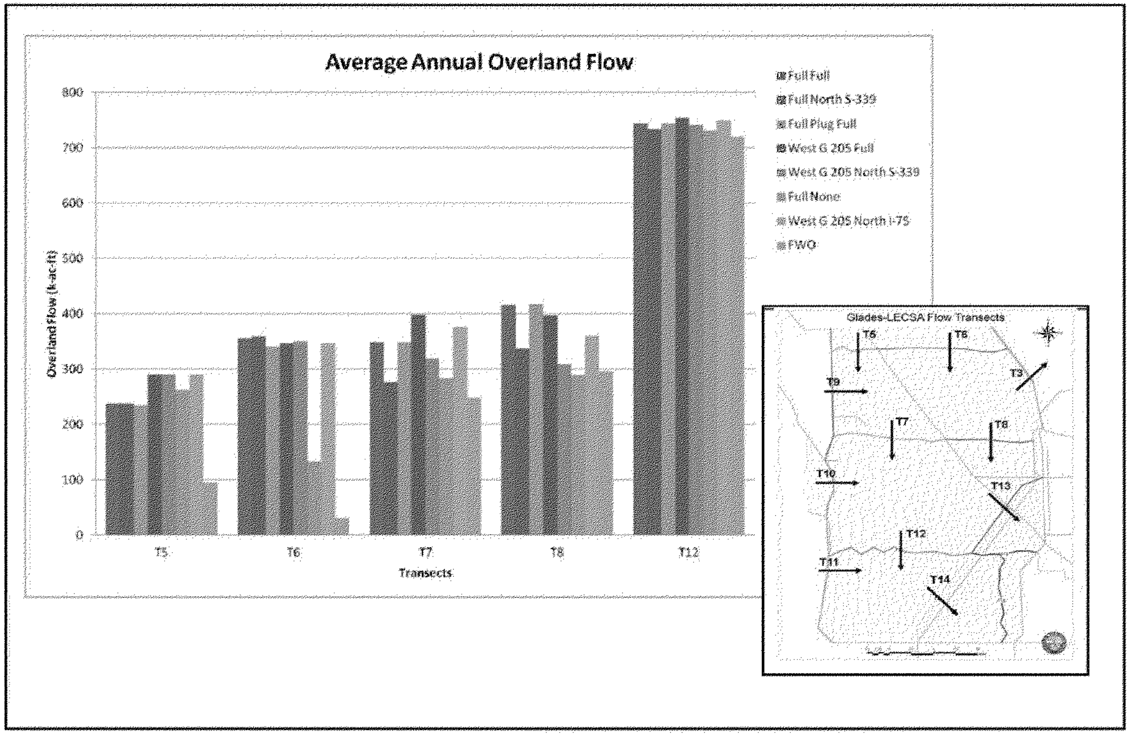


Figure E.1- 11. Average Annual Overland Flow (Thousand Acre Feet)

Table E.1-29. Hydrologic Mapping Results of Level 1 Screening Criteria

Hydrologic Output							
Option	HRF	Miami Canal	Average Annual Ponding Distribution	Average Annual Hydroperiod Distribution	Average Annual Overland Flow Vectors	Average Annual Overland Flow Across Transects	Subtotal
E	West G-205	North S-339	3.0	4.0	2.0	3.0	12
G	West G-205	North I-75	4.0	4.0	3.0	4.0	15
D	West G-205	Full	4.0	4.0	4.0	4.0	16
B	Full	North S-339	3.0	2.0	2.0	3.0	10
A	Full	Full	4.0	3.0	4.0	4.0	15
C	Full	Plug Full	4.0	3.0	4.0	4.0	15
F	Full	None	2.0	1.0	1.0	1.0	5

E.2.4.3 Excessive Ponding (Level 2)

In today's Greater Everglades, undue ponding becomes a seasonal problem in southern WCA 2A/2B, eastern and southern WCA 3A, and southern 3B due to the blockage of sheetflow by levees. In the wet season, rainfall becomes the predominant contribution to surface and groundwater. But, water discharges through water management structures into WCA 2A/B and into WCA 3A are usually increased during the wet season to provide relief to upstream areas. Thus, ponding becomes problematic leading to marsh and habitat degradation. Configurations were rated on a scale of (1-4) by evaluating ponding depths (depths > 2.0 feet) in eastern and southern WCA 3A. Everglades Viewing Windows were used to evaluate ponding depths over a percent period of record from 1965 through 2000 along transects (**Figure E.1- 12**). **Figure E.1- 12** depicts the percent period of record of inundation as well as the percent period of record at which water levels are at 2.0 feet, 2.5 feet and 3.0 feet above ground surface along transect L2 for one of the configurations. Percent period of record is shown relative to locations within the project area or distance in miles along Transect L2. Transect L2 runs from northern WCA 3A to Shark River Slough. To evaluate localized ponding in eastern and southern WCA 3A the last two points in WCA 3A in **Figure E.1- 13** were averaged. These points are depicted in **Figure E.1- 12** with a red circle. To evaluate the relative ponding depths between WCA 3A and WCA 3B and ENP, the first two points in WCA3B and ENP were averaged.

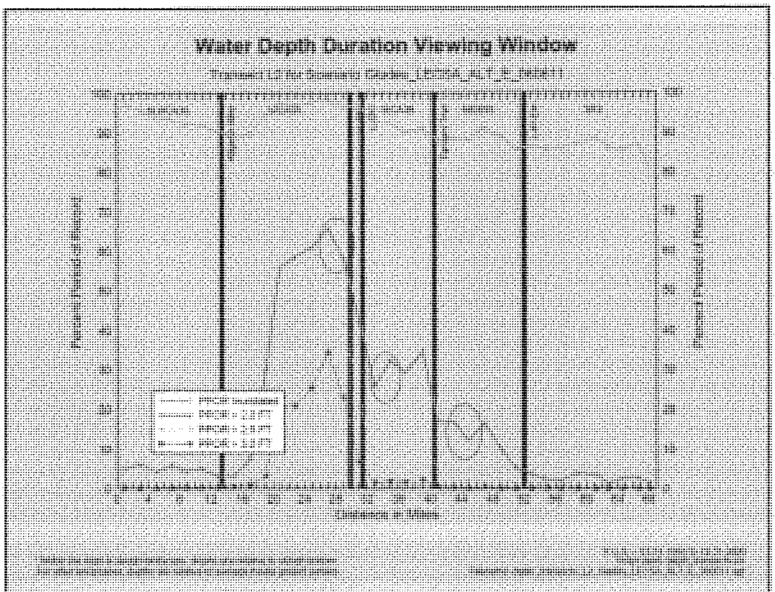


Figure E.1- 12. Everglades Viewing Windows Example Water Depth Duration Graph for Transect L2

Transects L1 in western WCA 3A , L2 through central WCA 3A, and L3 through eastern WCA-3A were chosen for the evaluation (**Figure E.1- 13**). Performance of each project configuration was compared to the FWO project condition.

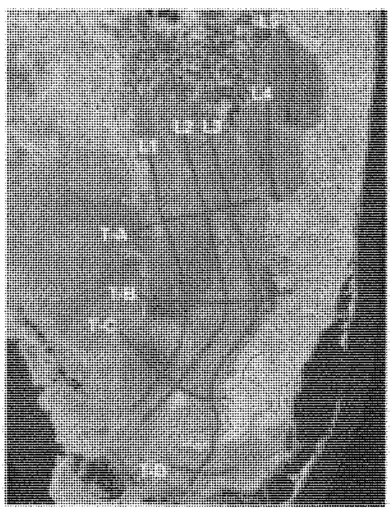


Figure E.1- 13. Transects of the Everglades Viewing Windows Screening Tool

The general trend of this analysis indicated that the project configurations improved ponding relative to the FWO project condition; however differences between alternatives were not discernible. Project configurations performed similarly.

E.2.4.4 Adaptability (Level 2)

Adaptability was measured using two separate metrics; 1) Robustness and 2) Future Compatibility. Robustness was defined as the ability to function effectively in the face of variability and uncertainty of future events. Future compatibility was defined as the efficiency of using the project configuration to complement future CEPP increments. Best professional judgment was used to apply each rating on a scale of (1-4).

Table E.1-30 illustrates the results of the (1-4) ratings. The western HRF was considered more robust than a full HRF as it can deliver water to the location within northern WCA 3A where it is most needed. The project configuration also avoids sending water to eastern areas of WCA 3A which is currently susceptible to excessive ponding. A longer length of fill in the Miami Canal was also considered to be more robust as any remaining canal that is not filled is assumed to continue to drain the area and reduce or limit the ability of the project to maintain expected benefits. The western HRF was considered to be more compatible than the full HRF as it can be modified in the future as needed. Construction of the feature does not prevent adding other conveyance and distribution features to northeastern WCA 3 in the future. A longer length of fill in the Miami Canal was also considered to be more compatible with the future as CERP recommends full fill of the entire length of the Miami Canal. It was also identified that it would be difficult in the future to return to the area and fill and/or gap those portions of the Miami Canal that were not filled.

Table E.1-30. Configurations Based on Adaptability

Configurations Adaptive Management				
Option	HRF	Miami Canal	Robustness	Future Compatibility
E	**West G-205**	**North S-339**	**3**	**3**
G	**West G-205**	**North I-75**	**3**	**3.5**
D	**West G-205**	**Full**	**3.5**	**4**
B	**Full**	**North S-339**	**2**	**2**
A	**Full**	**Full**	**3**	**3**
C	**Full**	**Plug Full**	**2**	**2**
F	**Full**	**None**	**1.5**	**1.5**

E.2.4.5 Ecologic Connectivity (Level 2)

This criterion evaluates increases in wetland acreage and marsh connectivity directly associated with the removal of man-made barriers to flow. The criterion was developed based on the set of CEPP project objectives related to restoring seasonal hydroperiods and freshwater distribution, and surface water depths within the project area. Water management practices beginning in the early 20th century led to the construction of an extensive system of canals, levees, and pump stations crisscrossing the once free-flowing natural system, which in turn has led to human-dominated operations of that system. This channelization, compartmentalization, and physical manipulation of how water flows into the Everglades due to water management operational criteria (i.e., regulation schedules) has altered or eliminated sheet flow and related hydrologic characteristics throughout much of the Everglades. Canals, levees, and roads constructed under the C&SF Project have been identified as causing landscape fragmentation, loss of connectivity of the natural system, alteration of volume, timing, and distribution of regional hydropatterns and degradation of habitat of wetland organisms. The loss of connectivity necessary for sheet flow has resulted in far-reaching effects on ecological processes and habitat. The ridge and slough landscape has become severely degraded in a number of locations and is being replaced with a landscape more uniform in terms of topography and vegetation, with less directionality. The desired restoration condition is to maximize the ecological connectivity and acreage of wetlands in the Everglades by removing or reducing the effects of landscape discontinuities caused by levees, canals, drainage ditches and spoil banks.

Project configurations were rated on a scale of (1-4) to estimate the degree to which each configuration performed with respect to ecologic connectivity. Ecologic connectivity was measured using two separate metrics; 1) Miles of Marsh Reconnected, and 2) Acreage of Marsh Restored.

Miles of Marsh Reconnected: This metric quantified the miles of marsh that are reconnected by backfilling of the Miami Canal from S-8 to S-151. Long, continuous and uninterrupted patterns of sheetflow from north to south are a defining characteristic of the Everglades and the habitat fragmentation caused by canals has disrupted the natural dispersion of organisms in the landscape. The metric captures the extent to which removal of structural barriers restores ecological connectivity across the Miami Canal footprint, thereby restoring the ecology in the marsh surrounding the canal. The target is to degrade / backfill all barriers to sheetflow to marsh elevation from S-8 to S-151. The total length of the Miami Canal from S-8 to A-151 is approximately 28.0 miles. GIS was used to calculate the miles of marsh reconnected for various sections of the Miami Canal (**Table E.1-31**).

Table E.1-31. Miles of Marsh Reconnected for Sections of the Miami Canal

S-8 to S-339 (Miles)	S-339 to I-75(Acres)	I-75 to S-151(Acres)	Total Canal Length
10.5	5.5	12.0	28.0

Acreage of Wetland Restored: Canals and levee systems represent a substantial area of dredged, filled, and degraded wetland habitats that could be restored back to functional, reconnected marshes. This metric quantified the acreage of wetland restored by backfilling of the Miami Canal from S-8 to S-151. This metric captured the differences among configurations in the spatial extent of wetlands adjacent to the Miami Canal. GIS was used to calculate the acreage of marsh restored for various sections of the Miami Canal and directly adjacent disturbed natural area (including spoil mounds) (**Table E.1- 32**).

Table E.1- 32. Acreage of Wetland Restored for Sections of the Miami Canal

S-8 to S-339 (Acres)	S-339 to I-75 (Acres)	I-75 to S-151 (Acres)	
67.3	56.7	131.5	Canal
256.8	77.4	178.0	Disturbed Natural Area
324.10	134.10	309.5	Total (Acres)

Table E.1- 33 illustrates the results of the (1-4) ratings. Project configurations with a full backfill of the Miami Canal from S-8 to S-151 (A and E) connected approximately 28.0 miles of marsh and were rated as providing the greatest amount of ecologic connectivity (Rating = 4). These configurations also restored approximately 767.70 acres of marsh. Project configurations with partial backfill of the Miami Canal (B, C, F, and H) were rated as providing intermediate levels of connectivity. Configuration C is full backfill of the Miami Canal from S-8 to S-151 with 4,000 foot plugs with 2,000 foot spacing. This is equivalent to backfilling approximately 66% of the Miami Canal from S-8 to S-151. Sixty six percent of 28.0 miles is equal to approximately 18.5 miles of marsh reconnected. The same logic is used for acreage of marsh restored. Sixty six percent of 767.70 acres is equal to approximately 506.7 acres of marsh restored. Configurations with no backfill of the Miami Canal (G) were rated as providing the least amount of ecologic connectivity (Rating = 1).

Table E.1- 33. Ratings of Options Based on Ecologic Connectivity

Configurations				Ecologic Connectivity	
Option	HRF	Miami Canal	Miles of Marsh Reconnected	Acreage of Marsh Restored	Subtotal
E	West G-205	North S-339	10.5	324.1	2
G	West G-205	North I-75	16.0	458.2	3
D	West G-205	Full	28.0	767.7	4
B	Full	North S-339	10.5	324.1	2
A	Full	Full	28.0	767.70	4
C	Full	Plug Full	18.5	506.7	3
F	Full	None	0	0	1

E.2.4.6 Recreational Impacts (Level 2)

Configurations for backfilling and/or plugging the Miami Canal in WCA 3A have brought forth much discussion among recreational stakeholders and project team members on the effects of changes to the landscape. Substantive changes to the landscape will affect stakeholder groups differently in how they access the Miami Canal and the marsh in WCA 3A. Information summarizing how alternative features could potentially affect recreational resources within the project area is summarized below for two main recreational groups; motorized boaters and swamp-geared vehicle users (*i.e.* track vehicles and swamp buggies). There are currently 108 track vehicle users registered with the Florida Fish and Wildlife Conservation Commission (FWC). Weekly bass tournaments and recreational fishing for bass and other species overwhelm the current facilities and provide thousands of documented angler hours. Configurations were rated on a scale of (1-4) to estimate the degree to which each configuration provided recreational access. Ratings were applied based on stakeholder input gathered during PDT meetings during plan formulation. Ratings of project configurations are provided in

.

Backfilling the Miami Canal: Backfill of canals in any manner substantively diminish the accessibility for deeper draft boats; and modifies the canal for nearly all users of the entire region. Such modifications may be either negative or positive, depending upon the type of vehicle usage. Swamp-geared vehicles do not easily cross a canal; plugs would improve their access as plugged canals would no longer be a barrier. Generally, any backfilling will virtually eliminate using bass boats for bass tournaments as these boats would not easily pass shallow water. Many shallow draft boats commonly use the open canal in a manner similar to an "interstate" and access the system before venturing off into the marsh. The shallower draft boats and non-motorized boats would potentially lose less access, as they can often travel in shallower water and could manage to cross plugs under most water conditions. Construction of plugs may lead to the development of a braided trail as users of shallow draft boats maneuver around or across plugs. Airboats less frequently use deeper canals as a means of access due to the inherent hazards of low freeboard and sinking in deep water.

Recommendations by Recreational Users (Recreational Motorized Boaters): Recreational motorized boaters have indicated that backfilling of the Miami Canal to marsh grade and/or with plugs from S-8 to S-151 are undesirable. Recreational motorized boaters have also indicated that the central (S-339 to S-340) and southern (S-340 to S-151) portions of the canal are more heavily used for recreational fishing than the northern portion of the canal (S-8 to S-339) due to the location of boat ramps within the project area. Boat ramps providing access to the northern portion of the canal are located adjacent to the S-8 pump station and are difficult to access while boat ramps located near I-75 and Holiday Park provide convenient access to the central and southern portions of the canal. While a project configuration with plugs would provide remnant deep water pools with potential access for fishing, users have identified boat channels as undesirable due to related speed restrictions and potential damage to boats that would occur during low water conditions.

Hydropattern Restoration Effects (Northern WCA 3A): The creation of a new HRF along the northern boundary of WCA 3A may offer new wildlife refugia and access to the area. Depending on length, depth, and width, the contribution of this feature may create substantial recreation opportunities in the area. If this area is deep enough for bass boats, it could replace some of the recreational opportunities lost to bass fisherman where proposed backfill might occur in the Miami Canal. However, a new HRF across the entire northern boundary of WCA 3A may potentially diminish existing swamp-geared vehicle access into the conservation area if water depths are deeper than 3 ½ feet; unless appropriate access consideration is given during HRF design. Many swamp-geared vehicle users' access points are currently located along the L-4 and L-5 Borrow Canals and Levees.

Recommendations by Recreational Users (Swamp-Geared Vehicles): Swamp-geared vehicle users have indicated that a HRF located along the northern boundary of WCA 3A is undesirable if it precludes current access points along the L-4/L-5 levee. Current configurations for the HRF considered included a full HRF located along the entire northern border of WCA 3A and a western HRF. Components of each feature included degradation of the L-4 Levee/L-5 Levee or a portion thereof and construction of a spreader canal south of Holey Land Wildlife Management Area. A spreader canal has been identified as undesirable; if users are unable to directly access the marsh by driving through the canal due to high water conditions.

Rationale for Ratings

Project configurations with a full backfill of the Miami Canal (A, C, and E) were rated as providing the least amount of access to the canal for recreational motorized boaters (Rating = 1). Project configurations with no backfill of the Miami Canal (G) were rated as providing the greatest amount of access for recreational motorized boaters (Rating = 4). Project configurations with partial backfill of the Miami Canal (B, F, and H) were rated as providing intermediate levels of access (**Table E.1-34**). Construction of the HRF was not considered a limitation to recreational boat access.

Each of the configurations considered below includes a HRF. While it is recognized that a HRF may diminish existing swamp-geared vehicle access into the conservation area; the HRF is more likely to be modified during design for recreational use. In addition, much of the activity in northern WCA 3A is related to current water levels. Northern WCA 3A is currently over drained. Swamp-geared vehicles are used during periods of low water to access camps for deer hunting. As water levels increase with the implementation of CEPP, potential swamp-geared vehicle users may increase their utilization of airboats for hunting. Backfilling the Miami Canal has the potential to more severely limit access to the marsh by recreational motorized boaters. As a result, importance was placed on how much of the Miami Canal was backfilled for those alternatives which contained both potential backfilling and HRF options.

Project configurations with a HRF located across the northern boundary of WCA 3A (Configurations A, C, and E) were rated as providing the least amount of access to the marsh by swamped-geared vehicle users (Rating = 1). Project configurations B, F, and H received a higher rating in comparison to configurations A, C, and E (**Table E.1-34**). These configurations also contained a HRF but backfilled a smaller portion of the Miami Canal and would be more desirable to recreational motorized boaters. Of the seven project configurations considered, configuration F was rated as providing the most amount of access (Rating = 4). This configuration also contained a HRF but did not backfill any portion of the Miami Canal. Construction of a full HRF was not considered to be more of a restriction to swamp-geared vehicles than a western HRF.

Table E.1-34. Ratings Configurations Based on Ability to Provide Access to Recreational Users (Motorized Boaters and Swamp-Geared Vehicle Users)

Configurations			
Option	**HRF**	**Miami Canal**	**Rating**
E	West G-205	North S-339	3
G	West G-205	North I-75	2
D	West G-205	Full	1
B	Full	North S-339	3
A	Full	Full	1
C	Full	Plug Full	1
F	Full	None	4

E.2.5 Distribution and Conveyance Options – MCDA and Cost Effective Results – Northern WCA 3A

Options F, E, G and D were identified as cost effective. **Table E.1-35** summarizes the estimated total construction cost of each project configuration and results of the Level 1 and Level 2 criteria evaluations. The configurations are listed in order of ascending total performance. Cost estimates assumed that only available onsite fill material to be used in backfilling the Miami Canal is located adjacent to the canal on the spoil mounds. These preliminary cost estimates did not assume that the material excavated from the construction of the HRF was suitable to use in the backfilling of the Miami Canal and of sufficient quantity to account for the entire material shortfall after utilization of the spoil mound material, so imported fill would be required

Table E.1-35. Results of Level 1 and 2 Screening for Decomp Project Configurations

	HRF	**Miami Canal**	**Level 1 Subtotal**	**Level 2 Subtotal**	**Total**	**Capital Cost Imported Fill**
E	West G-205	North S-339	24.5	11	35.5	$253,450,000
G	West G-205	North I-75	28.8	11.5	40.3	$308,823,888
D	West G-205	Full	29.8	12.5	42.3	$362,000,000
B	Full	North S-339	22.1	9	31.1	$264,450,000
A	Full	Full	28.7	11	39.7	$373,000,000
C	Full	Plug Full	28.7	8	36.7	$310,000,000
F	Full	None	14.4	8	22.4	$219,000,000

E.2.6 Refinement of Distribution and Conveyance Options - Northern WCA 3A

The options described above utilized the existing water budget entering WCA 3A, and while providing invaluable insight and information on the hydrology of WCA 3A, further modification and evaluation of these cost effective options was warranted when considering the additional water provided by the FEB and Lake Okeechobee operational refinements.

HRF Component Modifications

Each option in the final array includes a scenario with and without the STA-2/Compartment B diversion (Options 1-9 – scenarios a and b). The eastern portion of WCA 3A is currently affected by high water and prolonged periods of inundation created by outflow through the S-11 structures and impoundment structures (features associated with the Miami Canal, L-67A and L-67C Canal). In order to avoid exacerbating and potentially alleviate ponding in this area all configurations assumed that outflows from STA 3/4 currently directed to WCA 2A via the S-7 structure would be re-routed to the HRF when capacity was available. Additionally, in order to further alleviate ponding near the S-11 structures within WCA 3A and potentially reduce high water conditions in WCA 2A, flow from Compartment B and STA-2 was also considered to be re-directed to the HRF via the L-6 and L-5 canals.

The HRF element from Option G was carried forward as it stands and no modifications were made other than adding a scenario with re-direction of flow from Compartment B and STA-2 to the HRF via the L-6 and L-5 canals (Option 1, 2 and 3 of the final suite).

Additionally, due to the increase in available water under CEPP; recommendations were made to extend the HRF west of G-205, east to the G-206 structure (Options 4, 5 and 6 of the final suite) and to also include a HRF to further hydrate portions of northeast WCA 3A (Options 7, 8 and 9 of the final suite (**Table E.1-36**). Extension of the HRF to the G-206 structure would require similar modifications to the L-5 canal and STA 3/4 outflow structures, similar to option G, requiring similar costs for construction. G-206 also marks the western boundary of what was once considered to be the southern extent of sawgrass within WCA 3A. A HRF spanning the full northern boundary of WCA 3A from west of S-8 to G-206 would redistribute sheetflow within the boundaries of the historical ridge and slough landscape. Extending the HRF for these configurations provided needed information on whether the additional water made available from the FEB justified a longer spreader footprint.

Miami Canal Backfill Component Modifications

Option F, while cost effective and the least cost option, was not recommended for further consideration. This configuration includes a HRF spanning the entire northern boundary of WCA 3A, with no backfill of the Miami Canal from S-8 to S-151. The Miami Canal functions as a major, unnatural drainage for WCA 3. In combination with the northern levees of WCA 3 (L-4 and L-5), the Miami Canal has substantially impacted historical sheetflow and natural wetland hydroperiods. As a result, during wet periods, the natural capability of the WCA to store water is lost and the Miami Canal effectively over-drains the area. This project configuration was eliminated as it does not address construction of project features that would eliminate drainage effects associated with the Miami Canal.

Options E, G and D were identified as cost effective. However, a synthesis of the three Miami Canal components of these Options was made to backfill the Miami Canal from S-8 to S-I-75 (similar to Option G) with the addition of strategically placed plugs located directly adjacent to S-340 and/or south of the C-11 Extension. Through the above screening effort it became apparent that hydrologic improvements between backfill and plugging configurations perform similarly, so a hybrid approach of using plugs and backfill was established in order to achieve the benefits of Option D while only incurring a minor increase in cost over Option G. Additionally, as a result of further refinement of the design of the L-5 improvements necessary for conveying STA 3/4 water west, additional quantities of onsite fill was identified which provided the justification for extending the backfill from S-339 to I-75 (in lieu of paying for disposal of the L-5 materials, the fill will be used to backfill the Miami Canal).

These backfill and plug configurations of the Miami Canal were combined with the HRF configurations and the WCA 2 Bypass scenarios to form 18 combinations (**Table E.1-36**) of final options that resulted from the screening effort.

Table E.1-36. Combinations of HRF and Miami Canal Options

Option	HRF	Miami Canal	L-6 Diversion (a, b)
1a, 1b	West G-205	North I-75	With/Without
2a, 2b	West G-205	North I-75, Plug Around S-340	With/Without
3a, 3b	West G-205	North I-75, Plug Around S-340, Plug South of C-11	With/Without
4a, 4b	West G-206	North I-75	With/Without
5a, 5b	West G-206	North I-75, Plug Around S-340	With/Without
6a, 6b	West G-206	North I-75, Plug Around S-340, Plug South of C-11	With/Without
7a, 7b	Full	North I-75	With/Without
8a, 8b	Full	North I-75, Plug Around S-340	With/Without
9a, 9b	Full	North I-75, Plug Around S-340, Plug South of C-11	With/Without

A subset including four of these options was then further evaluated for inclusion in the final array of alternatives. Due to the expedited schedule for CEPP, only a limited number of options were able to be modeled. Focus was placed on modeling options which would allow the project team to evaluate the potential benefits of:

- Extending the HRF to the full northern extent of WCA 3A. Does this provide project benefits which warrant additional costs? Includes Options 4a and 7a. Evaluating hydrologic trends identified in this comparison with the trends identified in the comparison against option 6a were used to determine whether Options 8 or 9 warrant further consideration.
- Incorporating one or more plugs south of I-75. Does this provide project benefits which warrant additional costs? Includes Options 4a and 6a. Information gained from the evaluation of Options 4a and 6a can be applied to options which include the full HRF and plugging south of I-75 (Options 8a, 8b, 9a and 9b), negating the need for these separate model runs. Evaluating hydrologic trends between Options 4a and 6a will also determine if one or more plugs south of I-75 is needed, negating the need for a separate model run of a single plug directly adjacent to the S-340 structure (Option 5a and 5b).
- Options modeled to inform whether the benefits of diverting water from STA 2 to WCA 3A will be captured by evaluating hydrologic trends observed between Options 7a and 7b.

Provided below are detailed results related to the screening of the new distribution and conveyance options in northern WCA 3A (South of the Redline). To evaluate the options listed below, output from the RSM-GL (Version 2.3.1) was utilized. Hydroperiod distribution maps, ponding depth maps, and overland flow vector maps were used that depicted average annual calculations for the 41-year period of record as well calculations for a wet year (1995), dry year (1989) and an average year (1978). Results are presented in **Table E.1- 37, Table E.1- 38**, and **Table E.1- 39**. Best professional judgment was used to evaluate the relative performance of each option.

Table E.1- 37. Results from Refinement Effort: Hydropattern Restoration Feature.

HRF	Ponding Depth			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
W-G206	+	=	+	+
Full		=		
HRF	Hydroperiod			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
W-G206	+	=	+	+
Full		=		
HRF	Average Annual Overland Flow Vectors			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
W-G206	=	=	+	+
Full	=	=		

Table E.1- 38. Results from Refinement Effort: Miami Canal Features

Miami Canal	Ponding Depth			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
I-75 North	=	=	=	=
North I-75, Plug Around S-340, Plug South of C-11	=	=	=	=
Miami Canal	Hydroperiod			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
I-75 North	=	=		=
North I-75, Plug Around S-340, Plug South of C-11	=	=	+	=
Miami Canal	Average Annual Overland Flow Vectors			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
I-75 North	=	=		=
North I-75, Plug Around S-340, Plug South of C-11	=	=	+	=

Table E.1- 39. Results from Refinement Effort: Diversion of Water from STA 2 to WCA 3A

L-6 Diversion	Ponding Depth			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
Without				
With	++	+	++	+
L-6 Diversion	Hydroperiod			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
Without				
With	++	+	++	+
L-6 Diversion	Average Annual Overland Flow Vectors			
	Average Year (1978)	Wet Year (1995)	Dry Year (1989)	Period of Record (1965-2000)
Without				
With	+	+	+	+

+ Denotes Better performance

= Denotes Equal performance

E.3 CONVEYANCE AND DISTRIBUTION – SOUTHERN WCA 3A, 3B AND ENP

This section describes the identification of management measures, screening of management measures, formulation of options and the MCDA and cost effectiveness results for southern conveyance and distribution components of CEPP.

E.3.1 Southern Conveyance and Distribution: Management Measures

This section contains a description of unique Management Measures for conveyance and distribution from WCA 3A to WCA 3B and ENP. The management measures include the major features that form the basis of the options which were then combined with the options from other parts of the system to form the final array of alternatives. Sources of information and ideas for the alignment, sizes, and operations of the new features in the L-67A, L-67C, L-29, and L-30 levees (and their borrow canals), and Tamiami Trail included: CERP report; MWD studies (GDM, 8.5 SMA, TT, CSOP, COP); TTMNS; ERTP; research on tree islands and ridge and slough habitats; Working Group sponsored workshops, and PDT meetings.

Similar to those management measures for distribution and conveyance for northern WCA 3A (south of the Redline), management measures for southern WCA 3A, WCA 3B and ENP were formulated to meet the following project objectives:

Objective 1: Restore seasonal hydroperiods and freshwater distribution to support a natural mosaic of wetland and upland habitat in the Everglades system.

Objective 2: Improve sheetflow patterns and surface water depths and durations in the Everglades system in order to reduce soil subsidence, frequency of damaging fires, decline of tree islands and decrease salt water intrusion.

Objective 4: Restore more natural water level responses to rainfall to promote plant and animal diversity and habitat function

Levee Removal: Levees such as the L-67A would be completely removed in order to re-establish water flows. The removal of the levees would restore the sheet flow directionality and improve hydroperiods by ensuring a more consistent distribution of water. Additionally, the removal of these barriers would eliminate substantial fragmentation that inhibits animal movement and decreases habitat value. Material would be disposed of onsite through the incorporation into other features or may need to be transported offsite, which would increase project costs. Levee removal, with significant potential benefits, was retained as a measure for possible inclusion into components and alternatives.

Levee Gaps: Levees such as the L-67A would be degraded in certain areas to allow water flows from WCA 3A to WCA 3B. The levee gaps may have control structures for operational control to prevent water flows into WCA 3B during extreme high water events. Some improvements in habitat value would occur with the increased water flows from this measure, with reduced fragmentation leading to a healthier ecosystem. This measure would likely be less costly when compared to complete levee removal if the material is not needed for related management measure construction; however, there would be more likelihood that some hydropattern restoration may be impeded by remaining portions of the levees. As such, levee gaps, although not quite as effective as levee removal but with possible cost savings, was retained as a management measure.

Levee/Berm Construction: The construction of levees/berms within the WCAs could be utilized to guide surface water along preferential flow paths for distribution. Certain portions of WCA 3 may be situated in an area where additional structures are necessary to steer water flows into the area. The strategic placement of these levees/berms could reduce ponding in some areas while diverting surface flows to other areas that are typically dry. Additionally, levee/berm construction could direct water away from the eastern levees, reducing the possible need for seepage control with increased flows into the WCAs. This measure was retained.

Flow-through Wetlands (Restored Wetlands): A Flow-through wetland is a measure that is similar to the Flow Way feature that was evaluated as a water storage measure. A Flow-through would be used primarily for the distribution of freshwater, promoting the restoration of seasonal hydroperiods within Everglades areas.

Culverts within Existing Levees: Similar to the Levee Gaps, culverts could be constructed within levees such as the L-67A and L-67C to allow greater distribution of water flows. Culverts may provide greater operational control than levee degradation and could limit the cost of any possible spoil disposal. It is likely that there would also be some type of control structure to manage water flows during periods of extremely high water.

Gated Water Control Structures: Gated structures could be constructed within the borrow canal of the L-67A to allow for controlled passage of water from WCA 3A into WCA 3B or within the L-29 Canal to direct water into the desired location of North East Shark River Slough. L67A structures would likely be combined with Levee Gaps or complete Levee Removal to create a component that would essentially direct the flow of water into WCA 3B. Water that typically flows south in the L-67A borrow canal would slow and pool at the control structure, with some of the water overflowing through the gap in the L-67. The gated water control structures could be completely opened during significant storm events to allow for complete passage of water through conveyance channels such as the L-67A borrow canal. Gated water control structures may also be used in other portions of the study area where water flows in canals need to be managed. This measure was retained.

Weirs: Similar to the Gated structures, weirs could be constructed within the borrow canal of the L-67A to manage water flows and move water from WCA 3A into WCA 3B. Weirs would be less flexible during storms and other extreme high flow events. This measure was retained.

Operational Changes: Operations would be altered to move water more effectively throughout WCA 3. Operational changes may also be necessary to send water to the South Dade Conveyance System for agricultural/environmental water supply and also to manage water for flood risk. This measure is likely to be integral to any component or alternative that is formulated and was therefore retained as a measure.

Pump Stations: Include a pump station to move water from WCA 3A to WCA 3B was determined to be a non-effective means of conveying water as a control structure and gravity is sufficient to convey water across the L-67A. A pump station was included as a means to overcome the hydrologic head impediment to flow from WCA 3B to ENP, as there is uncertainty if gravity alone is sufficient to convey the water due to stage differences in ENP and WCA 3B.

Bridging: Additional bridging of Tamiami Trail would allow for an increase in the capacity of flows entering ENP, and also allow for more effective distribution of water into the Park. Bridging Tamiami Trail would accomplish two purposes: 1) The roadway would be elevated so increased stages in WCA 3B would not cause flooding impacts, and 2) Bridging would allow for increased sheet flow from the Water Conservation Areas into ENP. Additional bridging and subsequent flows could cause increased water levels along the eastern levees in ENP, causing a possible need for increased seepage control. This measure was retained for further consideration.

Elevating Roadway: Currently, elevations in Water Conservation Area 3B are kept at 7.5 feet in order to prevent flooding across Tamiami Trail. Water levels could be raised as high as 8.5 feet without any flooding impacts; however, any stage increase above that threshold would require the roadway to be elevated. Under this measure, fill material would be imported to physically raise the elevation of Tamiami Trail. This measure would not include additional culverts under the roadway, but may be combined with additional culverts or additional measures that in combination would allow for greater stages in WCA 3B and increased flows into NESRS. This measure was retained.

Collection Canal: A collection canal would be constructed on the northern side of the L-29 levee in WCA 3B in order to alleviate high water levels. Water would then be passed through the levee via the S-355 structures or another similar structure/s. In addition to relieving high water levels in WCA 3B, this structure could also be combined with other measures that are designed to increase water flow through WCA 3B. A collection canal was retained as a measure for possible inclusion into components and alternatives.

E.3.2 Screening of Distribution and Conveyance Management Measures

Results are presented in **Table E.1-40**. Measures not retained are marked with "x".

Table E.1-40. Results of Southern WCA 3A, 3B and ENP management measure screening

	Screening Criteria		
	Effectiveness (Project Objectives)	Maintenance Considerations	Environmental & Secondary Effects
Conveyance and Distribution from WCA 3A to WCA 3B			
Levee Removal	Retained		
Levee Degradation/Gaps	Retained		
Levee/Berm Construction	Retained		
Weirs	Retained		
Pump Stations	X	X	
Gated Water Control Structures	Retained		
Culverts within Existing Levees	Retained		
Conveyance and Distribution from WCA 3A/3B to ENP			
Collection Canal	Retained		
Elevate Roadway	Retained		
Gated Water Control Structures	Retained		
Weirs	Retained		
Pump Stations	Retained		
Levee/Berm Construction	Retained		
Operational Changes	Retained		
Bridging	Retained		
Flow-through Wetlands	Retained		

E.3.3 Formulation and Evaluation of Initial Distribution and Conveyance Options

Conceptual alignments were prepared through an interdisciplinary team of stakeholders and resource agencies staff and included general locations of features, although at this stage of the formulation, sizes of features generally were not specified. These conceptual alignments went through a refinement analysis that organized the common and reasonably feasible concepts into two primary flowway concepts that underwent analysis with the iModel screening and sensitivity tool.

The iModel tool relies on output from the RSM-GL regional hydrologic model. Once the RSM-GL output is incorporated, the iModel operates much more quickly than the large H&H regional model. Typical H&H models start with inputs of structure sizes and flow volumes, and produce outputs of water depths and durations at locations throughout the system. The iModel is "inverse" in that inputs to the iModel are ecological targets (water depths and durations) and outputs are the combination of structures and operations of the structures. It uses an optimization method that provides the overall "best" fit to the targets.

iModel can include or not include (i.e., turn on or turn off) individual structures, and compare the performance (achievement of targets) with or without these features. This is used to guide the team toward features and operations that are most suitable to carry forward to the detailed analysis using the RSM-GL regional model. The operations identified in the iModel are an efficient starting point for establishing the operations of features in the detailed regional model.

Two structurally and operationally different concepts were analyzed (**Figure E.1- 14**) – one that had multiple conveyance structures in the L-67 and L-29 levees (Concept 1), and one that had a similar set of conveyance structures but also contained a new levee within WCA 3B that would redirect water flow within WCA 3A and would change the patterns of seepage out of WCA 3B (Concept 2).

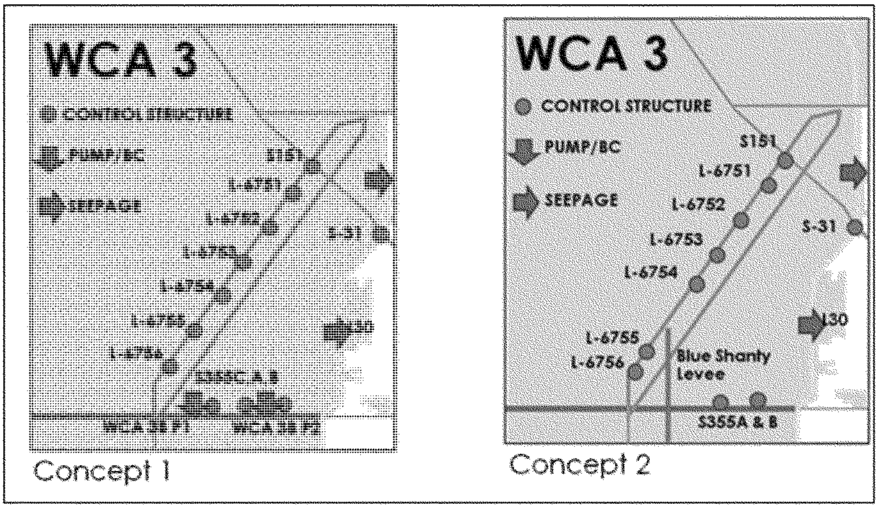


Figure E.1- 14. Configurations Identified for iModel

An iModel set was developed for both configurations. Simple assumptions using the ridge and slough vegetation performance measure were used as initial ecological targets for the iModel to try to achieve. The simulation results were not limited by other real world constraints, such as for seepage effects, levee integrity, or regulation schedules for nearby areas.

E.3.3.1 Refinement of System-Wide Operational Targets

The iModel distributes the existing and new water and develops optimal performance toward the overall hydrologic targets. The two runs (Concept 1, Concept 2) performed well in several locations, given that an average of 200,000 acre-feet of new water was being delivered to the system and that most constraints were not yet included. However, the team recognized that performance in many locations could be better, that some of the performance challenges were due to inconsistencies among the targets, and that seepage must be taken into account. Some of the stage targets elsewhere in the conservation areas and ENP could not be met, and performance in some locations did not meet expectations for restoration. Operational targets were refined prior to further iModel sensitivity runs.

Many factors were considered during the refinement of operational targets for the water conservation areas and ENP. Stages in WCA 1 were to remain unchanged from existing conditions. Stages in WCA 2 were to meet targets provided by the US Fish and Wildlife Service, which differed from the ridge and slough vegetation stage target. These locations were given high importance during subsequent iModel runs. Operational stage targets in WCA 3A, WCA 3B, and ENP considered several realities. Some areas have suffered more from subsidence and soil loss than other areas. For these most degraded areas, smaller incremental changes toward full restoration water depth targets might be more appropriate than large magnitude changes which would make conditions worse rather than better. There was and is a mix of different ecological communities in the water conservation areas. A single slough water depth target would not be suitable for sawgrass plain, marl prairie, and upland habitats, and might not be suitable for all locations that still contain tree islands. Targets were adjusted downward for these locations and, to avoid abrupt changes in water stage or depth, for locations between the deeper ridge and slough habitats and shallower sawgrass, marl, or upland habitats. Locations with adjacent deeper water targets and shallower depth targets required careful balancing.

The stage target for WCA 3B was amended to include a maximum 60 day duration for high water depths. This was added because many of the tree islands in WCA 3B have lost some of their elevation due to oxidation of their soil; their elevations are now much closer to the elevation of the sloughs and surrounding marsh. Deep water for a short time is not a problem, but deep water for a long time would be damaging to tree islands.

The small reductions of the depth targets in northern WCA 3A enabled the creation of a much better pattern of wet season to dry season variability in these northern locations as well as in many locations farther south in the system. Depth targets were kept at existing conditions in central WCA 3A (Site 3A-4) since it contains some of the best remaining ridge and slough habitat in the Everglades. In areas north of this central site, where conditions tend to be too dry, targets were increased relative to existing conditions. In areas south of this central site, where water is often too deep, depth targets were decreased slightly relative to existing conditions. This "pivot" around central WCA 3A minimized the increase of overall average water depths in WCA 3A and the concern about the effects of deep water at the L-29 levee in WCA 3A (WCA 3A Zone A constraint). It also reduced the wedge effect and produced water surface profiles that are closer to parallel to the ground surface (**Figure E.1- 15**).

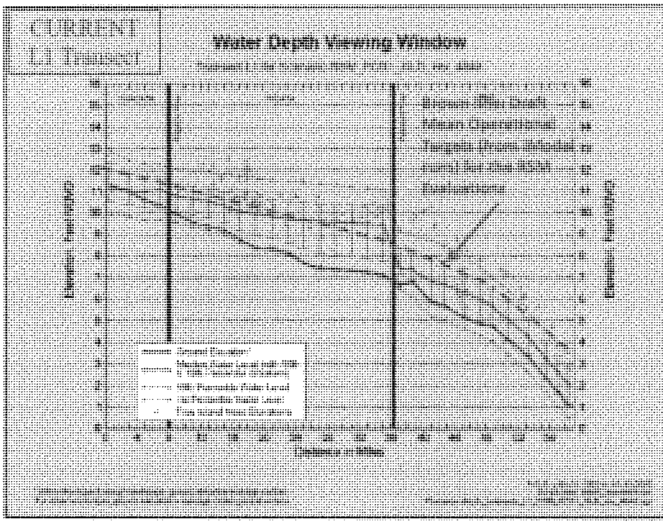


Figure E.1- 15. Water Depth Viewing Window for Transect L1 Extending Through WCA 3 and ENP

The resulting refined operational targets were mostly achievable with the CEPP water budget and provided a relatively smooth water surface gradient approaching parallel to the ground surface that also sloped downward from the northern edge of WCA 3A to southern ENP and Florida Bay.

The team returned to the large table of options for conveyance. Using the iModel with the refined operational targets, conducted multiple sensitivity runs to address the effects of changes in specific structures.

The refined operational targets for CEPP's iModel screening differ from full restoration targets from RECOVER due to a recognition among the agencies that topography, vegetation, and other natural conditions in the WCAs have changed since drainage and therefore achieving the 'full restoration' inundation duration through particular areas that have experienced the most change could have unintended effects. Therefore, for screening, operational targets were developed by the interagency CEPP ecosubteam that were considered reasonable inundation durations with acceptable timing, depths, and frequency of wet periods that would allow the areas to adjust to CEPP's increment of CERP restoration.

The ecological subteam set the targets used in the iModel runs based on the RECOVER Slough Performance Measure (described in **Appendix G**). The targets aim for an increment of restoration that will benefit the areas given the current ecology and elevations (e.g., sawgrass plain in northeastern WCA3. The RECOVER Slough PM provides a target that describes a full-restoration, pre-drainage pattern of hydroperiods within sloughs, with the expectation that suitable water depths for slough vegetation will provide the desired restoration condition for the entire ridge and slough landscape. Four hydrologic metrics are combined to determine suitability for slough vegetation: 1) continuous hydroperiod; 2) continuous dry-down duration below 0.7 ft (20 cm); 3) wet season average water depth; and 4) dry season average water depth. **Figure E.1- 16** shows the modified targets for WCA 3A and 3B. **Figure E.1-17** shows the modified targets for ENP.

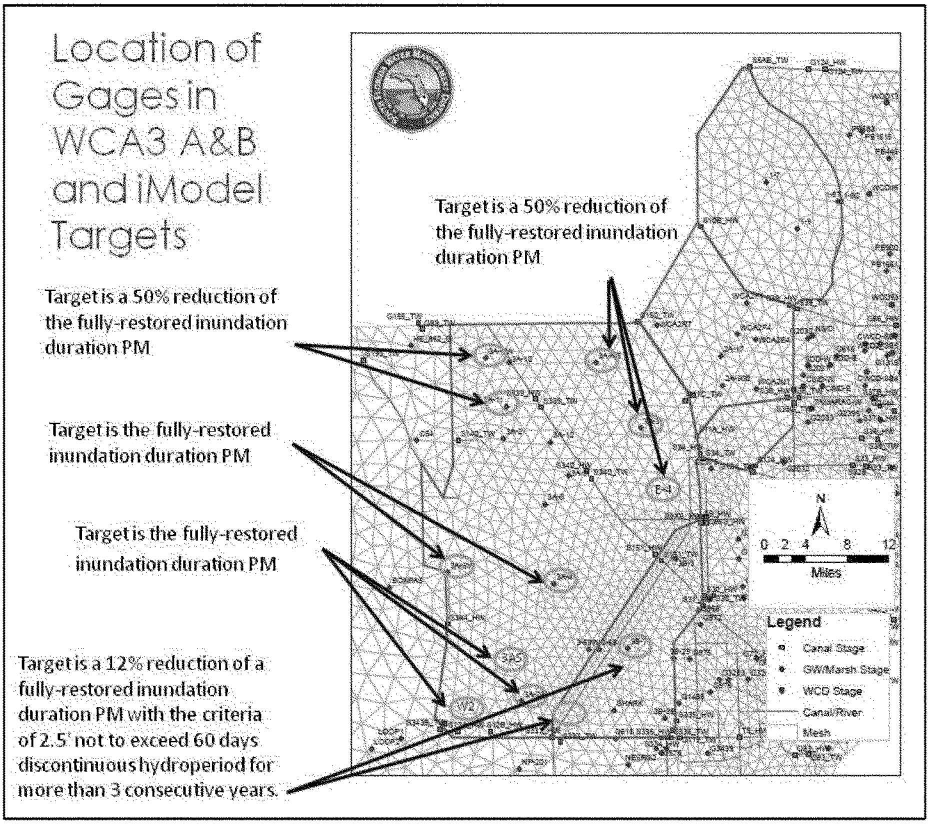


Figure E.1- 16. Locations for measuring inundation and depth in WCA 3A and WCA 3B

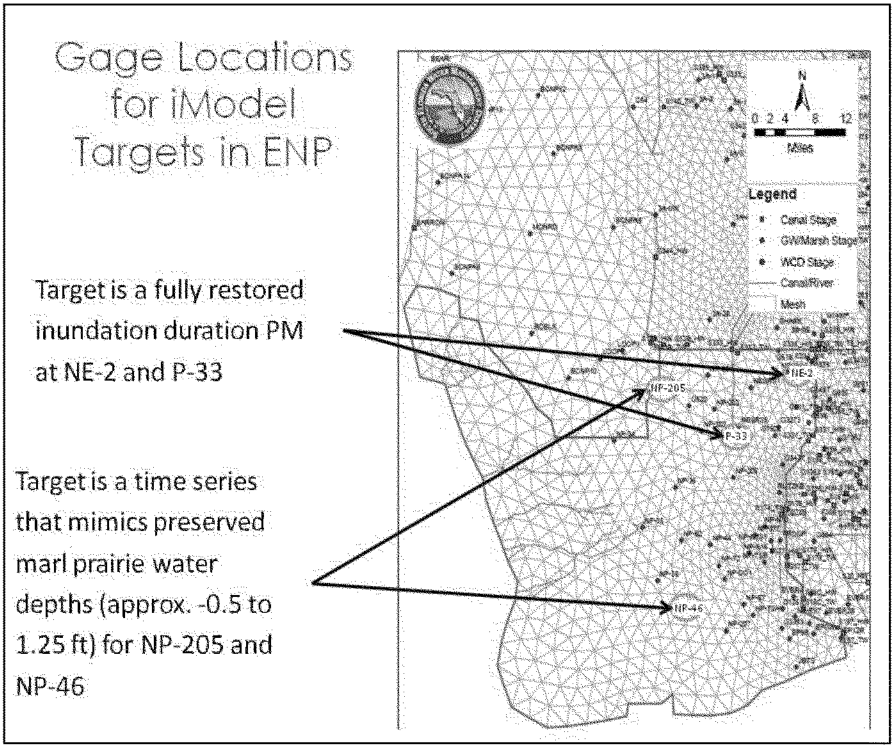


Figure E.1- 17. Locations for measuring inundation and depth in ENP

Removing the L-6 diversion resulted in too much water delivery to WCA 2, in exceeding the depth targets for WCA 2 and in increased discharge from southern WCA 2 through the S-11 structures. These southern discharges resulted in exceeding the WCA 3A Zone A too frequently. Thus, the L-6 diversion must be retained in the CEPP alternatives.

As flows and stages at Site 71 in central WCA 3B were increased, there was increased adverse seepage out of WCA 3B that would increase potential flooding in the developed areas east of WCA 3B. Increased seepage would require additional measures to manage seepage.

An 8.5 foot stage constraint in the L-29 canal did not greatly reduce stages and flows through WCA 3B into ENP. An 8.0 foot stage constraint measurably reduced flows and reduced attainment of stage targets. The major factor establishing the stage constraint in the L-29 canal is Tamiami Trail highway and the amount of modification to the existing highway.

E.3.3.2 Formulation of Initial Options for Distribution and Conveyance – Southern WCA 3A

The structures contained in the two conceptual configurations were assembled into 23 combinations of location and size of features to allow water to flow from WCA 3A into WCA 3B and ENP. Some of these combinations were modified from alternatives addressed in previous studies and others were suggested by agencies and stakeholders. Some of the combinations were deemed to be not substantially different from each other and were removed. Others were screened based on the information on structure size/usage described in the modeling conducted during the refinement of system-wide operational targets. The 23 options and the screening details are described in (**Table E.1-41**). Options not retained are marked with "x". The preliminary screening resulted in 10 options that underwent iModel analysis (**Table E.1-42**).

Table E.1-41. Features of 23 initial options for conveyance and distribution in southern WCA 3A, 3B, and ENP, and reasoning for removal from further consideration

Option	Title	S-333	3B/L-67A levee	L67C levee	L-29 levee	Blue Shanty levee, 3B	Blue Shanty levee, ENP	Divide in L 29 canal	L-29 canal operational limit	Tamiami Trail Bridge	Tamiami Trail road	L-67 Ext levee	3B Seepage Management	Narrative
1A	No - WCA 3B	2000					TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Constrained	
2	No - WCA 3B	Increase capacity					2.6m	Yes	9.7 ft west of divide / 8.5 feet east	2.6m	Road raise - model derived distance from divide	Yes/No	Constrained	Preliminary iModel results have demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumesno constraint from Tamiami Trail in the future with and without project conditions. A divide structure with different elevations in the L-29 would only serve a seepage management function.
3A1	Southerly Orientation 3B	2000	S4, S5, S6 @500cfs	Gaps at structures	355A,B,C		TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Unconstrained	
3A2	Southerly Orientation 3B	2000	S4, S5, S6 @750cfs	Gaps at structures	355A,B,C		TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Unconstrained	
3B2	Southerly Orientation 3B	2000	S 4, S5, S6 @750 cfs	Gaps at structures	355A,B,C Pump 1		TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Unconstrained	
3B3	Southerly Orientation 3B	2000	S 4, S5, S6 @750 cfs	Gaps at structures	355A,B,C Pump 1		TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Constrained	
4A	Southwest 3B - Blue Shanty	Existing	S5, S6 and S1-4	Degrade west of Blue Shanty levee	Degrade west of blue shanty levee	From L67A to L-29	TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Constrained	
4B	Southwest 3B - Blue Shanty	Existing	S5, S6 and S4	Degrade west of Blue Shanty levee	Degrade west of blue shanty levee	From L67A to L-29	TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Constrained	
4C	Southwest 3B - Blue Shanty	Existing	S5, S6	Degrade west of Blue Shanty levee	Degrade west of blue shanty levee	From L67A to L-29	TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Constrained	
5	Southwest 3B - Blue Shanty	Existing	Controlled structures	Degrade west of Blue Shanty levee	Controlled structures west blue shanty levee	From L67A to L-29	1m	Yes	9.7 ft west of divide / 8.5 feet east	1m	TTMNS rebuild western	Yes/No	TBD	Preliminary iModel results have demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.

Option	Title	S-333	3B/L-67A levee	L67C levee	L-29 levee	Blue Shanty levee, 3B	Blue Shanty levee, ENP	Divide in L 29 canal	L-29 canal operational limit	Tamiami Trail Bridge	Tamiami Trail road	L-67 Ext levee	3B Seepage Management	Narrative
6A	Southwest 3B	Increase capacity if needed	Controlled structures	Gaps at structures	more 355s; gravity		2.6m		8.5 feet	2.6m		Yes/No	TBD	Preliminary iModel results have identified optimal location of structures to achieve desired system operations and iModel has demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.
6B	Southwest 3B	Increase capacity if needed	Controlled structures	Gaps at structures	more 355s; pump		2.6m		8.5 feet	2.6m		Yes/No	TBD	Preliminary iModel results have identified optimal location of structures to achieve desired system operations and iModel has demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.
	Southwest 3B	Increase capacity	3 structures	3 gaps	more 355s; gravity		2.6m	2.6m	9.7 feet	2.6m	TTMNS rebuild		TBD	Eliminated - Non-compatible with authorized next-steps bridging (road work would have to be constructed then removed - lack of future compatability
	Soutwest 3B	Increase capacity	3 structures	3 gaps	pump		2.6m	2.6m	9.7 feet	2.6m	TTMNS rebuild		TBD	Eliminated - Non-compatible with authorized next-steps bridging (road work would have to be constructed then removed - lack of future compatability
7A	South-Central 3B	Increase capacity if needed	Controlled structures	Gaps at structures	more 355s; gravity		2.6m	2.6m	8.5 feet	2.6m		Yes/No	TBD	Preliminary iModel results have identified optimal location of structures to achieve desired system operations and iModel has demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.
7B	South-Central 3B	Increase capacity if needed	Controlled structures	Gaps at structures	more 355s; pump		2.6m	2.6m	8.5 feet	2.6m		Yes/No	TBD	Preliminary iModel results have identified optimal location of structures to achieve desired system operations and iModel has demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.
	South-Central 3B	Increase capacity	3 structures	3 gaps	more 355s; gravity		2.6m	2.6m	9.7 feet	2.6m	TTMNS rebuild		TBD	Eliminated - Non-compatible with authorized next-steps bridging (road work would have to be constructed then removed - lack of future compatability
	South-Central 3B	Increase capacity	3 structures	3 gaps	pump		2.6m	2.6m	9.7 feet	2.6m	TTMNS rebuild		TBD	Eliminated - Non-compatible with authorized next-steps bridging (road work would have to be constructed then removed - lack of future compatability

Option	Title	S-333	3B/L-67A levee	L67C levee	L-29 levee	Blue Shanty levee, 3B	Blue Shanty levee, ENP	Divide in L 29 canal	L-29 canal operational limit	Tamiami Trail Bridge	Tamiami Trail road	L-67 Ext levee	3B Seepage Management	Narrative
8A	Entire L-67A extent	Increase capacity if needed	6 structures	Gaps at structures	more 355s; gravity		2.6m	2.6m	8.5 feet	2.6m			TBD	Preliminary iModel results have demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.
8B	Entire L-67A extent	Increase capacity if needed	6 structures	Gaps at structures	more 355s; pump		2.6m	2.6m	8.5 feet	2.6m	Road raise - model derived distance from divide		TBD	Preliminary iModel results have demonstrated little variability in 9.7 vs. 8.5 feet in meeting targets are park. Formulation assumes 9.7 future with project condition.
9A	Entire L-67A extent	Increase capacity if needed	6 structures	Gaps at structures	more 355s; gravity		TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Unconstrained	
9B	Entire L-67A extent	Increase capacity if needed	6 structures	Gaps at structures	more 355s; pump		5.5	5.5	9.7 ft	5.5	Road Raise		Constrained	Preliminary iModel results have demonstrated little use of several structures on the L-67A when seepage is constrained.
10A	North/South	2000	S2,S3 S5,S6 @500cfs	Gaps at structures	355A,B,C 2 pumps @500cfs		TBD	TBD	9.7	TBD - TTNS	TBD - TTNS	TBD	Unconstrained	

Table E.1-42. Features of the 10 options that were modeled with the iModel screening tool.

Option	Title	S-333	3B/L-67A levee	L67C levee	L-29 levee	Blue Shanty levee, 3B	Blue Shanty levee, ENP	L-29 canal operational limit	Tamiami Trail Bridge	Tamiami Trail road	L-67 Ext levee
1A	No - WCA 3B	2000						9.7	2.6	Road Reconstruction	TBD
3A1	Southerly Orientation 3B	2000	S4, S5, S6 @500cfs	Gaps at structures	355A,B,C			9.7	2.6	Road Reconstruction	TBD
3A2	Southerly Orientation 3B	2000	S4, S5, S6 @750cfs	Gaps at structures	355A,B,C			9.7	2.6	Road Reconstruction	TBD
3B2	Southerly Orientation 3B	2000	S 4, S5, S6 @750 cfs	Gaps at structures	355A,B,C Pump 1			9.7	2.6	Road Reconstruction	TBD
3B3	Southerly Orientation 3B	2000	S 4, S5, S6 @750 cfs	Gaps at structures	355A,B,C Pump 1			9.7	2.6	Road Reconstruction	TBD
4A	Southwest 3B - Blue Shanty	2000	S5, S6 and S1-4	Degrade west of Blue Shanty levee	Degrade west of blue shanty levee	From L67A to L-29	Yes	9.7/8.5 with Divide	2.6	Road Reconstruction	TBD
4B	Southwest 3B - Blue Shanty	2000	S5, S6 and S4	Degrade west of Blue Shanty levee	Degrade west of blue shanty levee	From L67A to L-29	Yes	9.7/8.5 with Divide	2.6	Road Reconstruction	TBD
4C	Southwest 3B - Blue Shanty	2000	S5, S6	Degrade west of Blue Shanty levee	Degrade west of blue shanty levee	From L67A to L-29	Yes	9.7/8.5 with Divide	2.6	Road Reconstruction	TBD
9A	Entire L-67A extent	2000	6 structures	Gaps at structures	more 355s; gravity			9.7	2.6	Road Reconstruction	TBD
10A	North/South	2000	S2,S3 S5,S6 @500cfs	Gaps at structures	355A,B,C 2 pumps @500cfs			9.7	2.6	Road Reconstruction	TBD

E.3.4 Evaluation Criteria for Storage and Treatment Options

The preliminary screening resulted in 10 options that underwent iModel analysis for performance toward restoration (end-point) ecological targets that were developed independently, previous to CEPP, for the Everglades through the interagency RECOVER process (Level 1 below). The full restoration targets from RECOVER differ from the operational targets prepared for CEPP's iModel screening due to a recognition among the agencies that topography, vegetation, and other natural conditions in the WCAs have changed since drainage and therefore achieving the 'full restoration' inundation duration through particular areas that have experienced the most change could have unintended effects. Therefore, for screening, operational targets were developed by the interagency CEPP ecosubteam that were considered reasonable inundation durations with acceptable timing, depths, and frequency of wet periods that would allow the areas to adjust to CEPP's increment of CERP restoration. Expected adjustments include accretion of peat, which will help to restore elevations and plant species composition to pre-drainage conditions, which will help the areas stand ready for additional flows if agencies agree to send such flows in future restoration projects. These options also underwent an analysis for other important screening factors (Level 2 below).

E.3.4.1 Inundation (Level 1)

E.3.4.1.1 Criteria Description

Inundation is defined as the average % time above ground surface elevation. These are estimated for multiple locations throughout WCA 3A, WCA 3B, and ENP in a performance measure known as the Slough PM, developed by RECOVER. These figures also display the operational target adjustments for each location. The operational targets are further discussed in Sections E.3.3.1 and E.3.4 of this appendix.

E.3.4.1.2 Evaluation Tool Used

iModel (See Section E.3.3 for a description)

E.3.4.1.3 Scoring Methodology

Criterion was measured as percent deviation from NSM ridge and slough targets for the average % time above ground surface elevation (GSEL). Options were rated in quadrants (**Table E.1-43**). The quadrants were calculated based on the largest deviation from the target and the smallest deviation from target. However an ecological threshold was established for scoring: Location 3A4 (Site 64) existing condition considered to be sub-optimal but sustainable, so 3A4 Score = 3. Any Option scoring better than Site 64 scored at least Quartile 3.

Table E.1-43. Inundation quadrant rating

Quadrant Rating	
4 - Best	*Midpoint between Max and 3A4 Score <Option X < Max Score*
3	*3A4 Score < Option X < Midpoint between Max and 3A4 Score*
2	*Midpoint between Min and 3A4 Score < Option X < 3A4 Score*
1 –Worst	*Option X < Midpoint between Min and 3A4 Score*

A threshold for significant difference among options was also established. If there was less than 2% difference in inundation duration between minimum and maximum options scores: "Performs Similarly".

E.3.4.1.4 Criteria Results

Results are presented in **Table E.1-44**.

Table E.1-44. Results of iModel Inundation Rating

Option	Title	Inundation WCA 3A	Inundation WCA 3B	Inundation ENP
1A	No - WCA 3B	3.4	2.0	2.0
3A1	Southerly Orientation 3B	3.8	4.0	1.0
3A2	Southerly Orientation 3B	3.8	4.0	1.0
3B2	Southerly Orientation 3B	3.8	4.0	3.0
3B3	Southerly Orientation 3B	3.8	4.0	3.0
4A	Southwest 3B - Blue Shanty	3.8	3.0	1.5
4B	Southwest 3B - Blue Shanty	3.6	3.0	1.5
4C	Southwest 3B - Blue Shanty	3.8	1.0	1.5
9A	Entire L-67A extent	3.8	4.0	1.0
10A	North/South	4.0	4.0	2.0

E.3.4.2 Depth (Level 1)

E.3.4.2.1 Criteria Description

Depth is the average ponding depth (ft) above ground surface elevation. These are estimated for multiple locations throughout WCA 3A, WCA 3B, and ENP.

E.3.4.2.2 Evaluation Tool Used

iModel

E.3.4.2.3 Scoring Methodology

Criterion is measured as percent deviation from NSM ridge and slough targets quantified for the average ponding depth (ft) above ground surface elevation (GSEL). The scoring methodology is consistent with how inundation was calculated (**Section E.3.4.1.3.**)

E.3.4.2.4 Criteria Results

Results are presented in Table E.1-45.

Table E.1-45. Results of iModel Ponding Rating

Option	Title	Depth WCA 3A	Depth WCA 3B	Depth ENP
1A	No - WCA 3B	3 3	1.0	3.3
3A1	Southerly Orientation 3B	3 3	3.0	3.0
3A2	Southerly Orientation 3B	2.7	4.0	3.3
3B2	Southerly Orientation 3B	3 3	3.0	4.0
3B3	Southerly Orientation 3B	3 3	2.0	4.0
4A	Southwest 3B - Blue Shanty	4.0	2.0	3.0
4B	Southwest 3B - Blue Shanty	4.0	2.0	3.0
4C	Southwest 3B - Blue Shanty	4.0	1.0	3.0
9A	Entire L-67A extent	2.7	4.0	3.3
10A	North/South	3 3	4.0	3.7

E.3.4.3 Marl Prairie Recession Rate (Level 1)

E.3.4.3.1 Criteria Description

The Marl Prairie Recession rate was estimated for location NP205 within ENP. The Marl Prairie Recession rate is one of the key criteria for healthy marl prairie habitat. This habitat is less common than and has different requirements than the more widespread ridge and slough habitat in ENP.

E.3.4.3.2 Evaluation Tool Used

iModel

E.3.4.3.3 Scoring Methodology

Each column is the percent of target met for each alternative for the preferred recession rate (first data column) and marginal recession rate (second column). The preferred recession rate was weighted 20% while the marginal recession rate weighted 10% higher than raw score. All options exceeded target in the preferred column while none met the target in the marginal column. Average of the two weighted scores to come with a final number. The scale is equal increments based on the range of results (4 best, 1 worst).

E.3.4.3.4 Criteria Results

Results are presented in **Table E.1-46.**

Table E.1-46. Results of iModel Marl Prairie Rating

	Pref		Marg			
Alt	raw % target achieved	Weighting *.2	raw % target achieved	Weighting *.1	Sum Pref*.2 and Marg*.1	RANK
Opt 1A	148.88	178.65	58.87	64.76	243.41	1
Opt_3A1	153.81	184.57	67.85	74.63	259.21	4
Opt_3A2	162.33	194.80	57.20	62.92	257.72	3
Opt 3B2	157.85	189.42	59.29	65.22	254.64	3
Opt 3B3	166.37	199.64	55.74	61.32	260.96	4
Opt 4A	148.43	178.12	57.20	62.92	241.04	1
Opt 4B	168.16	201.79	50.31	55.34	257.14	3
Opt 4C	154.71	185.65	53.03	58.33	243.98	1
Opt 9A	150.67	180.81	62.84	69.12	249.93	2
Opt_10A	156.50	187.80	62.63	68.89	256.70	3

E.3.4.4 Operational Flexibility and Adaptability (Level 2)

E.3.4.4.1 Criteria Description

Operational flexibility: the speed, ease, efficiency of moving water to adjust changing conditions such as storms or other real-time needs. Robustness was defined as the ability to function effectively in the face of variability and uncertainty of future events.

Adaptability: measured using two separate metrics; 1) Robustness and 2) Future Compatibility. Robustness was defined as the ability to function effectively in the face of variability and uncertainty of future events. Future compatibility was defined as the efficiency of using the project configuration to complement future CEPP increments.

E.3.4.4.2 Evaluation Tool Used

Best professional judgment was obtained from interagency CEPP team members with working experience in WCA operations, ecology, and adaptive management, who could draw from their professional experience to judge the flexibility, robustness, and adaptability of the options.

E.3.4.4.3 Scoring Methodology

The scale is equal increments based on the range of results (4 easiest to adjust, 1 hardest).

E.3.4.4.4 Criteria Results

Results are presented in **Table E.1-47.** General trends include:

- Flexibility: Project configurations with the greatest amount of infrastructure would provide more operational flexibility. Operations can be changed rapidly to meet almost any conditions.

- Future Compatibility: Project configurations with the least amount of infrastructure would be more compatible with future CERP projects. Configurations would not need to be removed or vastly retrofitted in the future.
- Robustness: Project configurations scored similarly to ratings for operationally flexibility. Configurations with the greatest amount of infrastructure would improve ability to function effectively in the future, if there is a need to move more water through the system.

Table E.1-47. Results of the Adaptive Management Rating

Option	Title	Operational Flexibility	Future Compatibility	Robustness
1A	No - WCA 3B	1	4	1
3A1	Southerly Orientation 3B	3	3	2
3A2	Southerly Orientation 3B	3	3	3
3B2	Southerly Orientation 3B	4	2	4
3B3	Southerly Orientation 3B	4	2	4
4A	Southwest 3B - Blue Shanty	3	1	3
4B	Southwest 3B - Blue Shanty	2	1	2
4C	Southwest 3B - Blue Shanty	2	1	2
9A	Entire L-67A extent	3	3	3
10A	North/South	4	2	4

E.3.4.5 Ecologic Connectivity (Level 2)

E.3.4.5.1 Criteria Description

This criterion evaluates increases in wetland acreage and marsh connectivity directly associated with the removal of man-made barriers to flow. The criterion was developed based on the set of CEPP project objectives related to restoring seasonal hydroperiods and freshwater distribution, and surface water depths within the project area. Water management practices beginning in the early 20th century led to the construction of an extensive system of canals, levees, and pump stations crisscrossing the once free-flowing natural system, which in turn has led to human-dominated operations of that system. This channelization, compartmentalization, and physical manipulation of how water flows into the Everglades due to water management operational criteria (i.e., regulation schedules) has altered or eliminated sheet flow and related hydrologic characteristics throughout much of the Everglades. Canals, levees, and roads constructed under the C&SF Project have been identified as causing landscape fragmentation, loss of connectivity of the natural system, alteration of volume, timing, and distribution of regional hydropatterns and degradation of habitat of wetland organisms. The loss of connectivity necessary for sheet flow has resulted in far-reaching effects on ecological processes and habitat. The ridge and slough landscape has become severely degraded in a number of locations and is being replaced with a landscape more uniform in terms of topography and vegetation, with less directionality. The desired restoration condition is to maximize the ecological connectivity and acreage of wetlands in the Everglades by removing or reducing the effects of landscape discontinuities caused by levees, canals, drainage ditches and spoil banks.

E.3.4.5.2 Evaluation Tool Used

GIS and best professional judgment

E.3.4.5.3 Scoring Methodology

Previous method used to calculate and apply criteria does not apply to southern WCA 3A, 3B and ENP options since a majority of the options do not contain removal of levees and/or backfilling of canals. While the Blue Shanty Plans (Options 4A, 4B, and 4C) degrade portions of L-67 C and L-29 Levee, they also construct a levee in WCA 3B, negating the footprint of connectivity re-established. Configurations do increase marsh connectivity by providing hydrologic re-connection from WCA 3A to WCA 3B and ENP. Options were rated on 1 -4 scale.

E.3.4.5.4 Criteria Results

Option 1A provides limited ecological connectivity and no Options provide the level of connectivity CERP envisioned (**Table E.1-48**).

Table E.1-48. Results of the Ecological Connectivity Rating

Option	Title	Rating
1A	No - WCA 3B	1
3A1	Southerly Orientation 3B	2
3A2	Southerly Orientation 3B	2
3B2	Southerly Orientation 3B	2
3B3	Southerly Orientation 3B	2
4A	Southwest 3B - Blue Shanty	2
4B	Southwest 3B - Blue Shanty	2
4C	Southwest 3B - Blue Shanty	2
9A	Entire L-67A extent	2
10A	North/South	2

E.3.5 Distribution and Conveyance Options – MCDA and Cost Effective Results – Southern WCA 3A, 3B and ENP

Table E.1-49 and **Table E.1-50** provide a summary of the scores for both the level 1 and level 2 criteria for the 10 options evaluated with the iModel screening tool.

Table E.1-49. Scores for level 1 criteria and total cost for the 10 options evaluated with the iModel screening tool.

		Level 1								
Option	**Title**	Inundation WCA 3A	Inundation WCA 3B	Inundation ENP	Depth WCA 3A	Depth WCA 3B	Depth ENP	Recession Rates	**Summary Level 1**	Total Cost
1A	No - WCA 3B	3.4	2.0	2.0	3.3	1.0	3.3	1	16.1	6.2
3A1	Southerly Orientation 3B	3.8	4.0	1.0	3.3	3.0	3.0	4	22.1	23
3A2	Southerly Orientation 3B	3.8	4.0	1.0	2.7	4.0	3.3	3	21.8	25.6
3B2	Southerly Orientation 3B	3.8	4.0	3.0	3.3	3.0	4.0	3	24.1	52.5
3B3	Southerly Orientation 3B	3.8	4.0	3.0	3.3	2.0	4.0	4	24.1	52.5
4A	Southwest 3B - Blue Shanty	3.8	3.0	1.5	4.0	2.0	3.0	1	18.3	65.7
4B	Southwest 3B - Blue Shanty	3.6	3.0	1.5	4.0	2.0	3.0	3	20.1	50.4
4C	Southwest 3B - Blue Shanty	3.8	1.0	1.5	4.0	1.0	3.0	1	15.3	45.3
9A	Entire L-67A extent	3.8	4.0	1.0	2.7	4.0	3.3	2	20.8	38.2
10A	North/South	4.0	4.0	2.0	3.3	4.0	3.7	3	24.0	55

Table E.1-50. Scores and total cost for options evaluated with the iModel screening tool.

10A

E.4 SEEPAGE MANAGEMENT

The options for seepage management are formulated upon identification of the WCA 3B and ENP hydrologic conditions (depth and timing) resulting from the distribution and conveyance options. . However, it is possible to initially screen management measures for seepage management based on preliminary metrics. The seepage management measures are intended to address the following objective and constraints:

- Reduce water loss out of the natural system to promote appropriate dry season recession rates for wildlife utilization.

Additionally, measures were considered that would address the following project constraints:

In accordance with Section 601(h)(5) of WRDA 2000 and Chapter 373.1501(4)(d), F.S.

- Avoid any reduction in level of service for flood protection existing as of December 2000 caused by Plan implementation
- Provide replacement sources of water of comparable quantity and quality for existing legal users caused by Plan implementation
- Meet applicable Water Quality Standards

E.4.1 Seepage Management Measures

This section contains a list and description of management measures. The measures are limited to major features and activities that would form the basis for alternatives. Minor features or activities such as ditch plugging and elimination of exotic species of vegetation were not included as measures since comparison between alternatives for seepage management would not be affected.

The measures for Seepage Management are as follows:

Recharge Basin: A recharge basin could be utilized to maintain flows to wellfields that may be eliminated by blockage of lateral groundwater movement. The recharge basin would also provide aquifer protection by maintaining the saltwater-freshwater interface (prevent saltwater intrusion). A recharge basin was included in the Yellow Book. The Bird Drive Recharge Area (BDRA), Component U6 in the Yellow Book, assumed a 2,877 acre above-ground recharge area with water levels fluctuating up to 4 feet above grade. During plan formulation for the Everglades National Park Seepage Management Project (ENPSM), the following concerns were raised about the proposed feature:

- High porosity and transmissivity.
- Ability to hold water onsite for deliveries to the South Dade Conveyance System.
- Potential for flooding impacts to urban areas east of the project site.
- Design and operation may not be feasible.
- Project type is not implementable

Additionally, many parcels within the basin remain in private ownership and may not be available for the project as originally conceptualized. As such, a recharge basin was eliminated from further consideration in the CEPP.

New Pump Stations to Return Water to the Natural System: New pump stations could be utilized to return seepage water to the natural system. Similar to the purposes of the existing S-356 Pump Station, new stations could be positioned along the L-30/L-31N Canals to pump water from the canal into WCA 3B and ENP. Water quality of surface water from the canals may be of concern; however, this measure was retained for possible inclusion in components and alternatives.

Operate or Relocate Existing Pump Stations to Return Water to the Natural System: There is currently a pump station, S-356, that was constructed in order to pump surface water into ENP to return seepage water to the natural system and supplement flows; however, S-356 has never been operated due to a number of constraints that have yet to be resolved. This measure was retained for further consideration.

In-Ground Seepage Barrier: In-ground seepage barriers could be constructed of suitable material to prevent the lateral movement of ground water within the surficial layers of the Biscayne aquifer. Varieties of seepage barriers are based on the material used, design configuration, and the depth of the barrier. Issues that would be addressed include the maintenance of flood protection and quantity and quality of freshwater flow to existing legal water supply wells and the Biscayne Bay system to the east. A 2-mile Pilot Project is currently being constructed by a private entity along the L-31, which may provide opportunities to evaluate the feasibility and performance of this approach, including potential effects on water supply wells. As such, this measure was retained for further consideration.

Raise Canal Stages along L-30/L-31N: Downstream gates on the L-31N could be managed during the dry season in order to maintain higher canal stages. The higher canal stages would reduce the surface water hydraulic head in ENP, thereby reducing seepage out of ENP. However, the increased canal stages could potentially make the developed areas immediately to the east more prone to flooding. Associated canal improvements to the L-30/L-31 Canals and new pumping stations would likely be required for this measure. Additionally, it is likely that raising canal stages would also require additional features to maintain design purposes. For example, necessary associated features may include a flood attenuation reservoir for floodwater storage and new canal construction and/or canal relocation to deliver water to the south for agricultural/environmental water supply. This measure was retained for further consideration in components and alternatives.

Flood Attenuation Reservoir: A flood attenuation reservoir would be utilized to capture water during peak storm events. Water would be discharged into the above-ground impoundment to maintain flood protection for adjacent urban, industrial, and agricultural areas. There would be some residual risk with any potential failure of the structure and reinforced construction features and redundant measures may be required. This measure was retained for further consideration.

Above-Ground Storage for Seepage Gradient (Detention Areas): Detention Areas would consist of unconfined basins running between the L-31N and ENP where water is stacked above the elevation of the water surface in the park, reversing the groundwater gradient created by the canal. The gradient reversal would serve to maintain higher water levels and longer hydroperiods within the natural system, and increase flows to downstream areas within ENP. Detention Areas have been successfully utilized in the C-111 South Dade Project to create a hydraulic ridge and reduce seepage losses occurring across the levees to the east. Detention Areas are operationally flexible and can be optimized for water distribution both within the natural system and into populated areas. Additionally, detention areas are minimally invasive, and do not require significant alteration of the substrate to reduce seepage when compared to a seepage barrier. This measure was retained for further consideration.

Groundwater Wells: Groundwater wells could be utilized to withdraw seepage groundwater and re-distribute that water back into ENP. The amount of withdrawals would need to be managed to ensure that: 1) Enough water is being withdrawn and added back into the natural system and 2) Adequate amounts of seepage water is still flowing to the eastern well fields and areas such as Biscayne Bay. Groundwater wells have extremely high operating costs and would not likely be effective in consistently reducing seepage in the highly transmissive Miami Limestone or Upper Ft. Thompson layers. As such, due to costs and ineffectiveness, this measure was eliminated from consideration.

Line/Pipe canals: Lining or piping the canals was also evaluated as a management measure. Evaluation and assessment of shallow seepage barrier concepts concluded that seepage flows would continue underneath a shallow barrier and would not be effective in reducing seepage. Although lining or piping the canal may prevent seepage out of the canal, the main problem, seepage occurring out of the natural system, would not be affected. As such, this measure would be completely ineffective in reducing seepage on a broad scale and was therefore eliminated from further consideration.

New canals/relocate existing canals: Construction of new canals or relocation of existing canals may be required with the raising of canal stages in the L-30/L-31N Canals or other seepage management measures. The canals may be necessary for agricultural/environmental water supply deliveries in the South Dade Conveyance System and to move excess water in order to reduce flood risks. Any new canal construction/relocation would also have associated water control structures as necessary. Real estate costs for new canal construction and/or canal relocation could be excessive depending on location, and environmental impacts would also need to be considered. This measure was retained for further consideration.

Changes in Operations: Canal stages could be managed to maintain higher levels and manage seepage leaving the Water Conservation Areas and ENP. This measure would likely need to be combined with canal relocation and/or new canal construction, as well as flood attenuation.

Step-down Levees: Step-down levees would consist of a smaller levee that would be constructed east of L-30/L-31N. The step-down levee would provide an additional layer of seepage management, reducing groundwater levels immediately east of the component. Although this measure may be effective in reducing seepage, there would be difficulties for implementation due to the existence of lakes in previously mined areas immediately east of L-31N and high costs. In particular, a large, flooded lake would require that the western portion be filled in order to construct a step-down levee in this area, and therefore this measure is not constructible on a large scale. The Blue Shanty Levee will also function as a step-down level for WCA 3B and has been retained.

E.4.2 Screening of Seepage Management Measures

Table E.1-51 provides an illustration of the preliminary Management Measures considered and the ability to meet the screening criteria and also reasons for elimination if the measure was screened from further consideration. Screening criteria utilized in this analysis includes flooding impacts, costs, effectiveness, and constructability. Flooding was assessed to determine if the measure would cause adverse flooding impacts to the surrounding areas. Effectiveness refers to the ability of the measure to achieve the desired effect. Although preliminary cost estimates were not developed, excessive costs were considered where enough information was available to compare measures and eliminate those with extremely high costs. Land availability refers to whether there is sufficient or suitable property for construction and operation of the measure.

Table E.1-51. Results of Seepage Management Measure Screening

	Reasons for Elimination			
	Flooding	Effectiveness	Cost	Land Availability
Detention Area	Retained			
New Seepage Return Pump Stations	Retained			
Groundwater Wells		X		
Line/Pipe Canals		X	X	
Recharge Basin		X	X	X
Flood Attenuation Reservoir	Retained			
Relocate Existing Canals	Retained			
New Canals	Retained			
Operate / Relocate Existing Pump Stations	Retained			
Changes in Operations	Retained			
Raise Canal Stages	Retained			
Step-Down Levees	Retained			
In-Ground Seepage Barriers	Retained			

APPENDIX F

RECREATION

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F.1 AUTHORIZATION

The Comprehensive Everglades Restoration Plan (CERP), authorized by the Water Resources Development Act of 2000 (WRDA 2000), will involve modifying the Central and Southern Florida (C&SF) Project, which was constructed with extensive Congressional authorizations from the 1944 Flood Control Act to the Water Resources Development Act of 1996. The Federal Water Project Recreation Act (P.L. 89-72) and the Water Resources Development Act of 1986 (P.L. 99-662) provide additional guidance. Further specific CERP design guidance was signed on May 12, 2000, in the form of the Department of the Army and South Florida Water Management District (SFWMD) Design Agreement for Everglades and South Florida Ecosystem Restoration Project.

Additional authorization and guidance for the proposed ancillary recreation resources development is contained in CECW-AG, 11 June 1998 Memorandum, Policy Guidance Letter No. 59, Recreation Development at Ecosystem Restoration Projects and EP 1165-2-502. Despite austere budgets and policy requirements, recreational developments can and do contribute to community health and well being (CECW, 1998). The recreation resources that are being proposed as part of the CERP Central Everglades Planning Project (CEPP) will comply with the philosophy and inclusion of the CESAD-PD-J 15 SEP 2004 Memorandum, are economically justified, and fall within the ten percent rule.

Additional supporting documentation for public access and recreational opportunities is found in the Presidential Memorandum - America's Great Outdoors, April 2010, and the subsequent report put out jointly by the major federal land management agencies, Americas Great Outdoors Report, February 2011. The documents call for land managers to maintain or improve public access to government owned lands and waters also to maintain or improve recreational opportunities on said lands and waters.

The recreation proposal was developed by the U.S. Army Corps of Engineers (USACE) and local sponsor SFWMD. The proposed recreation is recommended for construction based on Congressional approval and sponsor willingness to pay.

F.2 INTRODUCTION TO RECREATION FOR THE CENTRAL EVERGLADES PLANNING PROJECT (CEPP)

This appendix contains a description of the conceptual plan that is being proposed for the Central Everglades Planning Project (CEPP) for recreation purposes at four sites within the EAA Compartment A2 footprint, one site in Northern WCA 3A and additional features in Southern WCA 3A/B. This analysis will determine the net benefits for the recreation sites proposed: within the proposed FEB footprint and along the L-5 in northern WCA 3A accessed from Hwy 27 and additional features at the southern end of WCA 3A and in 3B. Recreation features are being included in the CEPP as an incidental project benefit requested by the local sponsor, the South Florida Water Management District (SFWMD). These recreation benefits will not be used in the justification of the recommended plan. The SFWMD provided the conceptual recreation plan which identified facilities and their locations. Due to the incidental effect of the recreation elements, a determination of acceptable design to meet Corps standards has not been completed at this study phase. Recreation costs have been provided by the SFWMD and a contingency of 43% bring the estimated total costs for recreation to $6,400,000.

The CEPP areas enhanced wildlife watching, canoeing, hiking, horseback riding, bicycle riding and hunting will attract users from all around the nation. The adjacent STA's and WMA's currently experience approximately 1 million visitors per year total, and visitors from all over the state and nation. The CEPP FEB Area will experience increased visitation through its geographic proximity to Holeyland and Rotenburger WMA's and STA's 2, 3/4, 5, 6, and WCA 3 and due to large public interest in the CERP. The proposed recreational features for WCA 3A and 3B will also experience increased visitation through its geographic proximity to Everglades National Park and Big Cypress National Preserve.

The proposed features of the CEPP recreation plan will not require additional real estate to be purchased. All features will be compatible with the environmental purposes of the project, and will not detract from the environmental and may increase socioeconomic benefits being generated by the project. The activities that will be permitted in the project area (bicycle riding, horseback riding, nature study, wildlife viewing, walking/hiking, motor boating, canoeing/kayaking, fishing, and hunting) are all well-suited to the environmental purposes of the project. A major feature of the CEPP will be approximately 20 miles of levee top trails which will Loop around the proposed FEB in EAA Compartment A2 and tie into the FEB being constructed by SFWMD on EAA Compartment A1, additional levee top trails will run along the top of L-67A from Everglades Holliday Park to the Tamiami Trail at the south end and on the Blue Shanty Levee. The levee tops will provide many recreation activities to include Florida's Statewide Comprehensive Outdoor Recreation Plan (SCORP) projected deficits, as well as National and State recreation trends as noted in the Yellow Book, 1999, as described below.

This recreation appendix considers the planned structures with levees and strives to maintain existing access. The new structures envisioned accommodate public access across these features or provide a reasonable route to reach the same destinations. Where these structures types may change in future designs access across or a reasonable route will be maintained.

F.3 BENEFIT CATEGORIES

F.3.1 Study Area

The study area for the recreation benefit analysis is specific to Martin and Broward Counties, Florida. The 2008 Florida Statewide Comprehensive Outdoor Recreation Plan (SCORP) identifies the proposed project area as part of The Treasure Coast and South Florida Regions comprised of Indian River, St. Lucie, Martin, Palm Beach, Broward, Miami-Dade, and Monroe Counties. User-oriented recreation activity deficits identified by the SCORP for this region include; Bicycle riding, hiking, fresh and saltwater beach activities, Fresh and Saltwater non-boat fishing, nature study, swimming pools and horseback riding (SCORP, 2008). Approximately 88 miles of levee would provide access for biking, hiking, jogging, horseback riding, fishing and nature study/wildlife viewing. An additional 114 miles would be designated blueways. National recreation trends of walking, primitive camping, paddle sports and wildlife-related recreation could also be accommodated.

The population growth of south Florida will only add to the projected existing recreation deficits. Regional population figures and future population estimates were not factored into Table F-7 because the additional figures would display extreme recreation deficits that in all probability would not be accurate. The proposed ancillary recreation resources study area is with the project study area on CEPP lands, Palm Beach and Broward Counties, Florida, west of U.S. Highway 27 in the EAA and in WCA-3 (See **Figure F-2, Figure F-3 and Figure F-4**)

The recreation planning for the Flow Equalization Basin will incorporate an adaptive management strategy to address the uncertainty regarding what vegetation will occur within the cells. The project will also, as much as feasible, provide for blueways and greenways to circulate on the project levees, canals, and form interconnections between adjacent lands. The actual program of activities will be dependent on the resulting vegetation and how the activities will affect the projects purposes.

The vegetation types and resulting wildlife that are found in different habitats greatly change the nature based recreational interests. Potentially, emergent vegetation could dominant the cells in such a heavy monoculture manner that the wildlife is not present to draw the public that are interested in some of the nature based recreation. Further, in these conditions the area is also not sufficiently accessible to the interior waters as access can cause damage to vegetation thus creating internal trails that cause changes in flow. A blend of emergent and submerged vegetation tends to draw the wildlife that interests those members of the public desiring to view wildlife, hunt and fish.

Our intent to control vegetation may change or not be completely accomplished. Experience has shown that even where a monoculture of emergent vegetation is desired for project purposes this is not always accomplished due to many factors, such as fluctuations in water levels due to long wet or dry hydro periods. Therefore the recreation facilities will be developed in anticipation of this uncertainty.

During the development of the project designs we will incorporate the earthworks needed that would provide the locations for potential facilities. Construction staging areas and staff required boat ramps provide earthworks that can be utilized to additionally serve recreation. Retained staging areas and sharing boat ramps with staff thus incorporated into the designs are consistent with this same planning approach in other restoration projects. Specific to FEBs, we could include boat ramps of articulated block construction that serve staff access (**Figure F-1**) and foreseeable additional boat trailer parking areas for public could be expanded outside the levees as necessary to accommodate demand. Filled in corners at certain key levee intersections and elongated turnouts can fulfill the 1st phase of this adaptive strategy in a cost effective manner. These earthen features as used in earlier projects also are commonly used for construction and maintenance purposes later.

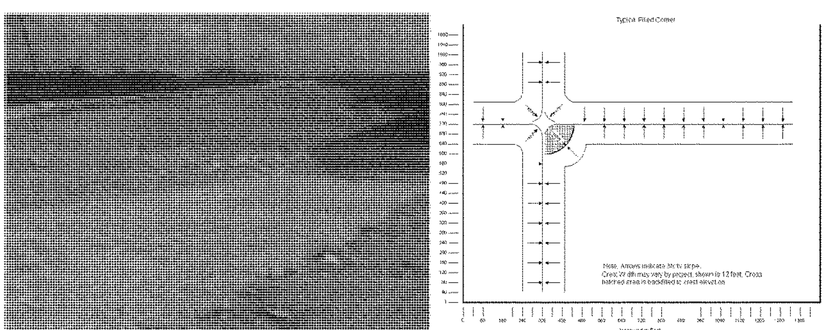

Figure F-1. Articulated block boat ramp and filled corner.

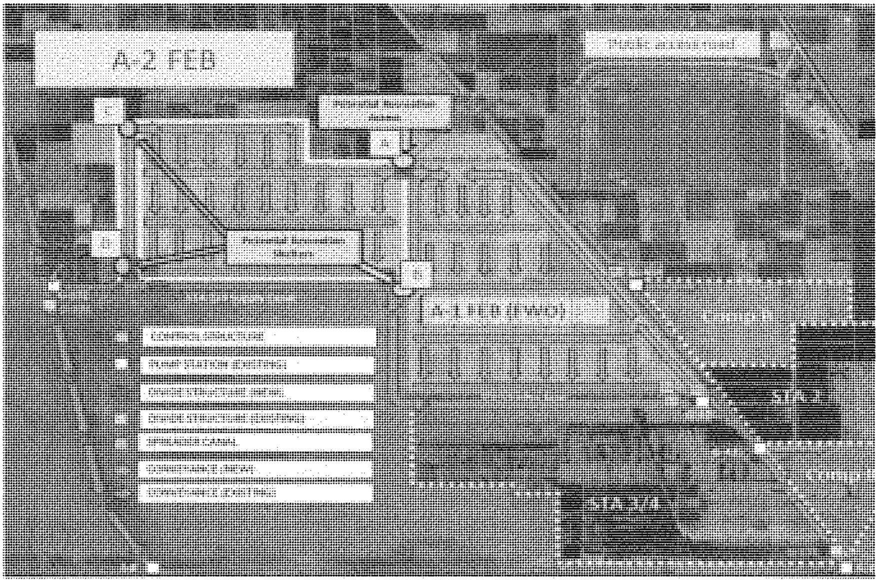

Figure F-2. A-2 Flow Equalization Basin Conceptual Recreation Plan

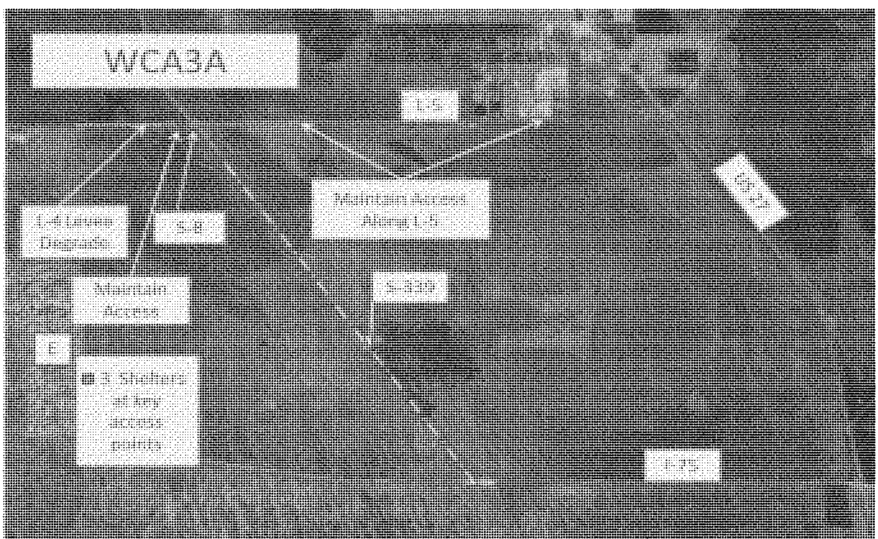

Figure F-3. Water Conservation Area 3A Conceptual Recreation Plan.

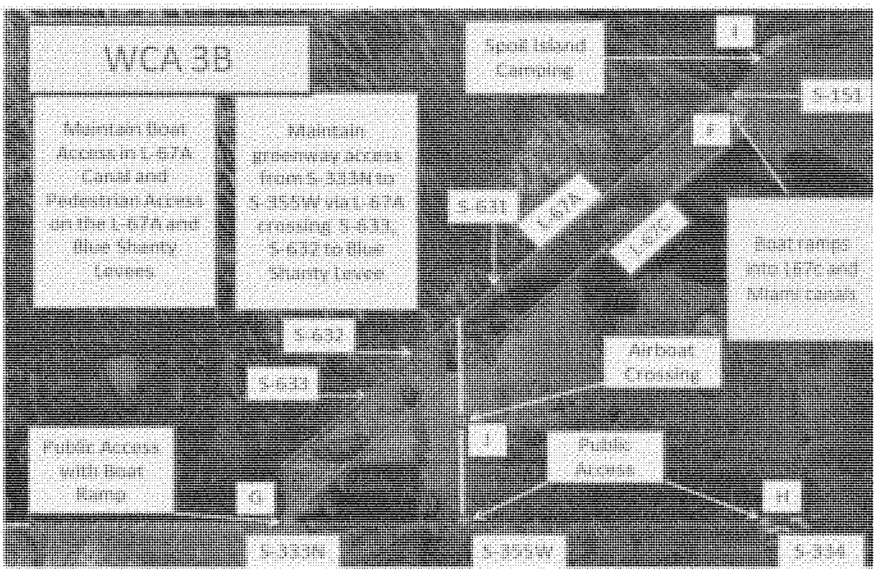

Figure F-4. Water Conservation Area 3B Conceptual Recreation Plan

F.3.2 'Site A' Northeast Corner of A-2 Flow Equalization Basin

An existing transition lane off of highway US 27 would provide access to this site. A two lane gravel road from Hwy 27 to the recreation facility is suggested. It is proposed that a construction staging area for the proposed FEB occur at this place. A parking area for visitors to the FEB A-2 will be located here. A trailhead, boat ramp, group shelter, prefabricated ADA accessible Double Vault Toilet, Interpretive Signs, Bike Racks, Bank Fishing Access, An Airboat crossing to get from FEB A2 to A1 and ADA Van Accessible Parking would also be located at this site.

Site A is the point of access to the A2- FEB for the public. Project designs should not inhibit public access to circumnavigate the entire FEB via the levees as pedestrian or by vehicle. The recreation program will control the access. The SFWMD owns fee title to this site.

Table F-1. 'Site A' Recreation features.

Feature	Quantity	Unit Cost	Total Cost
Vehicle/ Ped Gate	3	$5,000	$15,000
Signs	1	$2,000	$2,000
Sign 4'x4'	1	$4,000	$4,000
Picnic Tables	4	$500	$2,000
Bike Rack	1	$1,000	$1,000
Group Shelter 16'x24'	1	$30,000	$30,000
Vault Toilet, 2 gender	1	$40,000	$40,000
Addn't Fill Shelter Cubic Yards	225	$20	$4,500
Improved Vehicle Access Road (Shell Rock/Gravel) 2.25 miles 25'x2'x11,880 = 22000 cubic Yards	22000	$20	$440,000
Improved Parking Area 1550x90X4 =765 CY	765	$20	$15,300
Guard Rails	200	$200	$40,000
Split Rail Fence	100	$15	$1,500
ADA Fishing Platform	1	$50,000	$50,000
Boat Ramp	1	$100,000	$100,000
Airboat Crossing	1	$75,000	$75,000
Table Summary			$820,300

F.3.3 Site B' Southeast Corner of A-2 Flow Equalization Basin

Access to Site B would be by boat or by hiking or biking on the levee. This site will be much more primitive than the north east site containing only a filled corner, a staff boat ramp, a kiosk shelter, bike racks, and small gravel area. The SFWMD owns fee title to this site.

Table F-2. 'Site B' Recreation features.

Site B Features	Quantity	Unit Cost	Total Cost
4'x4' Sign	1	$4,000	$4,000
Picnic Tables	1	$500	$500
Bike Rack	1	$1,000	$1,000
Kiosk Shelter 12'x16'	1	$20,000	$20,000
Addn't Fill Shelter cubic yards	225	$20	$4,500
Table Summary			$30,000

F.3.4 'Site C' Northwest Corner of A-2 Flow Equalization Basin

Access to Site C would be by boat or by hiking or biking on the levee. This site will be much more primitive than the north east site containing only a filled corner, a staff boat ramp, a kiosk shelter, bike racks, and small gravel area. The SFWMD owns fee title to this site.

Table F-3. 'Site C' Recreation features.

Site C Features	Quantity	Unit Cost	Total Cost
4'x4' Sign	1	$4,000	$4,000
Picnic Tables	1	$500	$500
Bike Rack	1	$1,000	$1,000
Kiosk Shelter 12'x16'	1	$20,000	$20,000
Addn't Fill Shelter cubic yards	225	$20	$4,500
Table Summary			$30,000

F.3.5 'Site D' Southwest Corner of A-2 Flow Equalization Basin

Access to Site D would be by boat or by hiking or biking on the levee. This site will be much more primitive than the north east site containing only a filled corner, a staff boat ramp, a kiosk shelter, bike racks, and small gravel area. The SFWMD owns fee title to this site.

Table F-4. 'Site D' Recreation features.

Site D Features	Quantity	Unit Cost	Total Cost
4'x4' Sign	1	$4,000	$4,000
Picnic Tables	1	$500	$500
Bike Rack	1	$1,000	$1,000
Kiosk Shelter 12'x16'	1	$20,000	$20,000
Addn't Fill Shelter cubic yards	225	$20	$4,500
Table Summary			$30,000

F.3.6 'Site E' Water Conservation Area 3A Shelters

Access to Site E is along the L5 levee and by airboats, or track vehicles to shelters at common access points and junctions within the WCA 3A. See **Figure F-3** for proposed locations of shelters. The public currently has open access for the entire length of the L5 and L4 from US 27 through the S8, 24/7. Structures across levees will need to allow vehicle access along existing routes. The SFWMD owns fee title to this site.

Table F-5. 'Site E' Recreation features.

Site E Features	Quantity	Unit Cost	Total Cost
Shelters 12'X16'	3	$20,000	$60,000
Additional mobilization for one shelter	1	$5,000	$5,000
Addn't Fill Shelter 225 cy X3	775	$20	$15,500
Boat Ramp	2	$100,000	$200,000
Addn't fill for parking 450 CY	900	$20	$18,000
Fill for earthen crossing near S339 120x40x2 = 350CY	350	$20	$7,000
Table Summary			$305,500

F.3.7 **'Site F' S-151** Education and Boat Ramps

S151 Education and Boat Ramps Site

Here the Miami, L67A and L67C canals nearly meet and are within short walking distance of each other and the intersection of levees leaves sufficient dry land for a substantial site. The site is 5.5 miles along the L67A Levee, and provides hiking, bicycling and vehicle access to Holiday Park; and access via airboat or power boat. Public vehicles will be able to reach this site with an improvement to widen a 1.1 mile length of levee and one way traffic on two different levees. The widening of this levee may require mitigation depending on the actual width and quality of the wetlands affected. This will allow boat access with ramps into the north ends of the Miami and the L67C. The SFWMD owns fee title to a majority of this site. A portion of the boat ramp to the L67C borrow canal will be located on lands where SFWMD has a perpetual easement. The easement rights owned by SFWMD are tantamount to fee. These easements contain the following language: "...the right, privilege, use and easement in and to the lands hereinafter described for any and all purposes necessary to the construction, maintenance and operation of any project in the interest of flood control, reclamation, conservation and allied purposes now or that may hereafter be conducted by the grantee herein, its successors or assigns, including the right to permanently or intermittently flood all or any part of the area covered hereby as a result of the said construction, maintenance, or operation, in carrying out the purposes and intents of the statutes of the State of Florida relating to the Central and Southern Florida Flood Control District presently existing or that may be enacted in the future pertaining hereto."

Table F-6. 'Site F' Recreation features.

Site F Features	Quantity	Unit Cost	Total Cost
Vehicle/Ped gate	4	$5,000	$20,000
Signs	1	$2,000	$2,000
4'x4' sign	2	$4,000	$8,000
Picnic Tables	12	$500	$6,000
Bike Rack	1	$1,000	$1,000
Shelter 12X16	1	$20,000	$20,000
Kayak Launch	1	$5,000	$5,000
Group Shelter 32X40	1	$50,000	$50,000
Vault Toilet, 2 gender	1	$40,000	$40,000
Addn't Fill Shelter and Parking CY	450	$20	$9,000
1.1 mile Levee Widening 8X12X5338=18979 CY	18979	$20	$379,580
Guard Rail	200	$200	$40,000
Boat Ramp	2	$100,000	$200,000
Courtesy Dock L67A	1	$10,000	$10,000
Table Summary			$790,580

F.3.8 'Site G' Southwest Water Conservation Area 3 Access Point

Where the L67A and L67C canals meet the L29 at Hwy 41 there are currently boat ramps into L67A, L67C and WCA 3B. Here parking is very limited. This site is accessed across the existing S-333N and will see substantive changes to incorporate changes to the S333. This site, with improved parking capacity can provide access into these same waters and the L29 canal. This site would also serve as a trail head for blue and greenways accessible from Hwy 41. This does not attempt to capture costs to locate roller Gate Structures to prevent barriers to boats in L67A, to maintain existing vehicle crossing at S333. Existing public access allows pedestrian and vehicles towing boats to access boat ramps into L67A, L67C, WCA 3B, across the S-333W and S-334 structures and to drive on L29, 24/7. Pedestrian access is allowed to Holiday Park along the L67A and on L67C levee. This existing access will be maintained. The SFWMD owns fee title to this site.

Table F-7. 'Site G' Recreation features.

Site G Features	Quantity	Unit Cost	Total Cost
Vehicle and Ped/ gates	use existing gates		
Signs	1	$2,000	$2,000
Sign 4x4	3	$4,000	$12,000
Picnic Tables	1	$500	$500
Bike Rack	1	$1,000	$1,000
Kiosk Shelter 12'x16'	1	$20,000	$20,000
Vault Toilet 2 Gender	1	$40,000	$40,000
Addn't Fill Parking/Shelter	25000	$20	$500,000
Fishing Pier	1	$50,000	$50,000
Boat Ramps	3	$100,000	$300,000
Kayak Launch Sites	2	$5,000	$10,000
Table Summary			$935,500

F.3.9 'Site H' Southeast Water Conservation Area 3 Access Point

This site is located at the S-334 and serves as the most eastern terminus as a trail head. Here parking is sufficient. This site would serve as a trail head for blue and greenways accessible from Hwy 41. Vehicle and pedestrian access is allowed across this structure to reach boat ramps into the WCA 3B and L29 canal and westward to Tiger Tail Camp and S-333W. When constructed this westward access will be maintained to the new S-355W, the L29 divide structure. Eastward access will also be maintained. The SFWMD owns fee title to this site.

Table F-8. 'Site H' Recreation features.

Site H Features	Quantity	Unit Cost	Total Cost
Vehicle and Ped/ Gates	use existing gates		
Sign 4x4	1	$4,000	$4,000
Picnic Table	1	$500	$500
Bike Rack	1	$1,000	$1,000
Kiosk Shelter 12'x16'	1	$20,000	$20,000
Addn't Fill Shelter	225	$20	$4,500
Kayak launch Sites	1	$5,000	$5,000
Table Summary			$35,000

F.3.10 'Site I' Spoil Island Camping

On multiple spoil islands primitive camping would be provided for blue ways trail use or other access via boat. This is based on utilizing 5 spoil islands along the northern spoils of the L67A. Site improvements on each spoil island would include; a vault toilet, signs, a courtesy dock, a picnic table and fire rings along with grubbing and clearing. The SFWMD owns fee title to this site.

Table F-9. 'Site I' Recreation features.

Site I Features	Quantity	Unit Cost	Total Cost
Signs	1	$2,000	$2,000
Picnic Tables	30	$500	$15,000
Fire Rings	30	$250	$7,500
Vault Toilet	5	$55,000	$275,000
Grubbing and Clearing $ 3,500 per acre	5	$3,500	$17,500
Addn't Mobilization	1	$15,000	$15,000
Minor Courtesy Dock	5	$5,000	$25,000
Table Summary			$357,000

F.3.11 'Site J' Blue Shanty Public Access Features

Access to Site J would be by air boat within WCA 3B this would maintain existing airboat access east to west within WCA 3B by providing a means to cross the Blue Shanty Levee. Airboat Crossing would be located in a suitable location on the Blue Shanty levee to allow airboats to safely traverse the levee. See **Figure F-4** (1, will allow public access across for greenways use. The S-355W, will allow public vehicles to cross to access the L29 towards Tiger Tail camp. Vehicle for public access will not be allowed north bound on the Blue Shanty Levee. The culverts along the L67A levee, S-631, S-632 and S-633, see **Figure F-4** will allow pedestrian access across for public uses. The existing east to west greenways access will not be lost when the L29 levee is degraded. This access will be rerouted using the L67A levee and crossing the S-632 and S-633 to reach the Blue Shanty Levee returning to the L29. Cost associated with the public crossing these structures is incorporated in the structure costs. The SFWMD owns fee title to this site.

Table F-10. 'Site J' Recreation features.

Site J Feature	Quantity	Unit Cost	Total Cost
Airboat Crossing	1	$75,000	$75,000
Table Summary			$75,000

F.4 RECREATION BENEFITS

The national economic development (NED) benefit evaluation procedures contained in ER 1105-2-100 (22 Apr 00), Appendix E Section VII, include three methods of evaluating the beneficial and adverse NED effects of project recreation: travel cost method (TCM), contingent valuation method (CVM), and unit day value (UDV) method.

The unit day value (UDV) method was selected for estimating recreation benefits associated with the creation of the Central Everglades Planning Project. The UDV approach in recreation benefit analysis consists of two parts: determining value per visit and estimating visitation.

F.4.1 Determining Value Per Visit

When the UDV method is used for economic evaluations, planners will select a specific value from the range of values provided annually. Application of the selected value to estimate annual use over the project life, in the context of the with- and without-project framework of analysis, provides the estimate of recreation benefits.

The without project condition in the Everglades Agricultural Area portion of this analysis has no recreation value since the Everglades Agricultural Area inside of CEPP would not exist and would not be open to the public. It is presumed that the impoundment must be opened to the public in order to realize the recreation benefits being claimed. The without project condition for the areas outside of the EAA portion currently offer recreational opportunities. To capture additional recreation benefits from this project area we must look at existing visitation and subtract that from projected visitation claimed by the additional proposed recreation features. The with-project will be the expected value of the recreational activity based on the UDV method.

Table F-11 illustrates the method of assigning a point rating to a particular activity. The table also shows the point values assigned based on measurement standards described for the five criteria: Recreation Experience, Availability of Opportunity, Carrying Capacity, Accessibility and Environmental.

Table F-11. Guidelines for assigning points for general recreation.

Criteria	Judgment Factors				
Recreation experience1 Total Points: 30	Two general activities2	Several general activities	Several general activities: one high quality value activity3	Several general activities; more than one high quality activity	Numerous high quality value activities; some general activities
Point Value: 10	0-4	5-10	11-16	17-23	24-30
Availability of opportunity4 Total Points: 18	Several within 1 hr. travel time; a few within 30 min. travel time	Several within 1 hr. travel time; none within 30 min travel time	One or two within 1 hr. travel time; none within 45 min. travel time	None within 1 hr. travel time	None within 2 hr. travel time
Point Value: 3	0-3	4-6	7-10	11-14	15-18

Carrying capacity5 Total Points: 14	Minimum facility for development for public health and safety	Basic facility to conduct activity(ies)	Adequate facilities to conduct without deterioration of the resource or activity experience	Optimum facilities to conduct activity at site potential	Ultimate facilities to achieve intent of selected activities
Point Value: 8	0-2	3-5	6-8	9-11	12-14
Accessibility Total Points: 18	Limited access by any means to site or within site	Fair access, poor quality roads to site; limited access within site	Fair access, fair road to site; fair access, good roads within site	Good access, good roads to site; fair access, good roads within site	Good access, high standard road to site; good access within site
Point Value: 15	0-3	4-6	7-10	11-14	15-18
Environmental Total Points: 20	Low aesthetic factors6 that significantly lower quality7	Average aesthetic quality; factors exist that lower quality to minor degree	Above average aesthetic quality; any limiting factors can be reasonably rectified	High aesthetic quality; no factors exist that lower quality	Outstanding aesthetic quality; no factors exist that lower quality
Point Value: 10	0-2	3-6	7-10	11-15	16-20
Point Sum 46					

Point value assignments for **Table F-11** above are based on Economic Guidance Memorandum (EGM) 12-03. The Criteria and Judgment Factors for General Recreation were specifically used as the basis of the estimated point values for the proposed recreation area. Judgment factors were based on site visits and coordination with local agencies. The following selection factors were used for the criteria outlined in **Table F-11**.

The proposed CEPP recreation resources would provide several general activities that would be afforded by the project setting and the project levees. The proposed CEPP site offers solitude and panoramic views in a growing metropolitan region, and would provide specific recreation amenities (as outlined in **Table F-1** through **Table F-10**) for expanding local populations and increasing recreation demands. The environmental restoration component (water storage and release) could help to provide an increase of quality freshwater boat and bank fishing for the region on project lands. Boat launching ramps, shelters with benches and multi-purpose trail experiences would be enhanced by panoramic views and wildlife viewing opportunities. The proposed recreation sites would provide several general recreation activities.

The availability of opportunity rating is based upon current local recreation facilities near the project area in the proposed recreation resource location. A 25-mile radius around the proposed project area represents a fairly dense urban population to the east. A 50-mile radius would include more of the Everglades Agricultural Area and a couple of other wildlife management areas, regional parks and greenways with similar resources and a much larger urban setting to the East. The proposed multi-use trail, freshwater bank fishing, boat launch and shelters and benches would provide unique opportunities in the proposed water management areas. The proposed recreation resources will help to provide facilities for current and projected statewide Treasure Coast and South Florida Region deficits. There are similar recreation opportunities available within a one hour travel time and a few within a 30 minute travel time.

The proposed CEPP recreation resource carrying capacity values are based on the optimum use of the site potential, without overuse of the proposed recreation resources. Good water resources and access to them for boat and non-boat fishing, multi-use trail and environmental observation comprise a balanced use of the proposed recreation resource use. Adequate facilities will be constructed to conduct these activities without deteriorating the resource or activity experience. Peak use is expected to occur during half of the calendar year.

The accessibility rating is based upon the availability of the local highways, roads and streets in good condition that would provide access to the proposed recreation facilities. Existing access off of US-27, I-75, and US-41 would provide good access to these sites. The levees would provide approximately 99 miles of good multi-use trail access on the project sites. Area canals would also provide 114 miles of blueways from these sites.

The environmental quality rating is based upon the existing natural resources and aesthetic quality of the proposed project area. The proposed site of the FEB possesses poor aesthetic resources which would be dramatically improved with the CEPP construction. These areas would provide panoramic views of open water and Everglades type landscape features. The best aesthetics of the proposed project areas are of views from the levee out vast expanses of open water and over these areas to the east and south. Views from the CEPP levees to the north and west would be of the agricultural lands currently in sugarcane production.

The value of a day of general recreation at the proposed recreation sites for the Central Everglades Planning Project was determined using the guidelines for Assigning Points for the General Recreation in **Table F-11**. The points were then converted to dollar values using conversion factors included in the Economic Guidance Memorandum 14-03, Unit Day Values for Recreation, 2014, which is based on ER 1105-2-100. **Table F-12** was used to convert points to a UDV FY2014 dollar amount. Using linear interpolation the total point value for the recreation sites was determined to be 46. The user day value conversion equivalent is $7.79.

Table F-12: Conversion of points to dollar values.

Point Values	General Recreation Values
0	$ 3.84
10	$ 4.56
20	$ 5.04
30	$ 5.76
40	$ 7.20
50	$ 8.17
60	$ 8.89
70	$ 9.37
80	$ 10.33
90	$ 11.05
100	$ 11.53

F.4.2 Estimating Visitation

The State of Florida's Department of Environmental Protection's Division of Recreation and Parks coordinated and developed the Florida Statewide Comprehensive Outdoor Recreation Plan (SCORP) for 2008. This information was used to derive and project total recreation participation and allocates the participation from state to regional levels. The SCORP includes guidelines for resource-based outdoor recreation activities as listed in **Table F-14** and **Table F-15**. These guidelines are based on maximum levels of carrying capacity developed by the Division of Recreation and Parks for use and protection of state park resources. The Treasure Coast and Southern Regions include Palm Beach County, along with adjacent counties. The CEPP Flow Equalization Basin (FEB) and WCA-3 A and B Features would be large inland bodies of shallow freshwater in an area of the state where state based recreation resources are mainly coastal and saltwater based. SCORP was determined to be the best available resource for estimating recreation usage capacity.

The current SCORP indicates demands not met for the year 2015 with several activities associated with the proposed CEPP recreation activities (bicycling, hiking, and non-boat freshwater fishing). These demands not met will likely increase as population is projected to almost double in coming decades, but for economic justification purposes, user rates were calculated using the capacity projection for 2015. Due to the CEPP's relatively rural location and rustic/minimal recreation features proposed, it was determined that an extremely conservative usage rate would be projected. The projected usage rates follow the resource needs and guidelines published by the SCORP, but in every case rates were estimated to be substantially lower than the SCORPs published rates. It is also anticipated that the water-based recreation opportunities could be reduced during the dry periods, and only several miles on either side of access points will be utilized to their potential. This the most practical scenario for justifying the proposed recreation features for the CEPP.

The use guidelines designated for biking, hiking, and nature study trails were based on carrying capacity guidelines adopted by the SCORP and used by the state park system. The bicycle trail use guidelines are

40 to 80 users per mile per day and assume 10 to 20 riders per mile per day with a daily turnover rate of 4. The use guideline for hiking trails, 4-20 hikers per mile per day with a daily turnover rate of 4. The CEPP consist of approximately 99 miles of proposed levee top multi-purpose trails available for use. A conservative approach was used for the purpose of usage projections. Only 75 miles of the 99 total miles were used to determine daily user rates, because of combined distances to points of interest from each trailhead. These areas would be the most utilized. This philosophy underestimates the potential daily usage rate, but was determined to be the most likely scenario.

Additionally, the Outdoor Recreation Coalition of America (ARC) notes the trend in walking, bird watching and primitive camping increased 42%, 155%, and 58% respectively from the 1984 survey to the 1995 survey. The U.S. Fish & Wildlife Service, National Survey of Fishing, Hunting and Wildlife-Associated Recreation shows a 98% and 38% increase of residential and non-residential wildlife watching in the State of Florida (Yellow Book, 1999).

It is assumed that 10 linear feet of CEPP FEB shoreline is required for each person fishing at any given time. It is assumed that this space will be used twice per day and therefore the use guideline was established at five linear feet per person per day. It is assumed that bank fishing would be most popular adjacent to the CEPP pump stations and gated structures. It is also assumed bank fishing would occur up to a ¼ mile away from the structures on either side. Four structures are relatively close to the trailheads totaling two miles (10,560 linear feet) of bank fishing associated with the CEPP FEB for benefit estimation purposes.

The SCORP Projections for the Treasure Coast and Southern Regions show minimal projected shortage of horseback riding and/or nature study in the region by the year 2015. These activities are planned in the CEPP FEB Recreation Proposal because they are compatible activities and are anticipated to have greater state deficits as the population nearly doubles by the year 2050. With ensuing development in the immediate area and region, and the increase in population projections for the State of Florida, the study team believes there would be ample use of the proposed recreation facilities and by 2070 fully expects a continued shortage in some of the existing activities in this area.

F.5 ECONOMIC JUSTIFICATION OF RECREATION

The justification of incurring additional costs for recreation features is derived by utilizing a benefit to cost ratio. The tangible economic justification of the proposed ancillary recreation project component can be determined by comparing the equivalent average annual charges (facility costs) against the estimate of the equivalent average annual benefits, which would be realized over the period of analysis (project lifespan). These average annual recreation benefits and costs are summarized in **Table F-13**.

Engineering Regulation 1105-2-100 (The Planning Guidance Notebook) provides economic evaluation procedures to be used in all Federal water resources planning studies. The guidelines specified in the regulation, were observed in preparing this cost analysis. The federally mandated project evaluation interest rate of 3.5 percent, an economic period of analysis of 50 years and 2014 price levels were used to evaluate economic feasibility.

Table F-13: Summary of recreation costs and annual costs and benefits.

Summary of Feature Tables	
Site A Table Summary	$820,000
Site B Table Summary	$30,000
Site C Table Summary	$30,000
Site D Table Summary	$30,000
Site E Table Summary	$305,000
Site F Table Summary	$790,000
Site G Table Summary	$935,500
Site H Table Summary	$35,000
Site I Table Summary	$357,000
Site J Table Summary	$75,000
*Summary of Feature Costs	$3,410,000
PED, S&A and EDC	$1,070,000
Contingency	$1,930,000
Total Cost including contingency	**$6,400,000**
Summary of Annual Costs and Benefits	
Interest During Construction	$330,000
Total Investment	$6,730,000
Amortized	$287,000
OMRR&R	$68,000
Average Annual Cost	**$355,000**
Unit Day Value[1]	$7.79
Daily Use	200 users
Annual Use (200 users x 365 days)	73,000
Average Annual Benefit	**$570,000**
Benefit to Cost	1.6 to 1
Net Annual Benefits	$215,000

**Cost includes onetime fill costs*

[1] Unit Day Values are derived from EGM 14-03, Unit Day Values for Recreation

This analysis leads to the conclusion that there are 1.6 times the benefits than the costs. The benefit to cost ratio for the recreation features equals, 1.6 to 1 with net annual benefits equaling $215,000. The costs and benefits associated with this Recreation Plan have been preliminary estimated.

Table F-14: Potential recreation participation user day projection Central Everglades Planning Project (FEB).

Activity	Units Provided	Maximum Area Requirements	Turnover Rates	Guidelines	SCORP Regional Resource Deficits (Needs)(2015)		CEPP FEB Projected Expected Users
					User Occasions	Units	
Multi-use Trail (Biking, Hiking, Equestrian)	20 Miles	10-20 per mile	4/day	40-80 users per mile per day	4,657,562	54 Miles	15 15 15
Boating (Non & Motorized)	20 miles of canals and 21 sq miles of FEB	1-2 users per boat	2/day	1-2 boats per square mile	N/A	N/A	25
Nature Study	20 Miles	5-20 groups per mile	4/day	40-160 users per mile of trail/day	9,289,990	46 Miles	10
Freshwater Bank Fishing	10,560 linear Feet	10 linear feet (LF) of bank per person	2/day	5 LF of bank per user per day	786,890	2,801 LF	20
General Recreation Total							100 users per day

Table F-15: Potential recreation participation user day projection Central Everglades Planning Project (South)

Activity	Units Provided	Maximum Area Requirements	Turnover Rates	Guidelines	SCORP Regional Resource Deficits (Needs)(2015)		CEPP South Projected Expected Users
					User Occasions	Units	
Multi-use Trail (Biking, Hiking, Equestrian)	68 Miles	10-20 per mile	4/day	40-80 users per mile per day	4,657,562	54 Miles	15 15 15
Boating (Non & Motorized)	114 miles of canals and 6.84 sq miles	1-2 users per boat	2/day	1-2 boats per square mile	N/A	N/A	25
Nature Study	68 Miles	5-20 groups per mile	4/day	40-160 users per mile of trail/day	9,289,990	46 Miles	10
Freshwater Bank Fishing	6,600 linear Feet	10 linear feet (LF) of bank per person	2/day	5 LF of bank per user per day	786,890	2,801 LF	20
General Recreation Total							100 users per day

F.6 SENSITIVITY ANALYSIS

A sensitivity analysis was conducted to further reinforce expected benefits and provide extra support for the justification of recreation features. **Table F-16** includes a sensitivity analysis which contains the expected average annual benefits from the above table, a worst case scenario depicting the number of annual visitors required for benefits to equal costs, and a scenario in which the SCORP guidelines are utilized as they are presented. As can be noted from this sensitivity analysis, a minimum average rate of 125 users per day would be required to justify the proposed costs for recreation, and following the minimum guidelines from SCORP the expected minimum benefits from 9,935,100 users to the site could be 68.2 million dollars. However, to provide a conservative scenario, 20% of SCORP expected benefits are shown.

Table F-16: Sensitivity analysis using multiple scenarios.

Scenario	Annual Users	Average Daily Users	Annual Benefit
Worst Case Scenario to Cover Annual Cost	45,600	125	$355,000
Projected Scenario	73,000	200	$570,000
SCORP at 20%	1,879,020	5,148	$14,600,000

APPENDIX G

BENEFIT MODEL

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G BENEFIT MODEL

G.1 MODEL DOCUMENTATION

The Department of the Army Engineer Regulation (ER) 1105-2-100 requires that ecosystem restoration planning contribute to national ecosystem restoration (NER), which is measured in terms of increases in the net quantity and/or quality of desired ecosystem resources. The United States Army Corps of Engineers (USACE) uses NER benefits as the basis to compare alternatives and select plans for ecosystem restoration projects. The following documents the methodology that was used to quantify ecological benefits and support plan evaluation, comparison, and selection for the Central Everglades Planning Project (CEPP). The CEPP Planning Model underwent peer review per Engineering Circular (EC) 1105-2-412, 31 May 2011 (Assuring Quality of Planning Models) and was recommended for single-use on CEPP by the National Ecosystem Restoration Planning Center of Expertise (ECO-PCX) on July 24, 2013. The HQUSACE Model Certification Panel approved the CEPP Planning Model on August 13, 2013.

G.1.1 Description of the CEPP Planning Model

The CEPP planning model was specifically developed to evaluate project alternatives within the CEPP project domain (ecoregion and/or watershed in south Florida). The primary areas to be evaluated included the Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), the Water Conservation Areas (WCA 3A and 3B), Everglades National Park (ENP), and Florida Bay.

The CEPP planning model was developed by the Jacksonville District with support from multiple federal and state agencies. Members of the project delivery team include subject matter experts on Everglades flora and fauna, with extensive experience working in south Florida and Everglades wetlands ecosystems. Members of the project delivery team included ecologists, hydrologists, and planners from the USACE, United States Fish and Wildlife Service (USFWS), National Park Service (NPS), South Florida Water Management District (SFWMD), and Florida Department of Environmental Protection (FDEP).

Performance measures were used to make the correlation between hydrologic output and ecosystem functions and evaluate the degree to which proposed alternative plans met restoration objectives. Each of the project performance measures for the CEPP planning effort was derived from those performance measures approved for use in CERP by Restoration, Coordination and Verification (RECOVER). RECOVER is an interagency and interdisciplinary scientific and technical team that provides system-wide scientific and technical support to the CERP. Performance measure scores were generated from hydrologic models. Each performance measure had a predictive metric and a desired target representative of historical conditions or pre-drainage hydropatterns within the study area. The desired targets were based on hydrologic requirements necessary to meet empirical or model-derived ecological conditions. Performance measure scores were displayed as a function of restoration potential or achievement of the target with the minimum value of 0 representing a fully degraded ecosystem and a maximum value of 100 representing the restoration target. Habitat unit (HU) scores were produced from Habitat Suitability Indices (HSI), which converted the (0 to 100) scale of each performance measure to an (0 to 1) index value. These HSI were then applied to an acreage of potential benefit within the project area. Alternatives evaluated in the project included the future without project condition (FWO) and additional alternatives developed by the project delivery team.

G.1.2 Description of Project Performance Measures

To make the correlation between hydrologic output and ecosystem functions, the project delivery team utilized performance measures developed from the Northern Estuaries, Greater Everglades Ridge and

Slough, and Florida Bay Conceptual Ecological Models (CEMs) (Barnes 2005, Sime 2005, Ogden 2005a, Rudnick et. al. 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). These CEMs have been extensively peer reviewed and provide the framework for the planning and assessment of the CERP. Performance measures used to evaluate project alternatives are listed below. Each performance measure had one or more sub-metrics. A documentation sheet is maintained for each of the performance measures and can be found at http://www.evergladesplan.org/pm/recover/eval_team_perf_measures.aspx[1]. The documentation sheet provides the scientific basis and justification for the use of the performance measure by referencing peer reviewed literature as well as referencing the relationship of the performance measure to the CEMs.

Greater Everglades Performance Measure - Inundation Duration in the Ridge and Slough Landscape

- PM 1.1 Percent Period of Record (PPOR) of Inundation

Greater Everglades Performance Measure - Sheetflow in the Ridge and Slough Landscape

- PM 2.1Timing of Sheetflow
- PM 2.2 Continuity of Sheetflow
- PM 2.3 Distribution of Sheetflow

Greater Everglades Performance Measure - Hydrologic Surrogate for Soil Oxidation

- PM 3.1 Drought Intensity Index

Greater Everglades Performance Measure – Dry Events in Shark River Slough

- PM 4.1 Number of Dry Events
- PM 4.2 Duration of Dry Events
- PM 4.3 Percent Period of Record (PPOR) of Dry Events

Greater Everglades Performance Measure - Slough Vegetation Suitability

- PM 5.1 Hydroperiod
- PM 5.2 Dry down
- PM 5.3 Dry Season Depth
- PM 5.4 Wet Season Depth

Northern Estuaries Performance Measure

Caloosahatchee Estuary

- PM 6.1 Low Flow Targets
- PM 6.2 High Flow Targets

St. Lucie Estuary

[1] Note: The documentation sheets located at this website address note that the performance measures are hydrologic metrics based on output from the South Florida Water Management Model (SFWMM). The SFWMM was not used to produce output for the CEPP performance measures. Hydrologic models used for the CEPP are described in **Section G.1.3** (**Hydrologic Model Used**).

- PM 7.1 Low Flow Targets
- PM 7.2 High flow Targets

Southern Coastal Systems Performance Measure

- PM 8.1 Dry Season Regime Overlap
- PM 8.2 Wet Season Regime Overlap
- PM 8.3 Dry Season High Salinity
- PM 8.4 Wet Season High Salinity

G.1.3 Hydrologic Models Used

Each of the performance measures has defined metrics and targets. The performance measures are hydrologic metrics based on output from regional hydrologic models. These models provided daily, detailed estimates of hydrology across the 41-year period of record (January 1965 – December 2005) and were used to evaluate system responses to project alternatives. The regional models proposed as the primary tools for the CEPP assessment included the Regional Simulation Model for Basins (RSM-BN) (version 2.3.2) for the Northern Estuaries and Everglades Agricultural Area (EAA) and the Regional Simulation Model for the Glades and Lower East Coast Service Areas (RSM-GL) (version 2.3.2) for the WCAs, ENP, and the Lower East Coast (LEC). These models were developed by the Hydrologic and Environmental Systems Modeling Section of the SFWMD.

The RSM-BN is a link-node model designed to simulate the transfer of water from a pre-defined set of watersheds, lakes, reservoirs or any waterbody that receives or transmits water to another adjacent waterbody. 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 EAA.

The RSM-GL 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. RSM-GL 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 RSM-GL 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.

Output from the regional models was maintained in a data access, storage, and retrieval system (DASR) managed by the SFWMD and USACE under the CERP Information and Data Management Program. Output for each performance measure sub-metric was readily available to project team members and was typically provided in a comma-separated-value (csv) format. Output from the csv files were then imported into the CEPP spreadsheet. Output data was also provided in chart and graphic format to aid in the assessment of restoration benefits.

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

Additional documentation of the above mentioned models can be found at
http://www.sfwmd.gov/portal/page/portal/xweb%20-%20release%202/modeling.

The hydrologic models referenced above have been validated through the Corps Engineering Model Certification process established under the Engineering and Construction (E&C) Science and Engineering Technology (SET) initiative.

G.1.4 Spatial Extent of Performance Measures

The primary areas evaluated included the Northern Estuaries (St. Lucie River and Indian River Lagoon and the Caloosahatchee River and Estuary), the Greater Everglades (WCA 3A) and Francis S. Taylor (WCA 3B) Wildlife Management Areas (WMAs), ENP, and Florida Bay. The following documents the spatial extent of the project or the locations used to evaluate the performance of each alternative.

Northern Estuaries Performance Measures

Performance measures within the Northern Estuaries were used to evaluate habitat suitability for oyster and submerged aquatic vegetation based on target flows over water control structures. Within the Caloosahatchee Estuary, targets were based on freshwater discharges at the S-79 structure (**Figure G-1**). Within the St. Lucie Estuary, targets were based on freshwater discharges at the S-80, S-48, S-49 and Gordy road structures (**Figure G-1 and Figure G-3**). The 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. It has the potential to provide a more appropriate range of salinity conditions by reducing extreme salinity fluctuations. The salinity envelope target for the Caloosahatchee River and Estuary is a salinity range of 16 to 28 psu. The salinity envelop target for the St. Lucie is a salinity range of 12 to 20 psu. Extensive monitoring of the Caloosahatchee and St. Lucie Estuaries as well as flows and loads from the associated basins and Lake Okeechobee has been performed to determine representative median salinities associated with flow events at these structures. Salinity levels at stations throughout each of the estuaries have been recorded. Calculation of habitat benefits achieved by each of the project alternatives was restricted to portions of the estuary where changes in salinity in relation to freshwater flows across water control structures (i.e. S-79, S-80, S-48, S-49 and Gordy road structures) could be reasonably predicted. For analytical purposes, the area within the Caloosahatchee and St. Lucie Estuary systems to be potentially affected by the project was assumed to encompass 85,973 acres (70,979 acres for the Caloosahatchee Estuary (Zone CE-1) (**Figure G-2**) and 14,994 acres for the St. Lucie Estuary (SE-1) (**Figure G-3**)). Performance measure scores within the Northern Estuaries were generated from the RSM-BN.

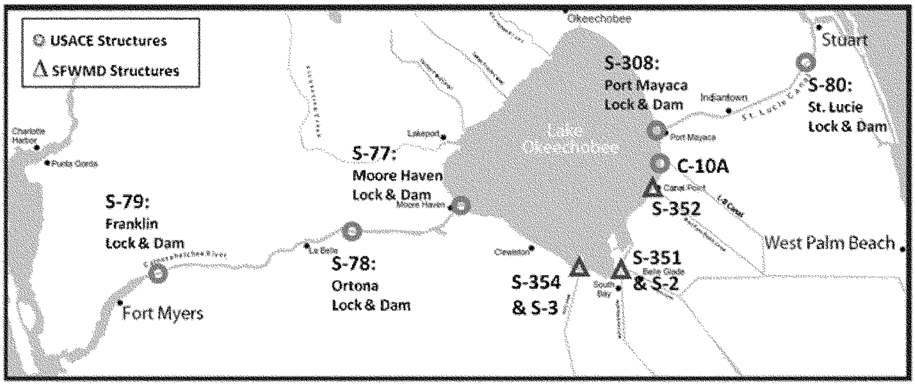


Figure G-1. Key Structures of Lake Okeechobee and the Northern Estuaries

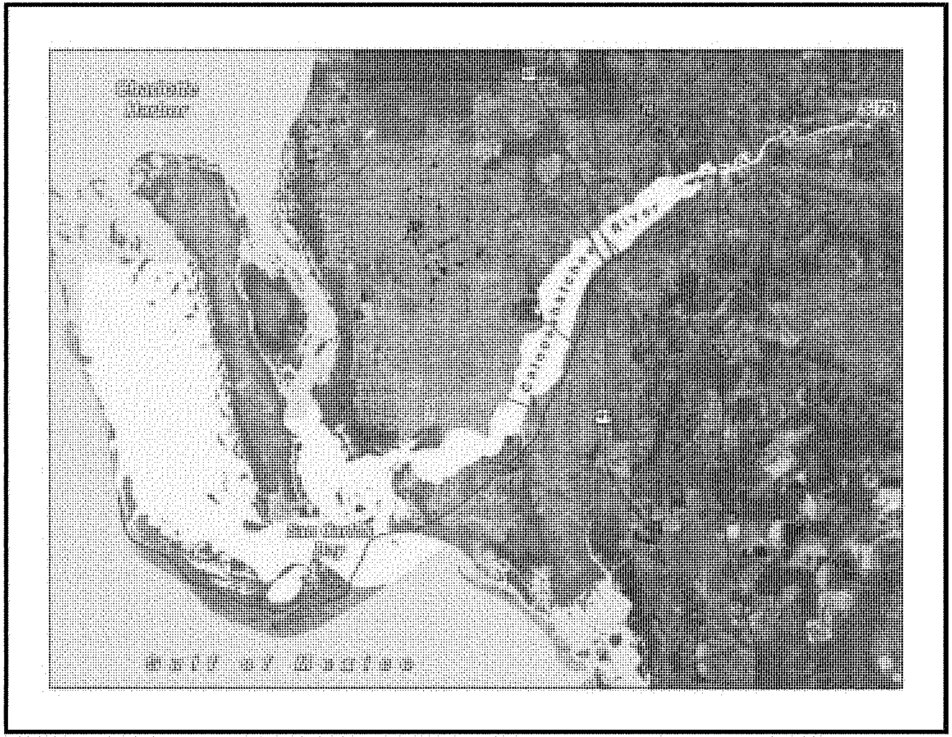


Figure G-2. Estimate of the Maximum Area of Potential Ecological Benefit for the Caloosahatchee Estuary (Zone CE-1)

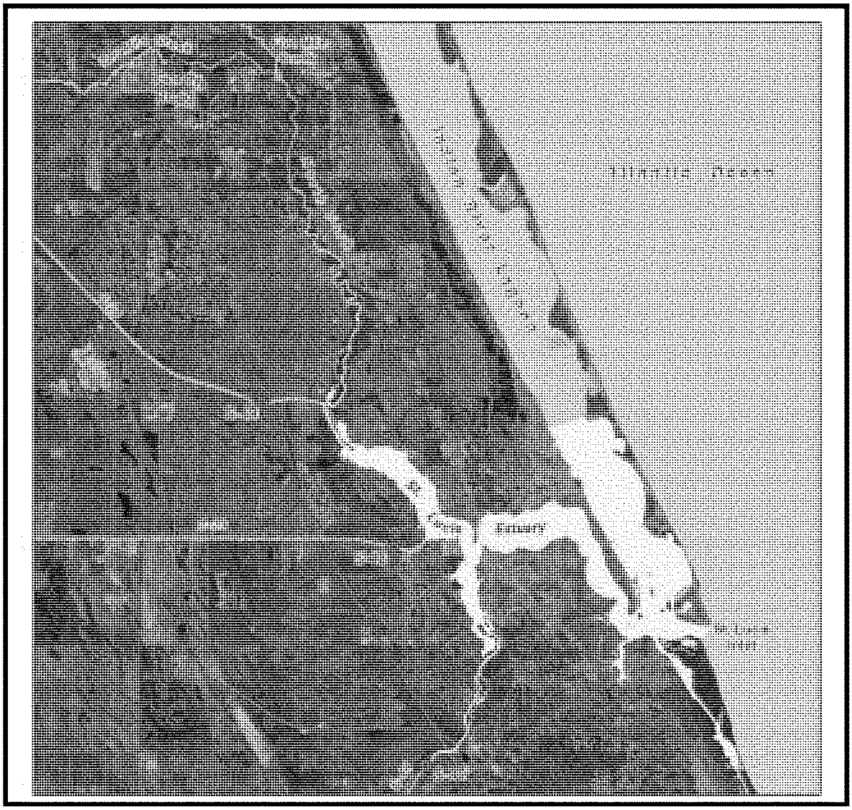


Figure G-3. Estimate of the Maximum Area of Potential Ecological Benefit for the St. Lucie Estuary (Zone SE-1)

Greater Everglades Performance Measures

Performance measure scores within the Greater Everglades were generated from hydrologic output from the RSM-GL using indicator regions (IRs) and/ or flow transects.

IRs were used for performance measures that measured the depth, distribution, duration of surface flooding and dry event severity (*i.e. Inundation Duration in the Ridge and Slough Landscape, Hydrologic Surrogate for Soil Oxidation, Slough Vegetation Suitability, and Dry Events in Shark River Slough*). IRs are groups of adjacent cells within the model grid that together represent a particular region of the Greater Everglades common to both present and pre-drainage systems. The cells within an IR are intended to be homogeneous in soil type, vegetative structure and topography and were therefore expected to show similar responses to hydrologic changes. Because IRs have ground elevations and community structure that are similar to much more extensive areas of the natural system, hydrologic patterns in each indicator region was used to evaluate how well alternative plans achieved hydrological restoration targets at sub-regional and regional scales. Indicator regions included IR 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 128, 129, 130, 131, 132, 133, 140, and 190. These IRs were adapted from the South Florida Water Management Model (SFWMM) and represent those previously defined by RECOVER to represent ridge and slough habitat. IRs defined by RECOVER that are located within WCA 3A, 3B and ENP and are characterized as marl prairie habitat (IRs 141, 143, 144, 145, 147, and 148) were not evaluated in the CEPP planning model. IRs MC-NE1, MC-NE2, MC-NW1, MC-NW2, MC-CE1, MC-CE2, MC-CW1, MC-CW2, MC-SE1, MC-SE2, and MC-SW1, MC-SW2 were added to capture the immediate hydrologic effects of the Miami Canal.

Transects are groups of adjacent cells within the model grid that span sections of the study area, with an orientation roughly perpendicular to the direction of flow. Transects were used for performance measures which measured the timing and distribution of flows (*Sheetflow in the Ridge and Slough Landscape)*. Transects included T-5, T-6, T-7, T-8, T-12, T-15, ENP-1 (T-26), ENP-2 (T-17), T-18N, T-18S, ENP-3 (T-18S + T19) T-23A, T23B, T23C, and T-27. These transects were adapted from the SFWMM and represent those previously defined by RECOVER. T-MC1, T-MC2, T-MC3, T-MC4, and T-MC5 were added to capture the immediate hydrologic effects of the Miami Canal.

To further evaluate the spatial extent of the project's effects within WCA 3 and ENP, the project team evaluated performance measure output for individual zones within the study area. Because the IRs and transects covered only a portion of the project area, the region was divided into nine zones to extrapolate from the IRs and/or transects to the larger areas they represent. **Figure G-4** to **Figure G-7** illustrate the location of IRs and transects within the RSM-GL model mesh and each of the nine zones. IRs added to capture the immediate hydrologic effects of the Miami Canal are shown only in **Figure G-5**.

Zones were delineated to capture the spatial extent of the structural components of the alternatives. Zones were also delineated based on differences in existing conditions within the study area. Zones evaluated included 3A-NE, 3A-NW, 3A-MC, 3A-C, 3A-S, 3B, ENP-N, ENP-S, and ENP-SE. A description of the justification for each zone is provided below.

Zone 3A-MC was sized to capture the immediate hydrologic effects of the Miami Canal. Zone 3A-MC was also delineated to completely contain the IRs adjacent to the Miami Canal.

Zone 3A-NE is one of the most over drained areas within northern WCA 3A and is severely degraded. Zone 3A-NE was sized to capture the hydrologic effects of a potential conveyance and distribution feature planned along the northeastern boundary of WCA 3A.

Zone 3A-NW is also over drained and severely degraded. Zone 3A-NW was sized to capture the hydrologic effects of a potential conveyance and distribution feature planned along the northwestern boundary of WCA 3A.

Zone 3A-C was delineated to represent an area of WCA 3A with a relatively well conserved ridge and slough landscape.

Zone 3A-S was delineated to represent an area of WCA 3A that has been impacted by impoundment structures. The southern portion of WCA 3A is primarily affected by high water and prolonged periods of inundation. The line delineating Zone 3A-C from Zone 3A-S was selected to be parallel to the Miami Canal in order to maintain a boundary roughly equidistant from the Miami Canal and be roughly mid-way between the Zone 3A-NW boundary and Tamiami Trail.

Zone 3B was delineated to represent an area hydrologically isolated from the project by levees. Zone 3B was delineated to determine hydrologic benefits of the project to WCA 3B.

Zone ENP-N was delineated to completely contain IRs 129 (Northeast Shark River Slough) and 140 (Lostman's Slough) located south of WCA 3A. The boundary of Zone ENP-N was also delineated to reach the southern extent of the L-67 Extension located in Everglades National Park.

Zone ENP-S was delineated to capture mid, southwest and south Shark River Slough in Everglades National Park.

Zone ENP-SE was delineated to capture Taylor Slough in ENP and reach the southern extent of Everglades National Park.

Where multiple IRs or transects occurred in a zone (**Figure G-7**), the performance measure results were averaged. If an individual IR or transect crossed more than one zone, the performance measure results for the IR or transect were applied to each of the zones the IR or transect crossed. For analytical purposes, the area within WCA 3A, WCA 3B and ENP to be potentially affected by the project was assumed to encompass 1,076,248 acres (*i.e.* summation of acreages within each of the nine zones).

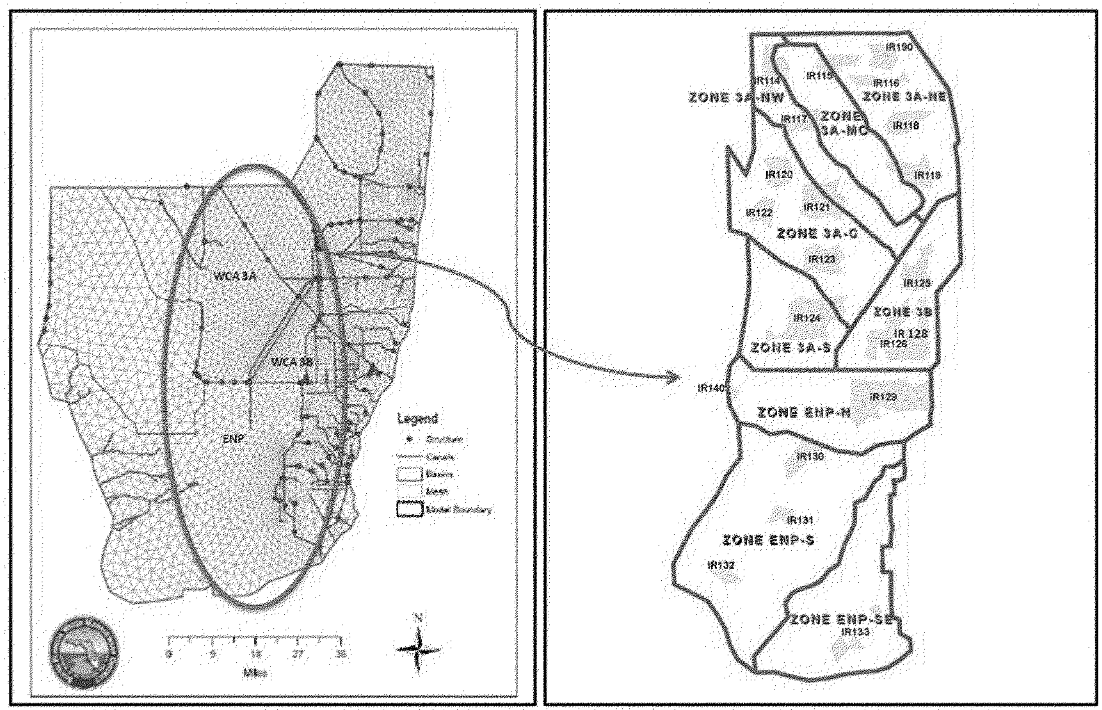


Figure G-4. Indicator Regions within the RSM-GL Model Mesh

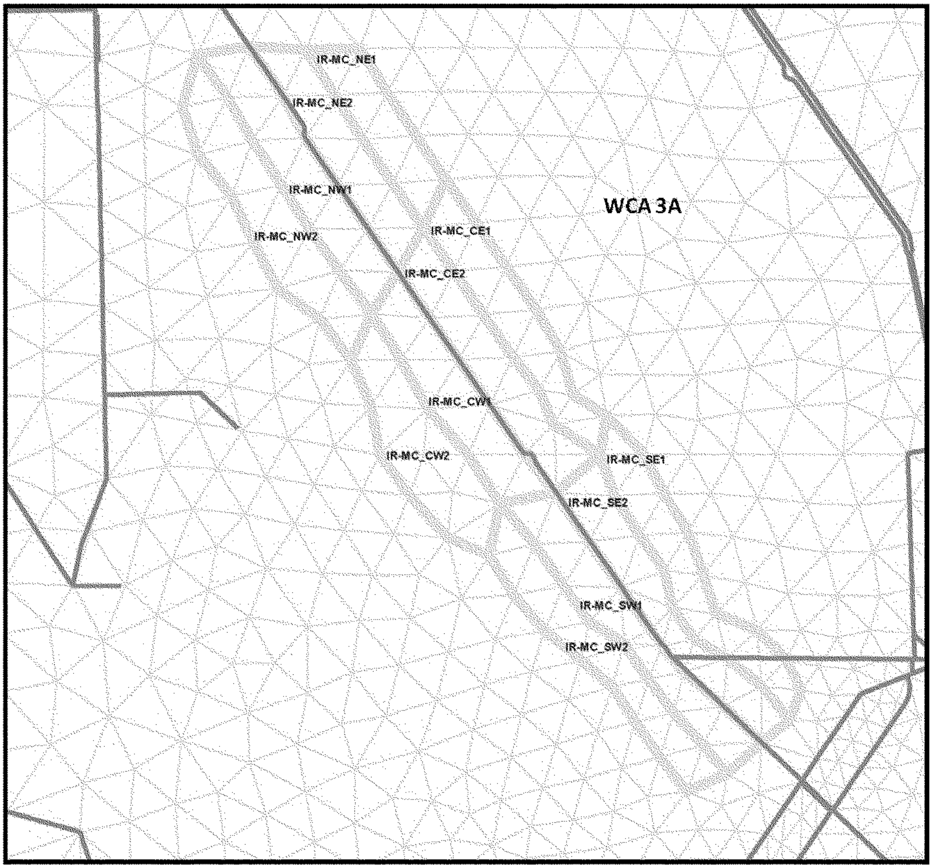


Figure G-5. Miami Canal Indicator Regions within RSM-GL Model Mesh

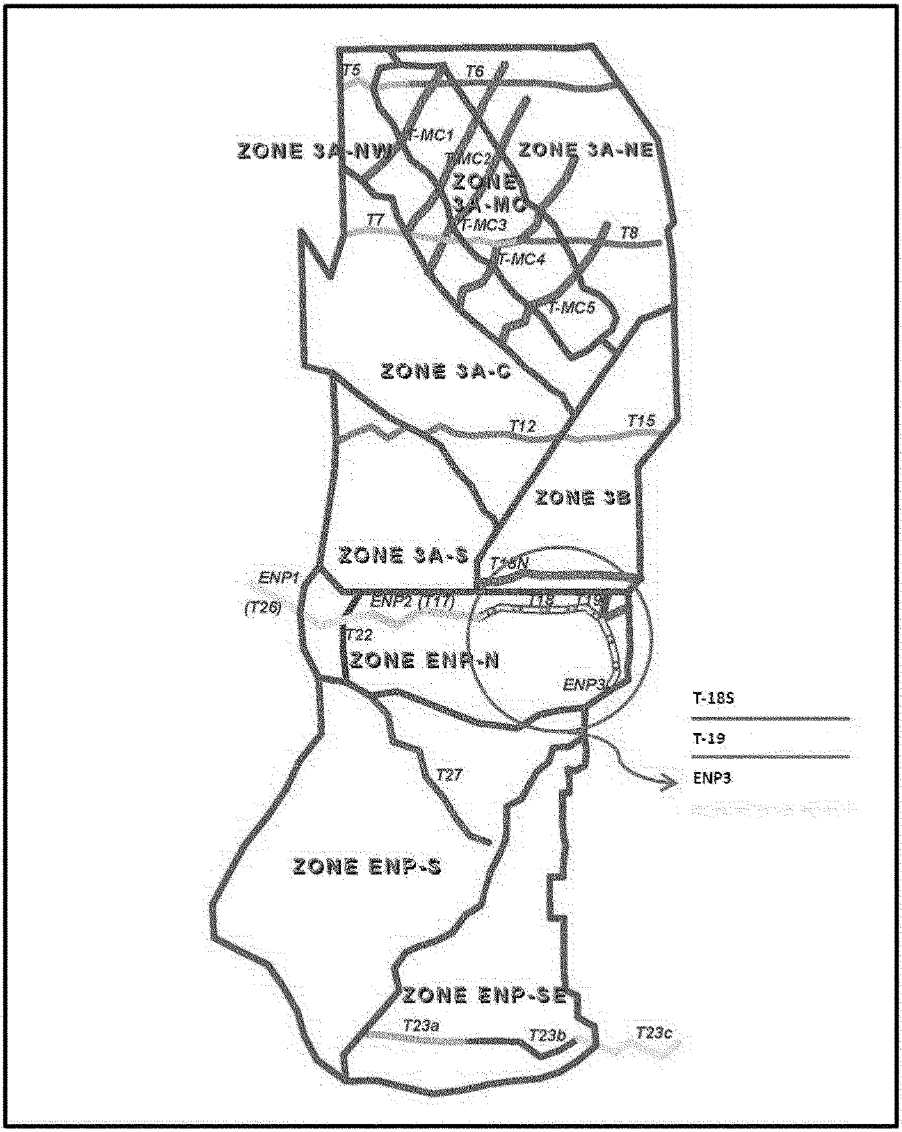


Figure G-6. Transects within the RSM-GL Model Mesh

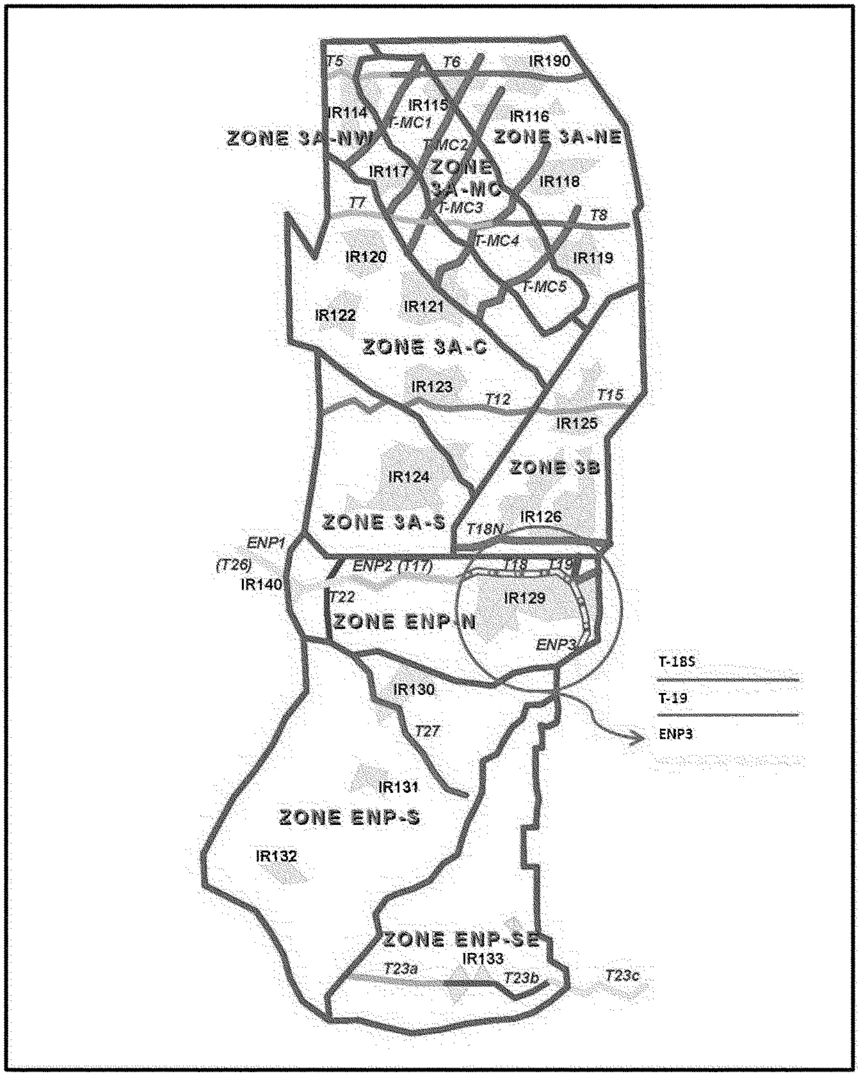


Figure G-7. Indicator Regions, Transects and Zones Within RSM-GL Model Mesh

Southern Coastal Systems Performance Measures

Performance measures for Florida Bay were used to measure predicted salinity values within the Bay. Simulated hydrology produced by RSM-GL for each CEPP alternative was post-processed using multiple linear regression (MLR) statistical models to estimate salinity conditions at 17 Marine Monitoring Network (MMN) stations in Florida Bay. To further evaluate the spatial extent of the project's effects, Florida Bay was divided into six zones of similarity based on water quality characteristics (**Figure G-8**). Zones evaluated included North Bay (FB-NB), East Bay (FB-EB), East-Central Bay (FB-EC), Central Bay (FB-C), South Bay (FB-S), and West Bay (FB-W). Where multiple MMN stations occurred in a zone (**Figure G-8),** the performance measure results were averaged. For analytical purposes, the area within Florida Bay to be potentially affected by the project was assumed to encompass 476,096 acres (*i.e.* summation of acreages within each of the six zones).

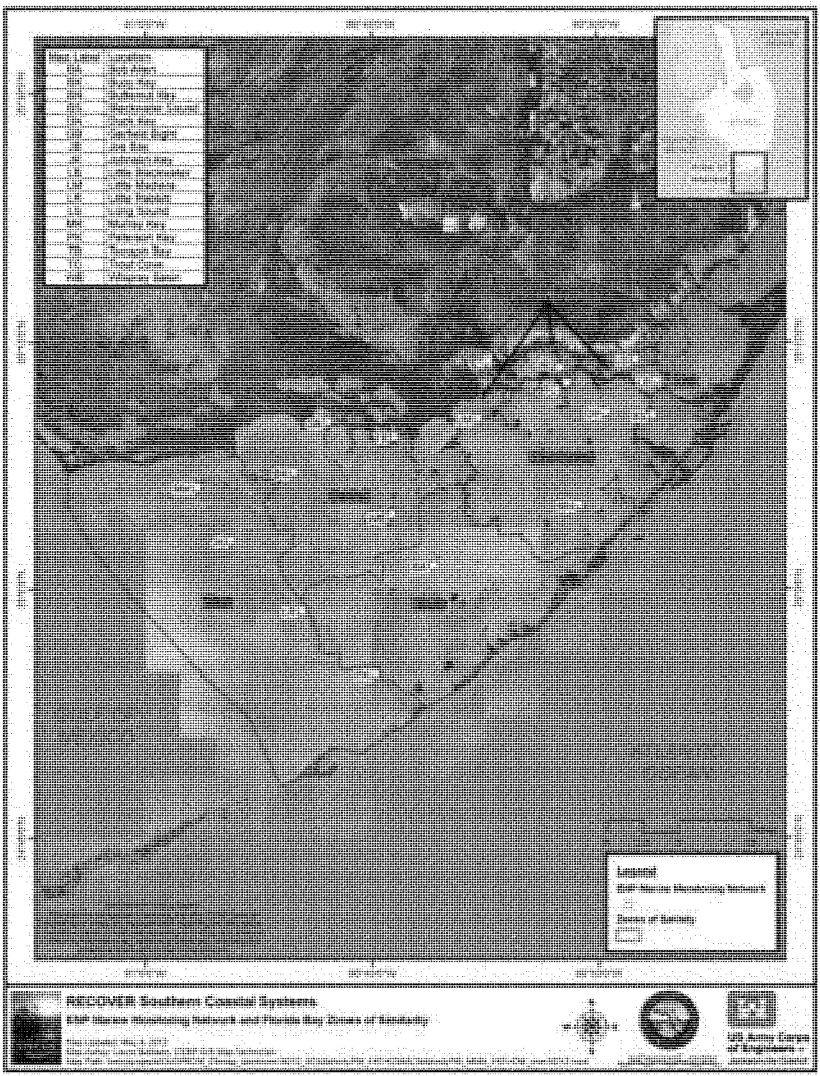


Figure G-8. Florida Bay Marine Monitoring Network and Florida Bay Zones of Similarity

G.1.5 Performance Measure Metrics

The following provides a brief description of the above performance measures including the performance measure target(s) for each, and the applicable metrics for the target(s).

G.1.5.1 Northern Estuaries Performance Measures

G.1.5.1.1 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 the C-43 canal at the S-79 structure where the mean monthly inflow should be maintained between 450 and 2,800 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.

G.1.5.1.2 St. Lucie Estuary

PM 7.1 Low Flow Targets and PM 7.2 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 envelope 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).
- 0 Lake Okeechobee regulatory discharge events (14 day moving averages > 2000 cfs)

For each of the estuaries, scores will be reported for project alternatives indicating the numbers of times discharge criteria (*i.e.* flow targets) and/or corresponding salinity envelope criteria are not met. Alternatives are scored based on achievement of targets.

Further information for this performance measure can be found at:
http://www.evergladesplan.org/pm/recover/recover_docs/et/ne_pm_salinityenvelopes.pdf.

G.1.5.2 Greater Everglades Performance Measures

G.1.5.2.1 Inundation Duration in the Ridge and Slough Landscape

PM 1.1 Percent Period of Record (PPOR) Inundated

The ecological target is a percent period of record (PPOR) of inundation representative of pre-drainage conditions as modeled by the NSM version 4.6.2 in the ridge and slough landscape. The percent period of record is the simulation period (January 1965 – December 2005). PPOR of inundation is the total time inundated (days) divided by the full period of record.

This performance measure is applied to IRs within the RSM-GL model mesh. To facilitate evaluation of each alternative's performance, separate scores are reported for each of the nine zones, by averaging scores from each IR within each zone (**Table G-1**). PPOR of inundation are reported for each of the project alternatives and target (NSM version 4.6.2). Alternatives are scored based on achievement of target.

Table G-1. Indicator Regions Aggregated by Zone

Zone	Indicator Regions
3A-NE	IR-115, IR-116, IR-118, IR-119, IR-190
3A-MC	IR-MC-NE1, IR-MC-NE2, IR-MC-NW1, IR-MC-NW2, IR-MC-CE1, IR-MC-CE2, IR-MC-CW1, IR-MC-CW2, IR-MC-SE1, IR-MC-SE2, IR-MC-SW1, IR-MC-SW2
3A-NW	IR-114, IR-117, IR-121
3A-C	IR- 120, IR-121, IR-122, IR-123
3A-S	IR-124
3B	IR- 125, IR 126, IR 128
ENP-N	IR-129, IR-140
ENP-S	IR-130, IR-131, IR-132
ENP-SE	IR-133

Further information for this performance measure can be found at:
http://www.evergladesplan.org/pm/recover/recover_docs/et/061807_prev_ge-2.pdf

G.1.5.2.2 Sheetflow in the Everglades Ridge and Slough Landscape

PM 2.1 Timing of Sheetflow

This performance measure consists of two components; the timing of sheet flow and the spatial distribution and continuity of sheet flow. The timing scores provide information about how the timing of discharges across transects (and each transect's sub-transect) are altered by alternative project configurations. The target is restoration of pre-drainage timing of flows within the area of impact of the project as simulated by the NSM version 4.6.2. For each year in the simulation period of record (January 1965 – December 2005), monthly flow volumes are calculated for each specified RSM-GL transect (and sub-transect), and then expressed as a percentage of total annual flow volume along the transect. The absolute value of the difference between the flow volumes for the project alternative condition and target condition (NSM version 4.6.2) is then calculated to yield a monthly deviation from target. The monthly distances between the target values and those yielded by the project alternatives are then summed to yield an annual deviation from target. A timing index score is then calculated by subtracting the annual deviation from target from the value of one. These calculations are conducted for each year in the period of record. The magnitudes of the index scores are proportional to the similarity between the timing of flows in the pre-drained system. An index score of 1.0 indicates that the timing of flows yielded by the project alternative perfectly matches the timing of flows yielded by the target condition.

This performance measure is applied to transects within the RSM-GL model mesh. To facilitate evaluation of each alternative's performance, separate scores are reported for each of the nine zones by averaging scores from each transect within each zone.

PM 2.2 Continuity of Sheetflow and PM 2.3 Distribution of Sheetflow

The continuity and distribution scores provide information about how flow distribution within individual transects are altered by alternative project designs/operations. The distribution target is to have uniformity of flow along the length of each transect at each time step (monthly) and the continuity target is to have uniform flow across paired transects which cross barriers or canals at each time step (monthly). The best performing alternatives will have the most uniform flow along the length of transects, and between paired transects.

Uniformity of sheet flow is measured by the Coefficient of Variation (Cv) statistic. The Cv is defined as the ratio of the standard deviation (σ) to the mean (μ). The Cv is calculated at each time step (monthly) for each transect or transect pair using flow per mile. The score at each location is the standard deviation (σ) of flow divided by the mean (μ) from all sub-transects in an individual transect or transect pair. The objective is to minimize the Cv at each time step; a low Cv score (Cv=0) is an indicator of pre-drainage sheet flow.

This performance measure is applied to transects within the RSM-GL model mesh. To facilitate evaluation of each alternative's performance, separate scores are reported for each of the nine zones by averaging scores from each transect within each zone. **Table G-2** indicates which transects are averaged within each of the nine zones for this performance measure.

Table G-2. Transects Aggregated By Zone

Performance Measure Transects Aggregated			
Zone	**2.1 Sheetflow in the Ridge and Slough Landscape – Timing**	**2.2 Sheetflow in the Ridge and Slough Landscape –Continuity**	**2.3 Sheetflow in the Ridge and Slough Landscape – Distribution**
3A-NE	T-6, T-8,	T-MC2_& T-MC3, T-MC3_& T-MC4, T-MC4 & T-MC5	T-6, T-8, T-MC2, T-MC3, T-MC4, T-MC5,
3A-MC	T-5, T-6, T-7, T-8	T-MC1 & T-MC2, T-MC2 & T-MC3, T-MC3 & T-MC4, T-MC4_ T-MC5	T-5, T-6, T-7, T-8, T-MC1, T-MC2, T-MC3, T-MC4, T-MC5,
3A-NW	T -5, T-7	T-MC1 & T-MC2, T-MC2 & T-MC3, T-MC3 & TMC4, T-MC4 & T-MC5	T-5, T-7, T-MC1, T-MC2, T-MC3, T-MC4, T-MC5,
3A-C	T-7, T-12	NA	T-7, T-12
3A-S	T-12	NA	T-12
3B	T-15	T18N & T18S	T-15, T18N
ENP-N	ENP-1 (T-26), ENP-2 (T-17), ENP-3 (T-18S +T-19)	T18N & T-18S	ENP-1 (T-26), ENP-2 (T-17), T-18S
ENP-S	T-27	NA	NA
ENP-SE	T-23 (T-23A+ T-23B +T-23C)	NA	T-23A, T-23B, T-23C

T-27 is only used to score the timing metric (sub-metric 2.1) of this performance measure in zone ENP-S. Ground surface elevations vary along T-27 such that uniform flow is not expected, and therefore the flow distribution metric does not apply. Also, water management has the potential to create unnaturally uniform flow by delivering water to higher elevation areas, creating a situation where the performance measure scores are difficult to interpret. As with T-27, ground surface elevations vary along T-23 in zone ENP-SE such that uniform flow is not expected. To score T-23 with the distribution metric (sub-metric 2.3), T-23 has been subdivided into sub-transects T-23A, T-23B and T-23C. Each sub-transect can be evaluated separately for uniformity of flow (there are separate scores for T-23A, T-23B and T-23C). The timing of flow (sub-metric 2.1) at each T-23 sub-transect is nearly the same, however, therefore it is not necessary to evaluate timing at each sub-transect separately. A single timing score for T-23 will be reported by computing the average of the timing scores from each of the T-23 sub-transects (T-23A, T-23B & T-23C).

Further information for this performance measure can be found at: http://www.evergladesplan.org/pm/recover/recover_docs/et/ge_sheetflow_01.pdf

G.1.5.2.3 Hydrologic Surrogate for Soil Oxidation

PM 3.1 Drought Intensity Index

This performance measure represents peat exposure to oxidation by using the NSM version 4.6.2 Drought Intensity as a target. Drought intensity is calculated by multiplying depth to water table from ground surface (ft) by duration (days) of belowground water levels to yield a ft-days below land surface summary for each specified RSM-GL cell in the simulation model. For each day of the period of record (January 1965 – December 2005) each specified RSM-GL cell is queried for water depth relative to land surface elevation. If water levels are below ground, the depth below ground is determined and scored in ft below ground units. If water levels are at ground level or above ground, the specified RSM-GL cell is scored as zero. Daily values of drought intensity for each cell are summed to compute an annual drought intensity score for each year in the simulation. Annual drought intensity scores are then summed across the period of record to produce cumulative drought intensity scores.

This performance measure is applied to indicator regions within the RSM-GL model mesh. To facilitate evaluation of each alternative's performance, separate scores are reported for each of the nine zones by averaging scores from each indicator region within each zone (**Table G-1**). Cumulative drought intensity scores are reported for each of the project alternatives and target (NSM version 4.6.2) for each zone. Alternatives are scored based on achievement of target.

This performance measure is similar to the Greater Everglades Performance Measure Dry Events in Shark River Slough. However, this performance measure is applied over a broader area, and also provides the relative severity of drought events. This is important in evaluating the potential occurrence of unnatural peat destroying fires which affect microtopography, and the structure and distribution of plant communities.

Further information for this performance measure can be found at:
http://www.evergladesplan.org/pm/recover/recover_docs/perf_measures/ge-03_090408.pdf[2]

G.1.5.2.4 Dry Events in Shark River Slough

PM 4.1 Number of Dry Events, PM 4.2 Duration of Dry Events, PM 4.3 PPOR of Dry Events

The ecological target is the recovery of the pre-drainage patterns of multiyear hydroperiods as modeled by the NSM version 4.6.2 in Shark River Slough within ENP. This performance measure reflects how many times, and for what duration, water levels fall below ground in Shark River Slough in the period of record. This measure is important in extrapolating the hydrologic behavior of alternative plans to ecological effects on floral (e.g., white water lily, sawgrass) and faunal (e.g., fishes, wading birds) assemblages in Shark River Slough.

The number and duration of dry events are used to calculate the percent period of record (PPOR) of dry events. The PPOR with dry conditions is calculated as the average duration of dry events (days) multiplied by the number of dry events divided by the total period of record (POR). The period of record is the number of days in the simulation period (January 1965 – December 2005). A dry event is calculated as a discrete segment of time from the point at which water levels fall below ground surface

[2] This performance measure was derived from the Greater Everglades Performance Measure - Extreme High and Low Water Levels in Greater Everglades Wetlands.

until the time they rise above ground. Minor events where water rises above ground slightly less than 0.2 feet, do not determine the end of a dry event at that moment until it continues to rise above 0.2 feet. PPOR of dry events are reported for each of the project alternatives and target (NSM version 4.6.2).

This performance measure is applied to IRs 129 – 132 within the RSM-GL model mesh (**Figure G-4**). Therefore, this performance measure is only scored at Zones ENP-N and ENP-S. To facilitate evaluation of each alternative's performance, separate scores are reported for each of the two zones, by averaging scores from each IR within each zone. PPOR of dry events are reported for each of the project alternatives and target (NSM version 4.6.2). Alternatives are scored based on achievement of target.

Further information for this performance measure can be found at:
http://www.evergladesplan.org/pm/recover/recover_docs/et/061807_prev_ge-1.pdf

G.1.5.2.5 Slough Vegetation Suitability

PM 5.1 Hydroperiod, PM 5.2 Dry down, PM 5.3, Dry Season Depth, PM 5.4 Wet Season Depth

A three step process was followed in the development of this performance measure to arrive at the targets and tools to predict performance. During Phase I, scientific evidence defining characteristic pre-drainage native Everglades slough indicator species, their historical and current distribution and defining hydrologic conditions was gathered. The analysis of plant associations across the Everglades identified that slough communities were historically dominated by white water lily (*Nymphaea odorata)* as well as slim spikerush (*Eleocharis elongata*) prior to the construction of the C&SF Project and therefore were selected as indicator species.

During Phase II the empirical evidence gathered during Phase I was evaluated to define performance measure targets. Based on the scientific evidence, the optimal hydrologic conditions for the two indicator species are;

1. to maximize continuous hydroperiods (days with depth ≥ 0.0 ft) (*Hydroperiod*)
2. to minimize dry down events below 0.7 ft (20 cm) (*Dry down*)
3. to maintain dry season average depths of 1.5 to 2 ft (~46 to 60 cm) (*Dry Season Depth*)
4. maintain a wet season average depths of 2 to 3 ft (~60 to 90 cm) (*Wet Season Depth*)

During Phase III, the targets gathered and defined during Phases I and II were matched to NSM version 4.6.2 frequency curves that best fit the hydroperiod optima for the two indicator species. The performance measure target is the empirical frequency curve from NSM version 4.6.2 that most closely matches the slough vegetation hydrologic optima. For example, return periods (years) of annual maximum continuous hydroperiods are plotted for the period of record (1965-2005) for each alternative at each IR. The percent of target achieved (%) for each year plotted on the frequency curve is computed relative to base conditions. The alternative's score for this metric at each IR is computed by averaging the percent of target achieved for all years. This is calculated for each of the above performance measure metrics.

This performance measure is applied to indicator regions within the RSM-GL model mesh. This performance measure is not scored at IR 140 or IR 190. To facilitate evaluation of each alternative's performance, separate scores are reported for each of the nine zones by averaging scores from each indicator region within each zone (**Table G-1**).

Note, IRs 140 and 190 have been defined by RECOVER to be representative of sawgrass and marl marsh. However, some ridge and slough habitat has been found within these regions historically. These IRs were therefore included in our analysis but not scored with the slough vegetation performance measure.

Further information for this performance measure can be found at:
http://www.evergladesplan.org/pm/recover/recover_docs/perf_measures/ge_slough_veg_pm_final_092611.pdf

G.1.5.3 Southern Coastal Systems Performance Measure
Salinity targets (here called "paleo-adjusted NSM salinity targets") are derived using simulated pre-drainage hydrologic conditions from the NSM version 4.6.2 and MLR statistical models (NSM-MLR) to estimate salinity conditions at 17 Marine Monitoring Network (MMN) stations in Florida Bay. Paleo-ecological information provided by the United States Geological Survey (USGS) studies in Florida Bay are used to adjust the NSM-MLR salinity time series values at each MMN station to more closely represent historical salinity conditions.

Simulated hydrology produced by RSM-GL version 2.3.2 is post-processed using the MLR statistical models to predict salinities at the MMN stations. The alternative salinity time series are then compared to the paleo-adjusted NSM salinity targets using the metrics described below. Each metric is appraised on a monthly and seasonal basis (for this performance measure, wet season = June through November; dry season = December through May).

G.1.5.3.1 Regime Overlap
PM 8.1 Dry Season Regime Overlap and PM 8.2 Wet Season Regime Overlap
For each MMN site, the distribution of salinities in the paleo-adjusted NSM record (target) is compared to the predicted distribution (CEPP alternative) of results between the 25th and 75th percentiles (hereafter referred to as the "mid-range"). The mid-range distribution of paleo-adjusted NSM salinities in the period of record is evaluated on a cumulative monthly and seasonal basis to determine the target for this metric.

The mid-range distribution is determined for monthly and seasonal CEPP alternative model output at each MMN site and compared to the target distribution. The overlap between the mid-range distributions is determined on a monthly and seasonal basis and is reported as a proportion of the mid-range values of each CEPP alternative model output that fall within the mid-range of the target. This provides a "regime overlap score" for each month on a 0 to 1 scale.

G.1.5.3.2 High Salinity
PM 8.3 Dry Season High Salinity and PM 8.4 Wet Season High Salinity
This metric focuses on the exceedances (in days) of the predicted data (CEPP alternative) above a high-salinity threshold. The high-salinity threshold is calculated using the period of record for the paleo-adjusted NSM. The 90th percentile value is determined separately for each MMN station and used as the high-salinity threshold. The high salinity target is for high salinity threshold exceedances in the CEPP alternative model output to be no more frequent than occurs in a comparable paleo-adjusted NSM time period (here called "target exceedances"). Target exceedances are calculated on a monthly and seasonal basis. The desired metric score is 1.0.

Further information for this performance measure can be found at:

http://www.evergladesplan.org/pm/recover/recover_docs/perf_measures/062812_rec_pm_scs_salinity_flbay.pdf

G.1.6 Method: Calculation of Ecosystem Benefits

The calculation of ecosystem benefits (quantitative scoring) consisted of four general steps, as illustrated in **Figure G-9**. These are: (1) rescaling of performance measures to common units; (2) combining performance measures into an aggregate score for each of the zones in the project area (*i.e., two zones in the Northern Estuaries, nine zones in WCA 3 and ENP, and six zones in Florida Bay)*; (3) and converting the zone scores into HUs that were then used to (4) compare alternatives.

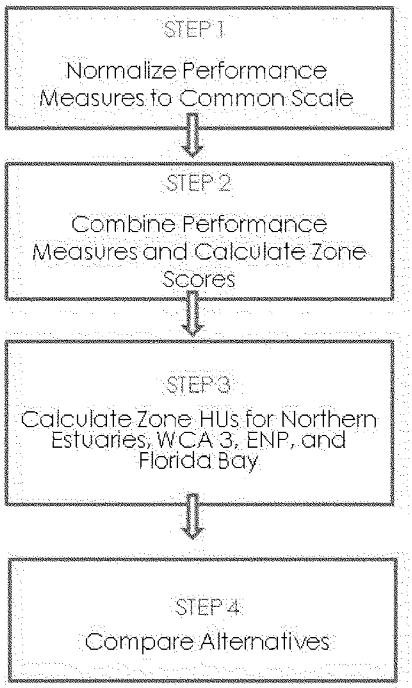


Figure G-9. Overview of Steps in Calculating Ecosystem Benefits and Numerical Outputs

G.1.6.1 Step 1: Normalize Performance Measures Scores to Common Scale

Summary: Raw performance measure outputs were linearly rescaled to have a common range of values between 0 and 100. These values were extrapolated to provide a set of performance measure scores for each zone. The product of this step was a set of performance measure scores on a common measurement scale within each region of the project area (i.e. Northern Estuaries, WCA 3, ENP, and Florida Bay).

Northern Estuaries Performance Measures

Survey information from the 2007 System Status Report (RECOVER 2007b) was used to determine the zero score on the zero to 100 scale for current conditions (*i.e.* Existing Conditions Baseline [ECB]). Oyster surveys performed in 2003 and 2004 indicate that as of those dates there were 18 acres of live oyster bars in the Caloosahatchee Estuary and 117 acres in the St. Lucie Estuary. Target acreages for these locations are 500 acres and 834 acres respectively. These targets were determined to be the maximum acres achievable after all CERP components affecting these areas are built and operational (RECOVER 2005). This target assumes all reservoir, Stormwater Treatment Area (STA) and wetland rehydration features which are needed to obtain favorable salinities are in place. Also in order to reach these targets, substrate improvements which includes muck removal and the addition of suitable substrate such as oyster cultch will be needed. To calculate the score on the zero to 100 scale for current conditions, a percentage of the target was used (*i.e.* 14% St. Lucie Estuary and 4% for the Caloosahatchee Estuary) based on the acres of oysters from the 2003 and 2004 surveys. Original scores for each performance measure for the ECB were then rescaled to these values. The minimum value for each performance measure for the original scale was then extrapolated using the known score determined for the ECB (14 for the St. Lucie Estuary and 4 for the Caloosahatchee Estuary) and the target score of 100.

Acreages of oysters were determined to be a suitable measure for purposes of determining the zero to 100 score for current conditions. Oysters which naturally dwell in the middle (mesohaline) portion of the estuaries are affected by both high and low flow violations of the salinity performance measure. Oysters provide many benefits to the estuaries because they improve water quality by filtering particles from the water, serve as prey and habitat for numerous other organisms, and play an important role in the estuarine food chain. Oysters serve as excellent indicator species because salinity conditions suitable for oysters also produce favorable conditions for a suite of other desirable estuarine organisms that dwell both directly on the reef as well as in other areas of the estuary. As a keystone species and valued ecosystem component, oysters are indicative of the ecosystem health as a whole.

Greater Everglades Performance Measures

Within WCA 3 and ENP, each of the project performance measures were developed using measurement units and a scale suitable to the hydrologic parameters the performance measure was designed to evaluate. In order to combine these different performance measures into a single overall score, it was necessary to transform all the performance measures to a common scale that represented a comparable range of ecosystem performance, regardless of differences in the original metrics. The scale chosen for this purpose was one that ranged from zero to 100, with the minimum of zero representing a fully degraded ecosystem and a maximum of 100 representing the restoration target.

Rescaling from the original performance measure scale to this common, zero to 100 scale was done by simple linear projection. The maximum score of 100 was assigned to performance measure values that, on their original scale, were defined as the ecosystem restoration target. These targets were established at the time the performance measures were originally developed. The minimum of zero was assigned to performance measure values that, on their original scale, represented hydrologic conditions in a fully degraded ridge and slough ecosystem.

In order to establish what constitutes this minimum value on the original scale within WCA 3 and ENP, reference areas within the existing system were chosen, and output from the ECB from the RSM-GL was used to set the minimum, "fully degraded" score for each performance measure. The ECB was used for this purpose because it is a description of assumed hydrologic conditions in December 2010-2011 as modeled by using a multi-year period of record based on assumptions such as land use, population, water demand and assumed operations of the C&SF Project. As such, the ECB provided the best available RSM-GL representation of current habitat quality within the project area.

Some Greater Everglades performance measures were scored using indicator regions within the RSM-GL domain while others used flow transects. ECB scores from indicator regions and flow transects in northwestern WCA 3A were selected as reference sites. The reference sites, which at one time were part of the ridge and slough landscape, are now fully degraded as a result of the existing hydrologic conditions.

The environmental condition of northern WCA 3A is an accurate measure of the current degraded ecologic condition of WCA 3A. Northwestern WCA 3A has been over drained and its natural hydroperiod shortened. Over drainage of northern WCA 3A has resulted in the invasion of a number of plant species (e.g. cattail and willow) associated with drier conditions and has increased the frequency of severe peat fires. Peat fires have resulted in the loss of the ridge and slough landscape that was once characteristic of the area as well as causing the release of soil phosphorous leading to conditions more favorable for cattail colonization and expansion. Today northern WCA 3A is largely dominated by a sawgrass/cattail community and scattered shrubs and lacks the natural structural diversity of plant communities seen in central and western WCA 3A.

These reference sites were intended to represent degraded conditions for all Greater Everglades performance measures. For indicator region based performance measure scores, the ECB score from IR 114 was used to establish the minimum score for the project performance measure. For project performance measures scored at flow transects, the ECB score from T-5, T-MC1, and/or transect pair T-MC1 & T-MC2 were used. These indicator regions and transects are all located in northwestern WCA 3A. Alternative plan performance measures scores were then rescaled relative to the minimum ECB score. **Table G-3** depicts the Greater Everglades performance measures, a description of the metric, and lists the reference degraded site used for each performance measure.

Table G-3. Rescaling of Project Performance Measures and Location of Degraded Reference Site for Greater Everglades Performance Measures

Metric #	Performance Measure Metric	Untransformed Values	Degraded Reference Site
1.1	Inundation Duration in the Ridge and Slough Landscape – PPOR Inundated	% PPOR with water depth > 0.0 ft	IR 114
2.1	Sheetflow in the Ridge and Slough Landscape – Timing of Sheetflow	flow /mile	Transect T-5
2.2	Sheetflow in the Ridge and Slough Landscape – Continuity of Sheetflow	flow /mile	Transect T-MC1 Transect Pair T-MC1&T-MC2
2.3	Sheetflow in the Ridge and Slough Landscape – Distribution of Sheetflow	flow /mile	Transect T-MC1
3.1	Hydrologic Surrogate for Soil Oxidation – Drought Intensity Index	water depth relative to land surface elevation (ft- days below ground)	IR 114
4.1	Dry Events in Shark River Slough – Number of Dry Events	number of dry events with water depth < 0.2 ft	IR 114
4.2	Dry Events in Shark River Slough – Duration of Dry Events	duration of dry events with water depth < 0.2 ft	IR 114
4.3	Dry Events in Shark River Slough – PPOR of Dry Events	% PPOR with water depth < 0.2 ft	IR 114
5.1	Slough Vegetation Suitability – Hydroperiod	maximize continuous hydroperiod (depth ≥ 0.0 ft	IR 114
5.2	Slough Vegetation Suitability – Dry down	minimize continuous dry down events (depth ≤ 0.7 ft (20 cm)	IR 114
5.3	Slough Vegetation Suitability – Dry Season Depth	attain dry season average depths of 1.5 - 2.0 ft	IR 114
5.4	Slough Vegetation Suitability – Wet Season Depth	attain average wet season depths of 2.0 - 3.0 ft	IR 114

Southern Coastal Systems Performance Measures

Within Florida Bay, a method to rescale performance measure scores to a common scale was already developed per the documentation sheet. Performance measures were rescaled on a zero to one scale as described in **Section G.1.5.3** above.

G.1.6.2 Step 2: Combine Performance Measures and Calculate Zone Scores

Summary: Within each zone, performance measure scores were combined for each project alternative to produce a net zone benefits score between 0 and 1.

In Step 2, performance measure scores were combined to yield a score for each project alternative. This was repeated for the two zones within the Northern Estuaries, each of the nine zones within WCA 3 and ENP, and for the six zones within the Florida Bay. This value, which would be between 0 and 1, was then used in Step 3 to calculate the zone's contribution to the total HUs for the alternative.

For performance measures that included more than one IR or flow transect within a zone, performance measure sub-metrics for individual IR and transects were aggregated to produce a single score for each performance measure sub-metric per zone.

The CEPP planning model implemented an assumption that performance measure results used as inputs to the planning model were of equal credibility and reliability. The CEPP planning model included an option to weight performance measures within each zone of the study area and/or weight specific IRs specifically within the WCA 3 and ENP zones. This was included to provide the capacity to investigate the sensitivity of HU computations to the emphasizing or de-emphasizing of individual performance measures (at specific locations) deemed to be disproportionately influenced by errors/biases in the underlying hydrologic model used to produce the performance measure sub-metric scores.

It must be noted, that three of the Greater Everglades performance measures (*Sheetflow in the Ridge and Slough Landscape, Dry Events in Shark River Slough, and Slough Vegetation Suitability)* included two or more sub-metrics, for example, for PM 5 there were PM sub-metrics 5.1, 5.2, 5.3 and 5.4. Performance measures for the Northern Estuaries and Florida Bay also contained multiple sub-metrics. If a performance measure score had more than one sub-metric, sub-metric scores were averaged to prevent a performance measure with multiple sub-metrics from contributing disproportionately in comparison to a performance measure having only a single metric. Once this step was complete, a single score (0 to 1 scale) was produced for each zone.

G.1.6.3 Step 3: Calculate Zone Habitat Units for Northern Estuaries, WCA 3, ENP, and Florida Bay

Summary: The 0 to1 benefits score for each zone was then multiplied by the acreage of the zone to generate a HU value for the zone.

For each zone, the zone benefits score from Step 2 was then multiplied by the zone's acreage to produce a HU value for acres of restored Everglades' wetland or acres of restored estuary. This was repeated for each of the zones within the project area. Each zone could have a maximum of 1 HU per acre. This is because a score of 1 represents 100% suitable habitat for that acre, for that specific performance measure. This enables evaluators and decision-makers to consider how differences between alternatives are distributed spatially, including potential trade-offs in benefits between sub-regions of the project area.

The HU values for all zones within WCA 3 and ENP (Zones 3A-NE, 3A-MC, 3A-NW, 3A-C, 3A-S, 3B, ENP-N, ENP-S, and ENP-SE) were summed to produce a total HU value for each alternative, as well as for the without-project baselines within this portion of the project area. HU values for all zones in Florida Bay

(Zones FB-W, FB-C, FB-S, FB-EC, FB-NB, and FB-E) and the Northern Estuaries (Zones CE-1 and SE-1) were also summed.

G.1.6.4 Step 4: Compare Alternatives

Summary: The total HUs and the difference in HUs between each alternative and the FWO project condition were displayed in tables that also report the partition of HUs into contributions from each zone within the Northern Estuaries, WCA 3, ENP, and Florida Bay.

The HU values for the FWO project condition were subtracted from each alternative to produce HU lift.

G.2 SUMMARY OF ALTERNATIVE PERFORMANCE

An extensive discussion of performance measure scores for each project alternative is documented below. Performance measure results are summarized by planning region (*i.e.* Northern Estuaries, WCA 3, ENP, and Florida Bay). Comprehensive summary tables of the individual performance of each project alternative are presented throughout this section for each zone within a given region. Comparisons are made between the ECB and the FWO. Each project alternative is then compared to the FWO. Performance measure scores are shown on a common measurement scale that ranges from zero to 100, with the minimum of zero representing a fully degraded ecosystem and a maximum of 100 representing the restoration target. Color coding has been used to facilitate interpretation of results and identify ranges of performance measure scores with values < 25 noted in red, values ≥25 and < 50 noted in yellow, values ≥ 50 to < 75 noted in green, and values ≥ 75 noted in blue. These comprehensive summary tables are used to illustrate the relative influence of each performance measure to a given zone. Performance measure graphics are included for select locations throughout each region to depict general trends in performance. The percent of target HUs achieved by a given alternative for each zone is also noted within the summary tables. A summary of the HU results is also presented in **Section 4 (Evaluation and Comparison of Alternative Plans)** of the main report for the CEPP alternatives (*i.e.* Alternatives 1-4 and 4R) and the recommended plan (*i.e.* Alternative 4R2).

Results of the cost effectiveness incremental cost analysis (CE/ICA) identified Alternative 4 with modifications to the infrastructure of the hydropattern restoration feature and backfilling of the Miami Canal, denoted as Alternative 4M, as providing the greatest overall benefits with the least cost per habitat unit; however, the evaluation identified the need to revise operations of Alternative 4M to minimize localized adverse ecological effects to WCA 2 and Biscayne Bay and to ensure project savings clause constraints were met. Operations were also refined to provide additional opportunities for other water related needs (*i.e.* water supply) in the Lake Okeechobee Service Area (LOSA) and the Lower East Coast (LEC). Modeling scenarios were subsequently conducted to identify project effects resulting from operational changes (*i.e.* Alternatives 4R and 4R2). Results of the methodology used to quantify ecosystem benefits indicate a reduction in alternative performance for Alternative 4R and 4R2 in comparison to Alternatives 1-4. A similar reduction in benefits would be expected for each of the other four alternatives in the final array (*i.e.* Alternatives 1-4) if these considerations had been applied. Alternatives 4R and 4R2 are therefore not directly comparable to Alternatives 1-4. For this reason the evaluation of Alternatives 1 through 4 and Alternative 4R and 4R2 are presented separately in the following sections. A summary of performance for Alternatives 1 through 4 is described in **Sections G.2.1** through **G.2.4**. Performance of Alternatives 4R and 4R2 are described in **Sections G.2.5** through **G.2.8**.

Additional analyses of alternative performance are provided in the system-wide RECOVER evaluation (**Annex E**).

G.2.1 Northern Estuaries (Alternatives 1-4)

The Caloosahatchee and St. Lucie Estuaries both receive excessive discharges from Lake Okeechobee as well as their local basins during wet years, and suffer from too little discharge on excessively dry years. Alternative performance in the Northern Estuaries was measured by evaluating the frequency and magnitude of freshwater inflows from Lake Okeechobee and the estuary watersheds. Flow targets are outlined under the RECOVER salinity performance measure. These targets were developed to achieve desired salinity ranges in the estuaries to meet the needs of key indicator species such as oysters and submerged aquatic vegetation. Within the Caloosahatchee Estuary, targets were based on freshwater discharges from the C-43 canal at the S-79 structure where the mean monthly inflow should be maintained between 450 and 2,800 cfs. Flows less than 450 cfs are considered harmful since these flow levels allow salt water to intrude, raising salinity above the tolerance limits for communities of submerged aquatic vegetation in the upper estuary. Flows greater than 2800 cfs cause mortality of marine seagrasses and oysters in the lower estuary and at flows greater than 4500 cfs, seagrasses begin to decline in San Carlos Bay (See **Section G.1.5.1.1**). Within the St. Lucie Estuary, targets were based on freshwater discharges at the S-80, S-48, S-49 and Gordy road structures where the target frequency of mean biweekly flows should be maintained between 350 and 2,000 cfs. Based on the salinity tolerances of oysters, flows less than 350 cfs result in higher salinities at which oysters are susceptible to increased predation and disease. Flows in the 350-2000 cfs range produce tolerable salinities. Flows greater than 2000 cfs result in low, intolerable salinity within the estuary. Flows greater than 3000 cfs damage seagrasses in the Indian River Lagoon (See **Section G.1.5.1.2**). Targets were developed to reduce minimum discharges and mediate high flow events to the estuaries to improve estuarine water quality and protect and enhance estuarine habitat and biota.

Table G-4 and **Table G-5** show performance measure scores on a zero to 100 scale for the Caloosahatchee and St. Lucie Estuaries. The percent of target HUs achieved by a given alternative for each zone is also noted.

Table G-4. Rescaled Performance Measure Scores (Zero to 100 Scale) for Caloosahatchee Estuary (Zone CE-1) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1-4
6.1	Low Flow (< 450 cfs)	4	78	78
6.2	High Flow (>2800 cfs)	4	17	31
	Percentage of Target HU (HSI x 100)	**4**	**48**	**55**

Table G-5. Rescaled Performance Measure Scores (Zero to 100 Scale) for St. Lucie Estuary (Zone SE-1) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1-4
7.1	Low Flow (< 350 cfs)	14	9	0
7.2	High Flow (>2000 cfs)	14	22	64
	Percentage of Target HU (HSI x 100)	**14**	**16**	**32**

In the Caloosahatchee Estuary, the FWO scored better in terms of meeting the desired performance measure targets relative to the ECB (**Table G-4**). The number of times mean monthly flows greater than 2,800 cfs were not met occurred 94 times for the ECB (**Figure G-10**). The number of times mean monthly flows greater than 2,800 cfs were not met for the FWO occurred 81 times. The number of times mean monthly flows less than 450 cfs were not met occurred 116 times for the ECB; 27 for the FWO (**Figure G-10**).

In the St. Lucie Estuary, the FWO scored better in terms of meeting the desired performance measure targets relative to the ECB (**Table G-5**). The number of times flows greater than 2,000 cfs from Lake Okeechobee regulatory releases were not met occurred 72 times for the ECB; 65 for the FWO (**Figure G-11**). The number of times flows less than 350 cfs were not met occurred 89 times for the ECB; 92 for the FWO (**Figure G-11**).

The FWO assumes the implementation of the C-43 Western Basin Storage Reservoir in the Caloosahatchee Estuary and the Indian River Lagoon South Project within the St. Luce Estuary. Differences in the number of times salinity criteria are not met between the ECB and FWO are likely attributable to the operation of these projects.

Modeling results of the CEPP alternatives indicate a reduction in the number of high discharge events from Lake Okeechobee to the Northern Estuaries. Within the Caloosahatchee Estuary, the number of times mean monthly flows greater than 2,800 cfs were not met decreased from 81 in the FWO to 68 with implementation of Alternatives 1-4. Within the St. Lucie Estuary, the number of times biweekly flows greater than 2,000 cfs from Lake Okeechobee regulatory releases were not met decreased from 65 in the FWO to 30 with implementation of Alternatives 1-4 (**Figure G-11**). Alternatives 1-4 maintained the number of low discharge events to the Caloosahatchee Estuary in comparison to the FWO. The number of low discharge events to the St. Lucie Estuary increased to 122 in comparison to the FWO which was roughly 92. The increase in these events is not expected to have a significant effect on vegetation and/or fish and wildlife resources (See **Section 5** and **Appendix C.2.1**).

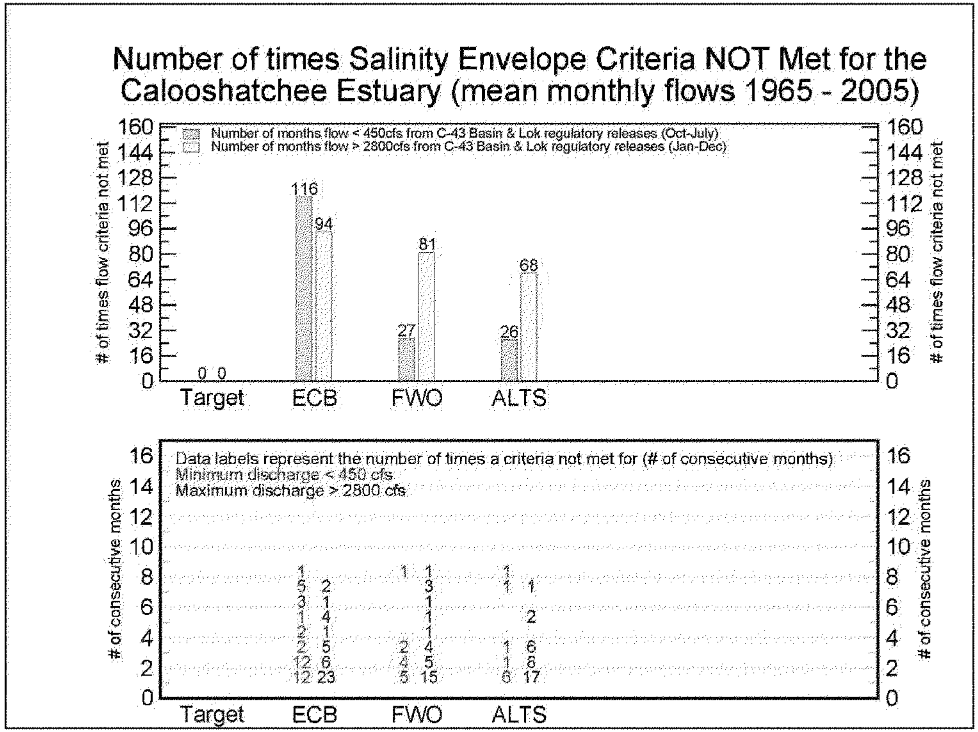


Figure G-10. Number of Times Salinity Criteria Not Met for the Caloosahatchee Estuary for Alternatives 1-4

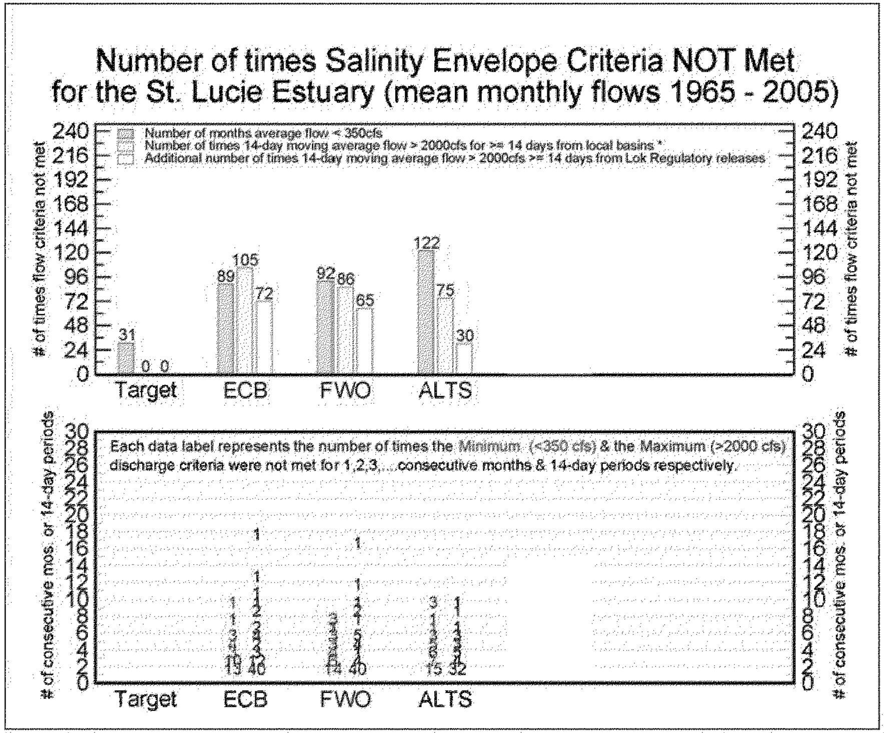


Figure G-11. Number of Times Salinity Criteria Not Met for the St. Lucie Estuary for Alternatives 1-4

Increases in low flow violations during the dry season were indicated by the modeling effort; however, due to the infrequency of the increases in these events is not expected to have a significant effect on SAV and oysters within the St. Lucie Estuary. Although these extreme dry spells are rare in the SLE, unlike the CRE they can occur and therefore supplemental flows during dry times may be warranted and have been accounted for in the IRLS water reservation process. If additional low flow canal releases become needed the preferred delivery path would be through the North Fork of the St. Lucie River as was modeled during the Indian River Lagoon South CERP project and not from the S-80 on the C-44 canal.

Flows that are altered beyond historic conditions have negatively impacted healthy floral and faunal communities. Historically, natural freshwater discharges into the Caloosahatchee and St. Lucie Estuaries sustained an ecologically appropriate range of salinity conditions to facilitate the presence of juvenile marine fish, shellfish, oysters and submerged aquatic vegetation. Current water management practices have resulted in rapid salinity changes and a shift in the ecological components that historically defined the estuaries to communities that have been deemed less desirable.

The area within the Caloosahatchee and St. Lucie Estuaries that has the potential to be beneficially affected by the project is 70,979 acres for the Caloosahatchee Estuary and 14,994 acres for the St. Lucie Estuary. Implementation of Alternatives 1-4 would achieve 55% and 22% of the target HUs for the Caloosahatchee and St. Lucie Estuaries respectively (**Table G-4** and **Table G-5**). The FWO would achieve 48% of the target HUs for the Caloosahatchee Estuary and 21% for the St. Lucie Estuary (**Table G-4** and **Table G-5**). Although the improvements in flows to the Northern Estuaries is small when CEPP is added onto the FWO as compared to the overall goal of CERP, the additional increment of improvement is one step closer to meeting restoration goals for the Northern Estuaries. Implementation of the CEPP would help to maintain the target frequency and duration of water releases to the Northern Estuaries and would help curtail continued habitat loss and allow the recovery of more desirable communities.

G.2.2 WCA 3 and ENP (Alternatives 1-4)

In the pre-drainage system, the inundation pattern supported an expansive system of freshwater marshes including longer hydroperiod sawgrass "ridges" interspersed with open-water "sloughs", higher elevation marl prairies on either side of Shark River Slough, and forested wetlands in the Big Cypress marsh. Flood control and water supply projects have compartmentalized and fragmented the Everglades landscape, reduced flows through the sloughs, and altered hydroperiod and depths. The result has been substantially altered plant community structures, reduced abundance and diversity of animals, and spread of exotic vegetation. The desired restoration condition is to restore pre-drainage patterns of multiyear hydroperiods and pre-drainage patterns of sheetflow.

G.2.2.1 Northern WCA 3A (Zones 3A-NW, 3A-MC, 3A-NE) (Alternatives 1-4)

The Miami Canal functions as a major, unnatural drainage for WCA 3A. In combination with the northern levees of WCA 3A (L-4 and L-5), the Miami Canal has substantially impacted historical sheetflow and natural wetland hydroperiods. As a result the natural capability of northern WCA 3A to store water is lost and the Miami Canal effectively over-drains the area. These hydrologic changes have increased the frequency of severe peat fires and have also resulted in the loss of ridge and slough topography that was once characteristic of the area. Most of WCA 3A north of Interstate 75 has experienced some form of fire and in more recent years those fires have moved farther south into the western portion of WCA 3A. Today, northern WCA 3A is largely dominated by sawgrass, cattail and scattered shrubs and lacks the structural diversity of plant communities seen in central and western WCA 3A. Alternatives for the CEPP consist of variations of the length and placement of a hydropattern restoration feature along the northern levees of WCA 3A and the length of backfill of the Miami Canal. Implementation of the CEPP is expected to rehydrate much of northern WCA 3A by providing a means for redistributing treated STA discharges from the L-4 and L-5 in a manner that promotes sheetflow and by removing the drainage effects associated with the Miami Canal. Resumption of sheetflow and related patterns of hydroperiod and water depth will significantly help to restore and sustain the microtopography, directionality, and spatial extent of ridges and sloughs and improve the health of tree islands in the ridge and slough landscape.

In northern WCA 3A, the ECB scored better in terms of meeting the desired performance measure targets relative to the FWO (**Table G-6**, **Table G-7**, and **Table G-8**).

Alternatives 1-4 improved hydrologic conditions in northern WCA 3A in comparison to the FWO by increasing depths and resulting hydroperiods within the area. Alternatives scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation suitability ((**Table G-6**, **Table G-7**, and **Table G-8**). Pertaining to slough vegetation suitability, greater performance was noted with regard to maximizing continuous hydroperiods (days with depth ≥ 0.0 ft) and minimizing dry down events below 0.7 ft. Scores for these performance measures fell within the 75 to 100 range for all alternatives. Alternatives 1-4 were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing and distribution of sheetflow. Scores for these performance measures ranged from 25 to 68.

Variation in the distribution of inflows into northern WCA 3A and backfill of the Miami Canal did not significantly influence performance among alternatives. Differences in hydrologic improvements between Alternatives 1-4 were modest relative to the differences of the alternatives to the FWO. Slight differences occurred in northwestern WCA 3A (Zone 3A-NW); Alternative 1 scored the highest in terms of meeting the desired performance measure targets within this area (**Table G-6**). Differences in hydrologic improvements between Alternatives 1-4 at this location may be a direct consequence of the variation in the distribution of inflows into northern WCA 3A. Alternative 1 delivered a larger volume of water to this region of the project area.

Table G-6. Rescaled Performance Measure Scores (Zero to 100 Scale) for Northwestern WCA 3A (Zone 3A NW) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	63	61	96	94	94	94
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	20	19	33	31	31	31
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	4	4	63	62	62	62
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	24	18	68	67	67	67
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	63	63	99	97	97	97
5.1	Slough Vegetation Suitability -- Hydroperiod	46	46	80	79	79	79
5.2	Slough Vegetation Suitability -- Dry down	51	48	86	84	84	84
5.3	Slough Vegetation Suitability -- Dry Season Depth	22	19	40	36	36	36
5.4	Slough Vegetation Suitability -- Wet Season Depth	22	20	48	45	44	45
	Percentage of Target HU (HSI x 100)	**44**	**43**	**78**	**76**	**76**	**76**

Table G-7. Rescaled Performance Measure Scores (Zero to 100 Scale) for WCA 3A Miami Canal (Zone 3A MC) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	55	45	93	92	91	92
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	18	17	30	28	28	28
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	4	4	63	62	62	62
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	28	23	62	63	63	63
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	52	44	85	82	81	83
5.1	Slough Vegetation Suitability -- Hydroperiod	42	35	77	76	75	76
5.2	Slough Vegetation Suitability -- Dry down	63	50	87	86	86	87
5.3	Slough Vegetation Suitability -- Dry Season Depth	37	32	52	50	50	51
5.4	Slough Vegetation Suitability -- Wet Season Depth	40	32	55	53	53	54
	Percentage of Target HU (HSI x 100)	**42**	**35**	**74**	**73**	**72**	**73**

Table G-8. Rescaled Performance Measure Scores (Zero to 100 Scale) for Northeastern WCA 3A (Zone 3A NE) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	40	25	99	99	99	99
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	16	15	27	25	25	25
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	6	4	61	59	59	59
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	18	17	57	59	59	59
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	50	26	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	38	27	75	78	77	78
5.2	Slough Vegetation Suitability -- Dry down	58	51	86	87	87	88
5.3	Slough Vegetation Suitability -- Dry Season Depth	35	30	48	49	49	50
5.4	Slough Vegetation Suitability -- Wet Season Depth	30	26	47	48	48	49
	Percentage of Target HU (HSI x 100)	**36**	**24**	**78**	**78**	**78**	**78**

Alternative 1 generally produced improved inundation patterns in northwestern WCA 3A. Indicator region 114 was inundated for 92% of the period of record for Alternative 1; a 19% increase in inundation duration relative to the FWO. Alternatives 2-4 inundated this location for 91% of the period of record; a 18 % increase relative to the FWO. Alternative 1 generally produced higher depths within northwestern WCA 3A as depicted by the normalized weekly stage duration curve for IR 114 (**Figure G-12**); an example IR for Zone 3A-NW. Depths were significantly increased on average by 0.6 to 0.8 ft relative to the FWO. Alternatives 2-4 significantly increased depths on average by 0.5 to 0.7 ft at this location. Improvements in depth of water below ground surface were also noted. Cumulative drought intensity is the sum of the daily depth of stage below ground (negative ponded depth) across the period of record. Alternative 1 reduced drought intensity at IR 114 over the period of record by 1,081 ft-days relative to the FWO. Alternatives 2-4 provided a reduction of 1,010 ft-days over the period of record at this location. Improved inundation patterns in northwestern WCA 3A resulted in better suitability for slough vegetation for Alternative 1. Alternative 1 provided slightly improved conditions for slough vegetation relative to Alternatives 2-4 by increasing hydroperiods and reducing the duration of dry down events below 0.7 feet, as shown for IR 114 in **Figure G-13**. None of Alternatives 1-4 met the desired dry and wet season water depths for slough vegetation in northwestern WCA 3A; however, Alternative 1 slightly improved conditions for slough vegetation relative to Alternatives 2-4 by increasing water depths in both the wet and dry season at this location. Patterns of alternative performance were similar at IRs 117 and 121; however differences between Alternatives 1-4 were less notable at IR 121 which is located farther from the L-4/L-5 boundary.

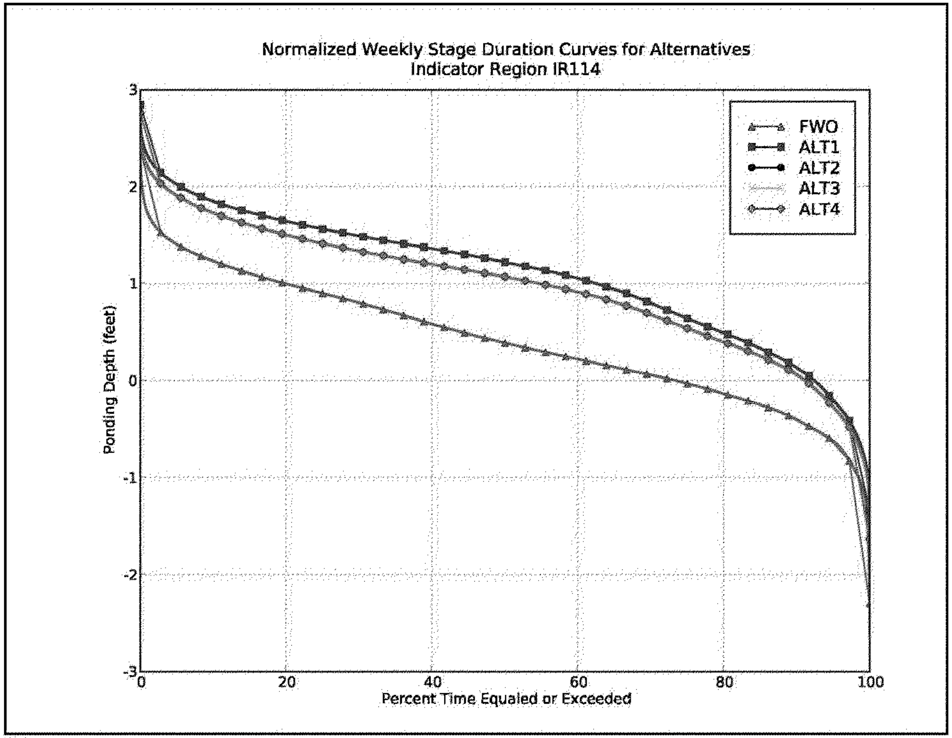


Figure G-12. Normalized Weekly Stage Duration Curve for Indicator Region 114 for Alternatives 1-4

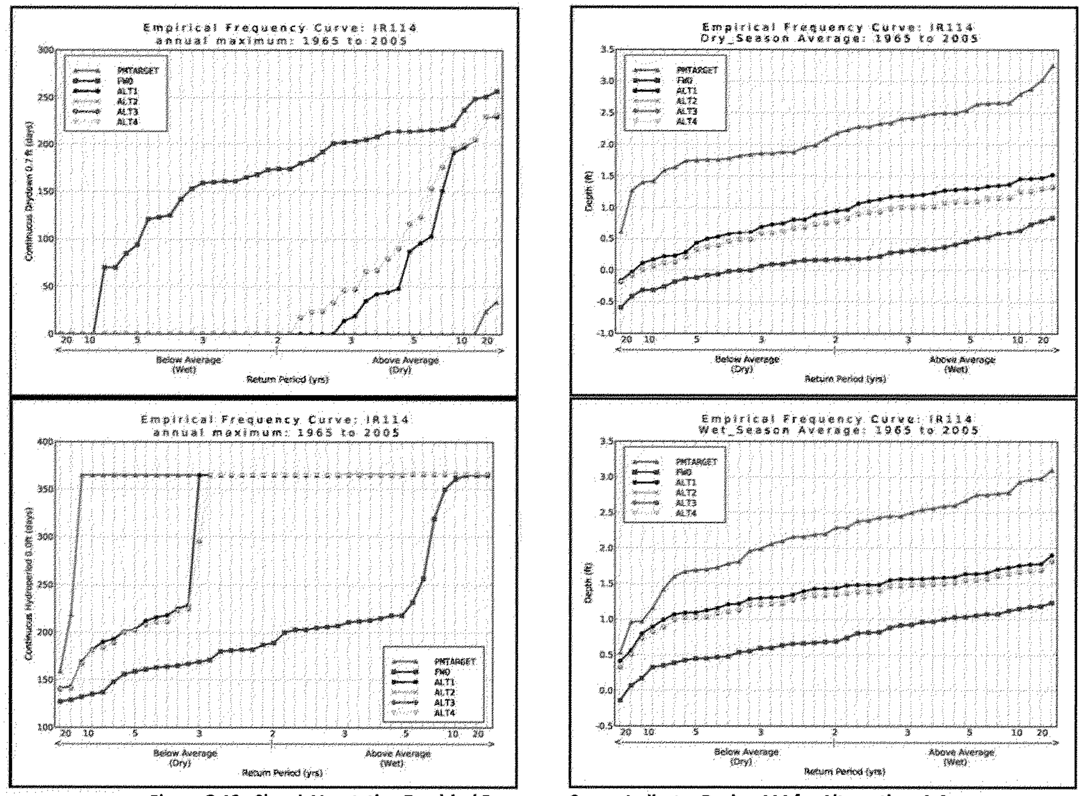


Figure G-13. Slough Vegetation Empirical Frequency Curves Indicator Region 114 for Alternatives 1-4

Alternatives 1-4 scored similarly in northeastern WCA 3A (Zone 3A-NE) (**Table G-8**). Alternatives 2-4 generally produced improved inundation patterns in northeastern WCA 3A in IRs located directly south of the eastern-most spreader located approximately 1.5 miles east of the G-206 structure. Alternatives 2-4 produced higher depths at IR 116 as depicted by the normalized weekly stage duration curve (**Figure G-14**); an example IR for Zone 3A-NE. Depths were significantly increased on average by 0.5 to 0.8 ft relative to the FWO with no significant change during extreme wet conditions and a slight increase in depth for extreme dry conditions. Alternative 1 significantly increased depths on average by 0.4 to 0.7 ft at this location. Alternatives 2-4 performed better for measures of inundation duration, drought intensity, and slough vegetation suitability. Alternative 1 produced slightly better performance for measures of sheetflow (*i.e.* timing and continuity) resulting in equivalent percent of target HUs achieved for this region of the project area (**Table G-8**). This suggests that a hydropattern restoration feature located west of the S-8 structure as modeled for Alternative 1 is sufficient in hydrating and improving sheetflow in this region relative to Alternatives 2-4.

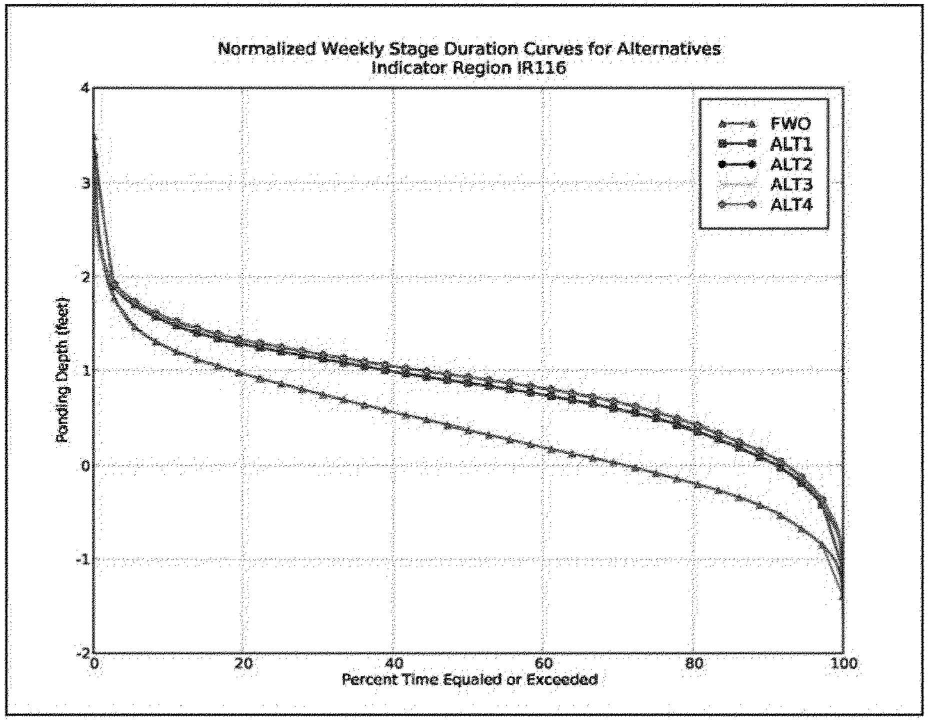


Figure G-14. Normalized Weekly Stage Duration Curve for Indicator Region 116 for Alternatives 1-4

If drainage and disrupted sheetflow continues as a result of the drainage effects of the Miami Canal within northern WCA 3A, further ridge and slough degradation and peat loss is expected due to continued increases in the frequency of fires and oxidation and decreased inundation durations. Reversal of soil loss and restoration of organic soil accretion will only be achieved through reducing the percent of time that soils are dry and vulnerable to fires. Hydrology in northern WCA 3A will be significantly affected by the implementation of CEPP. Alternative performance in WCA 3 and ENP was measured by evaluating the depth, distribution, and duration of surface flooding, and the timing and distribution of flows. Of the performance measures used, scores for Alternatives 1-4 for measures of inundation duration ranged from 87% of the period of record to 96% of the period of record across northern WCA 3A (**Table G-9**). Inundation duration for the FWO ranged from 60% of the period of record to 95% of the period of record (**Table G-9**). Reductions in drought intensity in northern WCA 3A relative to the FWO ranged from 8 to 6000 ft-days over the period of record (**Table G-10**).

Table G-9. Percent Period of Record of Inundation for Alternatives 1-4 (Raw Performance Measure Scores)

Zone	Indicator Region	FWO	ALT1	ALT2	ALT3	ALT4
Zone 3A-NW	IR 114	73	92	91	91	91
	IR 117	91	95	95	95	95
	IR 121	93	96	96	96	96
Zone 3A-MC	MC NE 1	64	94	94	94	94
	MC NE 2	60	96	95	95	95
	MC NW 1	75	94	93	93	93
	MC NW 2	72	91	90	90	90
	MC CE 1	79	93	93	93	93
	MC CE 2	72	88	88	87	88
	MC CW 1	83	92	91	91	91
	MC CW 2	88	95	94	94	94
	MC SE 1	92	94	94	94	94
	MC SE 2	93	91	91	90	91
	MC SW 1	91	93	92	92	93
	MC SW 2	91	94	94	94	94
Zone 3A-NE	IR 115	68	93	94	94	94
	IR 116	71	91	92	92	92
	IR118	77	91	91	91	91
	IR 119	95	96	96	96	96
	IR 190	73	92	93	93	93

Table G-10. Hydrologic Surrogate for Soil Oxidation (Water Depth Relative to Land Surface Elevation Ft-Days Below Ground) for Alternatives 1-4 (Raw Performance Measure Scores)

Zone	Indicator Region	FWO	ALT1	ALT2	ALT3	ALT4
Zone 3A-NW	IR 114	-1431	-350	-421	-421	-421
	IR 117	-461	-227	-255	-255	-255
	IR 121	-256	-140	-159	-159	-158
Zone 3A-MC	MC NE 1	-2172	-274	-260	-260	-260
	MC NE 2	-6218	-162	-212	-212	-212
	MC NW 1	-1398	-275	-345	-345	-345
	MC NW 2	-1752	-527	-622	-622	-622
	MC CE 1	-1206	-395	-393	-393	-391
	MC CE 2	-2911	-1284	-1360	-1397	-1314
	MC CW 1	-1040	-508	-551	-554	-545
	MC CW 2	-603	-259	-287	-287	-287
	MC SE 1	-447	-346	-367	-380	-340
	MC SE 2	-590	-956	-1030	-1084	-954
	MC SW 1	-533	-458	-506	-525	-476
	MC SW 2	-473	-294	-325	-331	-314
Zone 3A-NE	IR 115	-1861	-347	-298	-298	-298
	IR 116	-1705	-431	-367	-367	-365
	IR118	-1545	-502	-484	-486	-468
	IR 119	-172	-133	-156	-164	-131
	IR 190	-1417	-364	-318	-320	-316

The delivery of additional flow to the Everglades compared to the FWO would return many of the currently dehydrated areas to a level of hydration which moves toward the natural system condition. All alternatives act to rehydrate northern WCA 3A promoting peat accretion, reducing the potential for high intensity fires, and promoting the transition from upland to wetland vegetation. Implementation of Alternatives 1-4 would achieve 76-78% of the target HUs for Zone 3A-NW (**Table G-6**), 72-74% of the target HUs for Zone 3A-MC (**Table G-7**), and 78% of the target HUs for Zone 3A-NE (**Table G-8**). The FWO would achieve 43%, 35%, and 24% of the target HUs for Zones 3A-NW, 3A-MC, and 3A-NE respectively (**Table G-6**, **Table G-7**, and **Table G-8**).

G.2.2.2 Central and Southern WCA 3A (Zone 3A-C, 3A-S) (Alternatives 1-4)

Central WCA 3A is considered to be fairly well conserved ridge and slough habitat. Vegetation and patterning in the central portion of WCA 3A resembles the pre-drainage conditions most closely and represents some of the best examples of Everglades habitat left in south Florida. This region of the Everglades appears to have changed little since the 1950s (which was already post-drainage) and contains a mosaic of tree islands, wet prairies, sawgrass stands, sawgrass ridges, and aquatic sloughs.

In central WCA 3A, the ECB scored better in terms of meeting the desired performance measure targets relative to the FWO (**Table G-11**). The FWO generally produced decreased depths relative to the ECB.

Depths were generally decreased by 0.1 to 0.2 feet, with no significant change during extreme wet or extreme dry conditions.

Alternatives 1-4 provided slight improvements in hydrologic conditions in comparison to the FWO (**Table G-11**). Alternatives 1-4 produced slightly higher depths than the FWO as depicted by the normalized weekly stage duration curve for IR 122 (**Figure G-15**); an example IR for Zone 3A-C. Depths in central WCA 3A are generally increased by 0.1 to 0.2 ft during average to dry conditions, with a slight depth reduction during the wettest 10% of conditions and no significant change during extreme dry conditions. Increases in depth within central WCA 3A were not as significant as increases in observed depths relative to the FWO in northern WCA 3A; however maintenance of existing conditions within this region of the project area is desirable as ridge and slough habitat is well conserved. Implementation of Alternatives 1-4 would achieve 80% of the target HUs for Zone 3A-C (**Table G-11**). The FWO would achieve 77% of the target HUs (**Table G-11**).

Table G-11. Rescaled Performance Measure Scores (Zero to 100 Scale) for Central WCA 3A (Zone 3A C) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	100	100	100	100	100	100
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	42	43	46	46	45	46
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	63	60	64	65	65	65
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	100	100	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	74	72	82	80	78	80
5.2	Slough Vegetation Suitability -- Dry down	88	85	91	89	90	89
5.3	Slough Vegetation Suitability -- Dry Season Depth	42	37	43	41	41	42
5.4	Slough Vegetation Suitability -- Wet Season Depth	42	38	48	46	46	47
	Percentage of Target HU (HSI x 100)	**79**	**77**	**80**	**80**	**80**	**80**

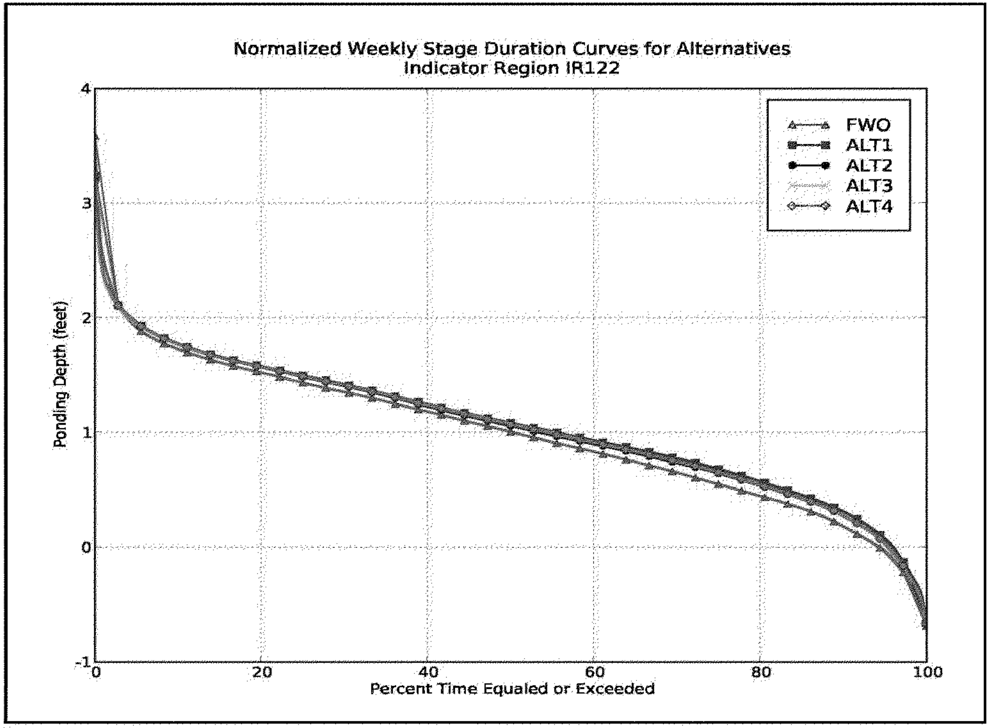


Figure G-15. Normalized Weekly Stage Duration Curve for Indicator Region 122 for Alternatives 1-4

The southern portion of WCA 3A is primarily affected by long durations of high water and a lack of seasonal variability in water depths created by impoundment structures (*i.e.* L-29 levee). The increased duration of high water events within southern WCA 3A has negatively impacted tree islands and caused fragmentation of the sawgrass ridges, again resulting in the loss of historic landscape patterning.

In southern WCA 3A, the ECB scored better in terms of meeting the desired performance measure targets relative to the FWO (**Table G-12**). The FWO generally produced decreased depths by 0.2 to 0.3 feet with no significant change during extreme wet or extreme dry conditions.

Within southern WCA 3A, Alternatives 1-4 scored similarly to the FWO in terms of meeting the desired targets for each of the performance measures (**Table G-12**). Alternatives 1-4 produced similar depths to the FWO as depicted by the normalized weekly stage duration curve for IR 124 (**Figure G-16**); an example IR for Zone 3A-S. It should be noted that Alternatives 1-4 performed slightly worse for measures of slough vegetation suitability relative to the FWO (**Table G-12**). Performance with respect to this metric can best be explained by the operational targets that were used during plan formulation. Daily water management operations (WCA 3A Regulation Schedule) in WCA 3A are based on a 3 gauge average. These gauges are located in northeast, central and southern WCA 3A. Operational targets used during plan formulation aimed at keeping depth targets at existing conditions in central WCA 3A as it contains some of the best remaining ridge and slough habitat. In northeastern WCA 3A where conditions tend to be too dry, depth targets were increased relative to existing conditions. In southern WCA 3A, where water is often too deep, depth targets were slightly decreased relative to existing conditions. This "pivot" around central WCA 3A minimized the increase of overall average water depths in WCA 3A. This resulted in slightly lower scores for the slough vegetation performance measure within southern WCA 3A which would indicate a potential shift toward conditions that are less suitable for emergent slough habitat.

However, significant shifts in slough vegetation within this region of the project area are not expected as a result of implementation of Alternatives 1-4. Prolonged high water levels currently experienced during both the wet and dry seasons have resulted in the loss of slough vegetation within southern WCA 3A. Implementation of Alternatives 1-4 would not significantly reduce the high water levels experienced in southern WCA 3A when compared with current water management practices.

Implementation of Alternatives 1-4 would achieve 82-83% of the target HUs for Zone 3A-S (**Table G-12**). The FWO would achieve 83% of the target HUs (**Table G-12**).

Table G-12. Rescaled Performance Measure Scores (Zero to 100 Scale) for Southern WCA 3A (Zone 3A S) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	100	100	100	100	100	100
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	45	47	50	50	48	50
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	60	59	61	58	59	60
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	100	100	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	84	82	82	80	79	82
5.2	Slough Vegetation Suitability -- Dry down	100	95	93	93	93	93
5.3	Slough Vegetation Suitability -- Dry Season Depth	82	73	73	70	71	72
5.4	Slough Vegetation Suitability -- Wet Season Depth	71	64	62	59	61	62
	Percentage of Target HU (HSI x 100)	**84**	**83**	**83**	**82**	**82**	**83**

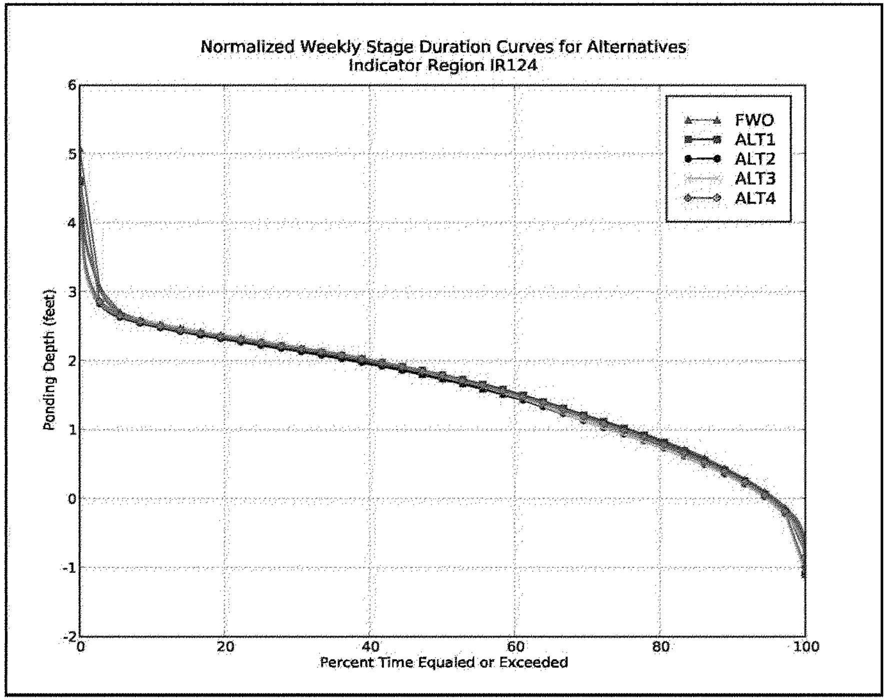


Figure G-16. Normalized Weekly Stage Duration Curve for Indicator Region 124 for Alternatives 1-4

G.2.2.3 WCA 3B (Zone 3B) (Alternatives 1-4)

Within WCA 3B, the ridge and slough landscape has been severely compromised by the virtual elimination of overland sheetflow since the construction of the L-67 Canal and Levee system. WCA 3B has become primarily a rain-fed compartment, experiencing very little overland flow and has largely turned into a sawgrass monoculture where relatively few sloughs or tree islands remain. Loss of sheetflow to WCA 3B has also accelerated soil loss reducing elevations of the remaining tree islands in WCA 3B, making them vulnerable to high water stages. Alternatives for the CEPP consist of variations in the construction of conveyance features on the L-67 A, C and L-29 levees in addition to variations in levee removal. Alternatives for the CEPP also include operational modifications to existing structures and the construction of seepage management features. Implementation of the CEPP is expected to begin to re-establish hydrologic connectivity of WCA 3A, WCA 3B, and ENP.

In WCA 3B, the ECB scored better in terms of meeting the desired performance measure targets relative to the FWO (**Table G-13**). The FWO generally produced lower depths within WCA 3B. Depths were decreased by 0.1 to 0.2 feet during normal to dry conditions.

Alternatives 1-4 improved hydrologic conditions in WCA 3B in comparison to the FWO by increasing depths and resulting hydroperiods within the area. Alternatives 1-4 scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation suitability (**Table G-13**). Pertaining to slough vegetation suitability, greater performance was noted with regard to maximizing continuous hydroperiods (days with depth ≥ 0.0 ft) and minimizing dry down events below 0.7 ft. Scores for these performance measures ranged from 74 to 97. Alternatives 1-4 were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing and distribution of sheetflow. Scores for these performance measures ranged from 0 to 58.

Table G-13. Rescaled Performance Measure Scores (Zero to 100 Scale) for WCA 3B (Zone 3B) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	86	76	93	97	95	88
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	0	0	0	0	0	2
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	41	35	36	33	29	27
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	56	58	35	7	14	47
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	84	71	93	96	95	86
5.1	Slough Vegetation Suitability -- Hydroperiod	72	63	77	82	79	74
5.2	Slough Vegetation Suitability -- Dry down	86	80	91	95	95	88
5.3	Slough Vegetation Suitability -- Dry Season Depth	45	38	46	58	46	40
5.4	Slough Vegetation Suitability -- Wet Season Depth	28	23	34	48	35	29
	Percentage of Target HU (HSI x 100)	**65**	**57**	**68**	**69**	**67**	**64**

Poor performance was noted for measures of sheetflow. The timing, continuity, and distribution of sheetflow performance measure provides information about how flow timing and distribution within individual transects are altered by alternative project designs/operations (See **Section G.1.5.2.2**). Overland flow directionality generally showed poor alignment with landscape patterning.

Figure G-17 depicts average annual overland flow vectors for the period of record (1965-2005). These maps provide a visual representation of the movement of water over the landscape with the angle of each individual vector (arrow) representing the direction of flow and the color of the vector representing the volume of flow. Overland flow vectors for the FWO were directed toward the southeast corner of WCA 3B. Alternatives 2 and 3 produced overland flow vectors in a west to east direction. In some instances overland flow vectors were oriented in a south north direction for these two alternatives. Alternatives 1 and 4 maintained the directionality of overland flow seen in the FWO. Alternative 4 improved overland flow directionality in the southwest corner of WCA 3B west of the Blue Shanty levee where vectors were more aligned in a north to south direction. Typical Everglades vegetation, including tree islands, wet prairies, sawgrass marshes, and sloughs occur throughout WCA 3B. Increases in depths and resulting hydroperiods would promote wetland vegetation transition, through contraction of sawgrass marshes and expansion of wet prairies. Poor alignment of overland flow with landscape patterning would have potential effects on what ridge and slough landscape currently remains within WCA 3B. Sheetflow plays an essential role in maintaining the directionality, and spatial extent of ridges and sloughs. Poor alignment of overland flow could impact microtopography within WCA 3B by reducing the current differences in elevations between ridges and sloughs. Approximately one-third of all tree islands within WCA 3B are elevated only 0.7-1.1 feet above the surrounding marsh. Tree islands within WCA 3B may also suffer from inundation and prolonged high water periods that may induce stress.

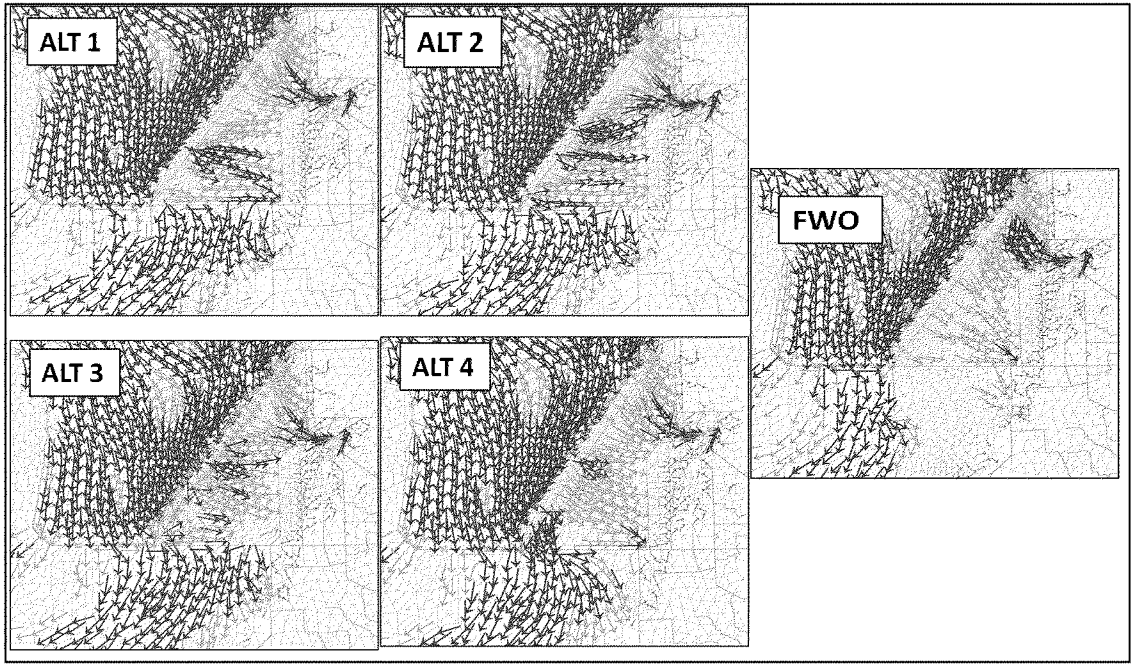


Figure G-17. Average Annual Overland Flow Vectors (1965-2005) for the FWO and Alternatives 1-4

In comparison to other regions of the project area where differences in hydrologic improvements between Alternatives 1-4 were modest, alternative performance varied greatly in WCA 3B. Alternative 2 scored the highest in terms of meeting the desired performance measure targets within this area (**Table G-13**), followed by Alternatives 1 and 3. Alternative 4 performed poorly relative to the other alternatives.

Alternative 2 generally produced improved inundation patterns in WCA 3B. Indicator region 128 was inundated for 95% of the period of record for Alternative 2; an 11% increase in inundation duration relative to the FWO. Alternatives 3, 1, and 4 inundated this location for 94%, 93%, and 90% of the period of record respectively. Alternative 2 generally produced higher depths within WCA 3B as depicted by the normalized weekly stage duration curve for IR 128 (**Figure G-18**); an example IR for Zone 3B. Depths were significantly increased on average by 0.2 to 0.4 ft relative to the FWO under all hydrologic conditions. Alternative 3 significantly increased depths by 0.2 to 0.3 feet during the wettest 10% of conditions and during dry to normal conditions. Alternative 1 increased depths by 0.1 to 0.2 feet during the wettest 10% of conditions and during normal to dry conditions. Alternative 4 slightly increased depths during the wettest 10% of conditions and increased by 0.1 to 0.2 feet during normal to dry conditions. Alternative 2 reduced drought intensity at IR 128 over the period of record by 842 ft-days relative to the FWO. Alternatives 3, 1, and 4 provided reductions of 810 ft-days, 763 ft-days, and 499 ft-days over the period of record at this location.

Alternative 2 provided slightly improved conditions for slough vegetation relative to Alternatives 3, 1, and 4 by increasing hydroperiods and reducing the duration of dry down events below 0.7 feet, as shown for IR 128 in **Figure G-19**. None of Alternatives 1-4 met the desired dry and wet season water depths for slough vegetation in WCA 3B. Patterns of alternative performance were similar at IRs 125 and 126.

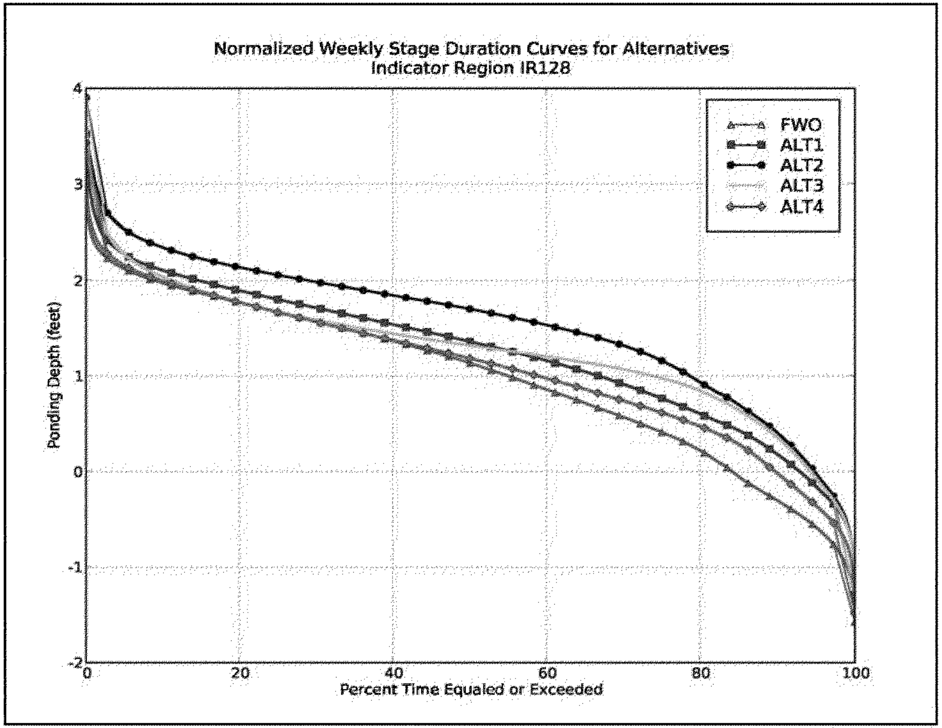


Figure G-18. Normalized Weekly Stage Duration Curve for Indicator Region 128 for Alternatives 1-4

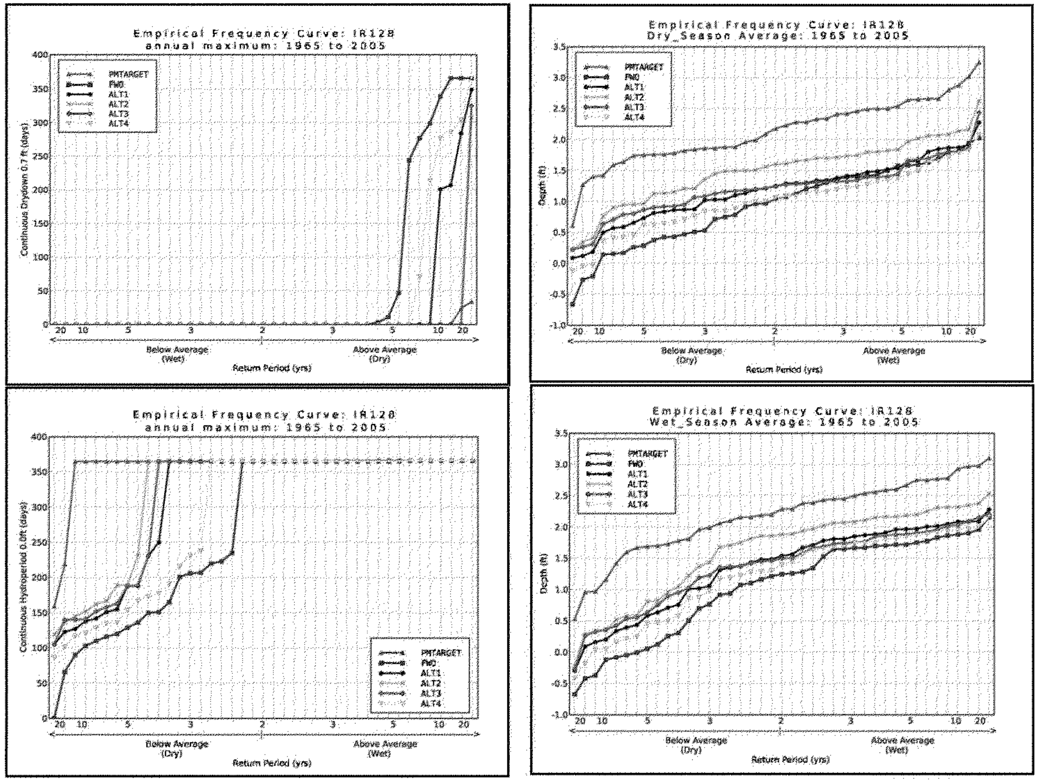


Figure G-19. Slough Vegetation Empirical Frequency Curves Indicator Region 128 for Alternatives 1-4

Observed patterns of hydrology can best be explained by the current topography within WCA 3B and the influence of adjacent canal stages. Water stages and depths in WCA 3B are typically much lower than water stages and depths in WCA 3A due to limited surface water inflows into WCA 3B and the reduction of seepage from WCA 3A to WCA 3B due to the design of the L-67 canal and levee system. Water levels in WCA 3B are affected by seepage losses to the east towards the L-30 borrow canal and to the south towards the L-29 canal. Stages within the L-29 canal must be lower than those in the adjacent marsh in order for water to pass southward into ENP. Alternatives 4 allowed water to pass southward from WCA 3B into ENP as a result of the additional pump stations located on the L-29 and the removal of the L-29 levee west of where it intersects the Blue Shanty levee.

It must be noted that there are no IRs west of the Blue Shanty levee within WCA 3B to capture the potential benefits of the flow-way generated by Alternative 4. Performance measure scores within WCA 3 and ENP are generated from hydrologic output from the RSM-GL using IRs and/ or flow transects. The location of these IRs were determined prior to the formulation of CEPP alternatives. Alternative 4 produced desirable depths within the flow-way. The flow-way generated by the Blue Shanty levee increased flows through western WCA 3B (**Figure G-20**) while maintaining protective water depths (*i.e.* a reduction in extreme high water depths or wet season highs greater than 2 feet) in eastern WCA 3B (**Figure G-18**). Alternative 4 also best achieved the goal of re-establishing hydrologic and ecologic connectivity of WCA 3A, WCA 3B, and ENP by degrading the L-67 C and L-29 levees west of the Blue Shanty levee. Long, continuous and uninterrupted patterns of sheetflow from north to south are a defining characteristic of the Everglades. Overland flow vectors for Alternative 4 were oriented in a north to south direction within the flow-way created by the Blue Shanty levee.

Implementation of the Alternatives 1-4 improved inundation patterns within WCA 3B by re-hydrating much of the area. Implementation of Alternatives 1-4 would achieve 64-69% of the target HUs for Zone 3B (**Table G-13**). The FWO would achieve 57% of the target HUs (**Table G-13**).

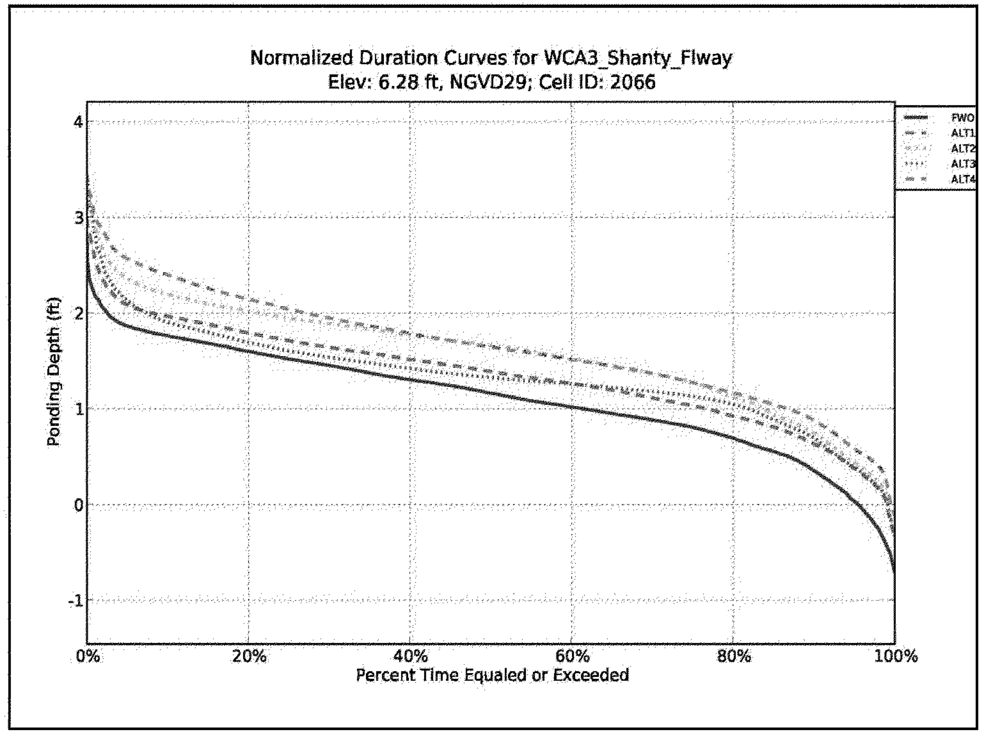


Figure G-20. Normalized Weekly Stage Duration Curve for Gage in Blue Shanty Flow-Way for Alternatives 1-4

G.2.2.4 ENP (Zones ENP-N, ENP-S, ENP-SE) (Alternatives 1-4)

Flows through Shark River Slough under current water management practices are much reduced when compared with pre-drainage conditions. The number, duration and timing of dry events are more likely to reflect the needs of urban and agricultural water supply and flood control than the natural patterns of rainfall, evaporation and transpiration. The result has been lower wet season depths and more frequent and severe dry downs in the sloughs and reduction in the extent of the important shallow water "edges". Dry downs that are too frequent or sever inhibit the productivity and resilience of animal populations, including the prey base (i.e. marsh fishes and other aquatic animals) and wading birds that depend upon them. Over-drainage in the peripheral wetlands along the eastern flank of Northeast Shark River slough (NESRS) has resulted in shifts in community composition, invasion by exotic woody species, and increased susceptibility to fire. Implementation of the CEPP is expected to rehydrate much of NESRS by providing a means for redistributing flows from WCA 3A through WCA 3B to ENP. Restoration of flow volumes will significantly improve hydroperiods and water depths while reducing the frequency and severity of dry downs.

The ECB scored better in terms of meeting the desired performance measure targets relative to the FWO within northern ENP (Zone ENP-N) (**Table G-14**). The FWO generally produced slightly reduced depths within northern ENP during normal to dry conditions. The FWO performed slightly better relative to the ECB for portions of southern and southeastern ENP (Zone ENP-S and ENP-SE) (**Table G-15**) and (**Table G-16**).

Alternatives 1-4 improved hydrologic conditions in northern and southern ENP (Zones ENP-N and ENP-S) in comparison to the FWO by significantly increasing depths and resulting hydroperiods in NESRS (**Table G-14**, and **Table G-15**). Alternatives 1-4 scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation suitability. Alternatives 1-4 also consistently improved the number and duration of dry events in NESRS in comparison to the FWO. Scores for these performance measures generally ranged from 68 to 100. Alternatives 1-4 were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing of sheetflow. Scores for these performance measures ranged from 18 to 75. Alternatives 1-4 performed similarly to the FWO in southeastern ENP (Zone ENP-SE) (**Table G-16**). Performance measure scores for slough vegetation were notably low.

Table G-14. Rescaled Performance Measure Scores (Zero to 100 Scale) for Northern ENP (Zone ENP-N) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	70	68	97	95	98	97
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	19	21	18	27	32	32
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	41	35	36	33	29	27
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	50	46	60	59	59	49
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	52	50	95	91	96	95
4.1	Number and Duration of Dry Events -- Number	68	60	90	93	95	95
4.2	Number and Duration of Dry Events -- Duration	18	26	100	100	100	100
4.3	Number and Duration of Dry Events -- PPOR	1	2	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	59	53	90	90	92	92
5.2	Slough Vegetation Suitability -- Dry down	69	69	98	99	99	100
5.3	Slough Vegetation Suitability -- Dry Season Depth	24	23	63	61	66	65
5.4	Slough Vegetation Suitability -- Wet Season Depth	15	12	74	72	75	74
	Percentage of Target HU (HSI x 100)	**46**	**44**	**82**	**81**	**83**	**82**

Table G-15. Rescaled Performance Measure Scores (Zero to 100 Scale) for Southern ENP (Zone ENP-S) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	66	65	83	83	88	92
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	30	35	52	53	57	57
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	53	51	77	77	84	89
4.1	Number and Duration of Dry Events -- Number	61	62	73	72	75	78
4.2	Number and Duration of Dry Events -- Duration	74	75	93	91	88	100
4.3	Number and Duration of Dry Events -- PPOR	51	52	84	82	73	100
5.1	Slough Vegetation Suitability -- Hydroperiod	58	58	68	68	70	75
5.2	Slough Vegetation Suitability -- Dry down	82	86	96	96	96	96
5.3	Slough Vegetation Suitability -- Dry Season Depth	31	32	40	40	43	44
5.4	Slough Vegetation Suitability -- Wet Season Depth	26	24	37	36	39	41
	Percentage of Target HU (HSI x 100)	**52**	**53**	**71**	**71**	**74**	**79**

Table G-16. Rescaled Performance Measure Scores (Zero to 100 Scale) for Southeastern ENP (Zone ENP-SE) for Alternatives 1-4

Metric #	Performance Measure Metric	ECB	FWO	ALT1	ALT2	ALT3	ALT4
1.1	Inundation Duration in the Ridge and Slough Landscape	100	100	100	100	100	100
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	13	20	24	24	24	24
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	48	48	49	49	49	49
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	100	100	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	14	11	14	14	18	15
5.2	Slough Vegetation Suitability -- Dry down	5	4	17	7	13	17
5.3	Slough Vegetation Suitability -- Dry Season Depth	1	0	1	1	1	1
5.4	Slough Vegetation Suitability -- Wet Season Depth	4	4	5	5	5	5
	Percentage of Target HU (HSI x 100)	**59**	**60**	**61**	**61**	**61**	**62**

Performance for Alternatives 1-4 was similar in northern ENP (Zone ENP-N). Alternatives 1-4 produced significantly higher depths than the FWO as depicted by the normalized weekly stage duration curve for IR 129 (**Figure G-21**); an example IR for northern ENP (Zone ENP-N). Alternatives 1-4 significantly increased depths by 0.7 to 1.0 ft under all hydrologic conditions. **Figure G-22** depicts the average annual hydroperiod distribution for the period of record (1965-2005) in ENP. NESRS is inundated on average for 300 to 330 days per year in the FWO and in some locations 240 to 300 days per year. Alternatives 1-4 improve hydroperiods in NESRS by extending periods of inundation on average to 330 to 365 days per year.

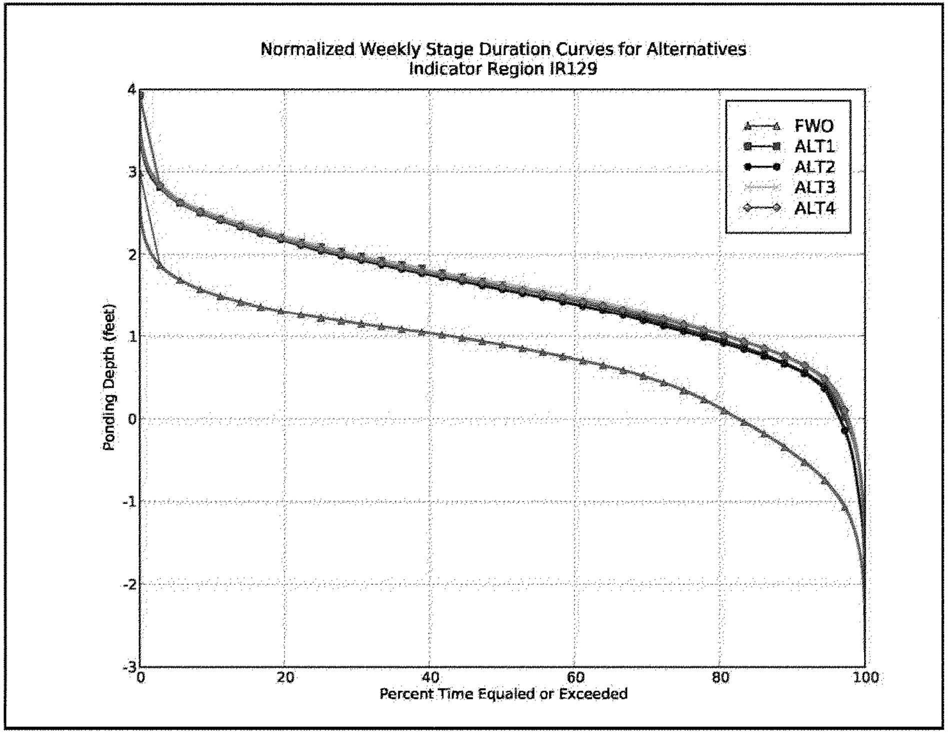


Figure G-21. Normalized Weekly Stage Duration Curve for Indicator Region 129 for Alternatives 1-4

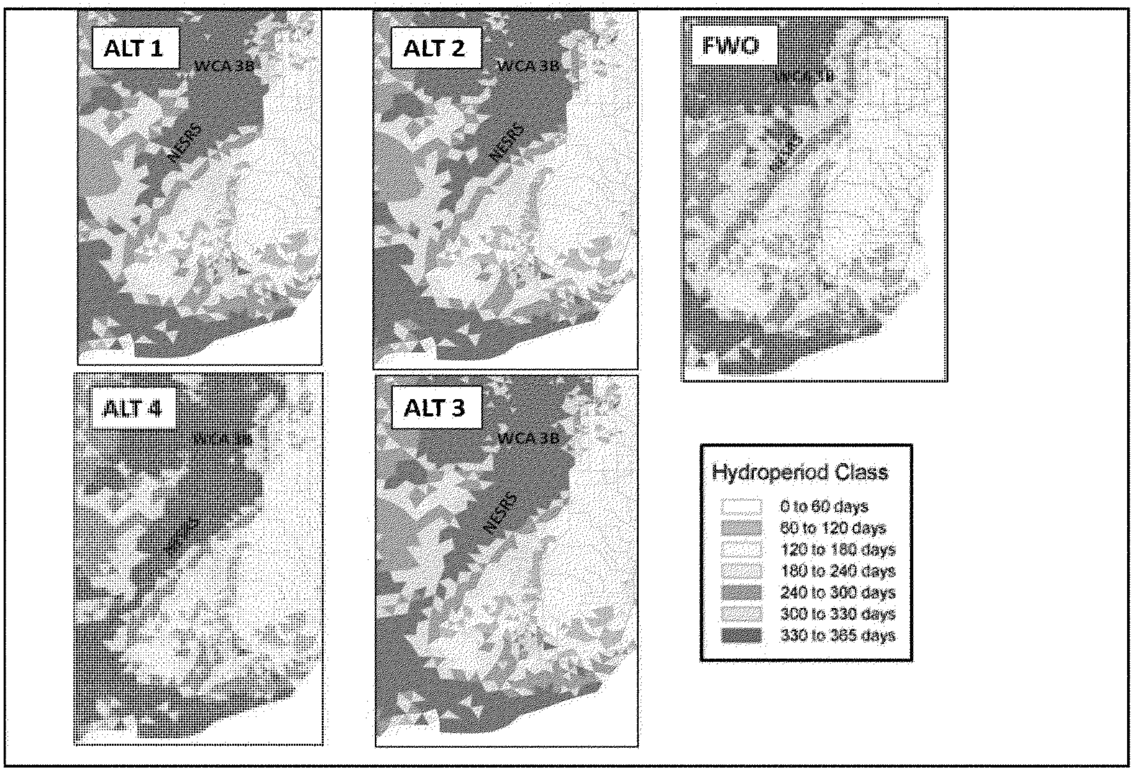


Figure G-22. Average Annual Hydroperiod Distribution for the Period of Record (1965-2005) for Alternatives 1-4

Differences in performance occurred primarily in southern ENP (Zone ENP-S). Performance for Alternatives 1-4 in southern ENP is contradictory to alternative performance in WCA 3B where Alternatives 3 and 4 performed poorly in comparison to Alternatives 1 and 2. Within southern ENP, Alternatives 3 and 4 produced slightly higher depths as depicted by the normalized weekly stage duration curve for IR 130 (**Figure G-23**); an example IR for southern ENP (Zone ENP-S). Alternative 4 produced slightly higher depths than Alternative 3. Within southern ENP, Alternative 4 produced significantly higher performance measure scores by approximately 10 points relative to Alternatives 1, 2, and 3.

Alternative 4 generally produced improved inundation patterns in southern ENP. Indicator region 130 was inundated for 96% of the period of record for Alternative 4; a 9% increase in inundation duration relative to the FWO. Alternative 3 inundated this location for 95% of the period of record. Alternatives 1-2 inundated this location for 93% of the period of record. Alternative 4 reduced drought intensity at IR 130 over the period of record by 676 ft-days relative to the FWO. Alternatives 3, 2, and 1 provided a reduction of 558, 477, and 456 ft-days over the period of record at this location respectively. Alternative 4 improved the number and duration of dry events in NESRS relative to the remaining alternatives at several of the IRs in Zone ENP-S (**Table G-17**). Improved inundation patterns in southern ENP resulted in better suitability for slough vegetation for Alternative 4 (**Figure G-24**). Patterns of performance for Alternatives 1-4 were similar at IRs 131 and 132; however differences between alternatives were less notable at IR 132 which is located farther from the L-29 Levee. Seepage management features associated with these alternatives may have influenced improved hydrologic conditions in southern ENP by reducing the amount of water flowing east. Both Alternatives 3 and 4 contain a partial seepage barrier wall spanning 5 miles south of Tamiami Trail along L-31 N.

Efforts to provide flood control and water supply for the LEC have resulted in over-drying and adverse ecological effects in eastern portions of ENP. Hydrology in northern ENP will be significantly affected by the implementation of Alternatives 1-4. Implementation of the Alternatives 1-4 would achieve 81-83% of the target HUs for Zone ENP-N (**Table G-14**) and 71-79% of the target HUs for Zone ENP-S (**Table G-15**). The FWO would achieve 44% of the target HUs for Zone ENP-N and 53% for Zone ENP-S (**Table G-14** and **Table G-15**).

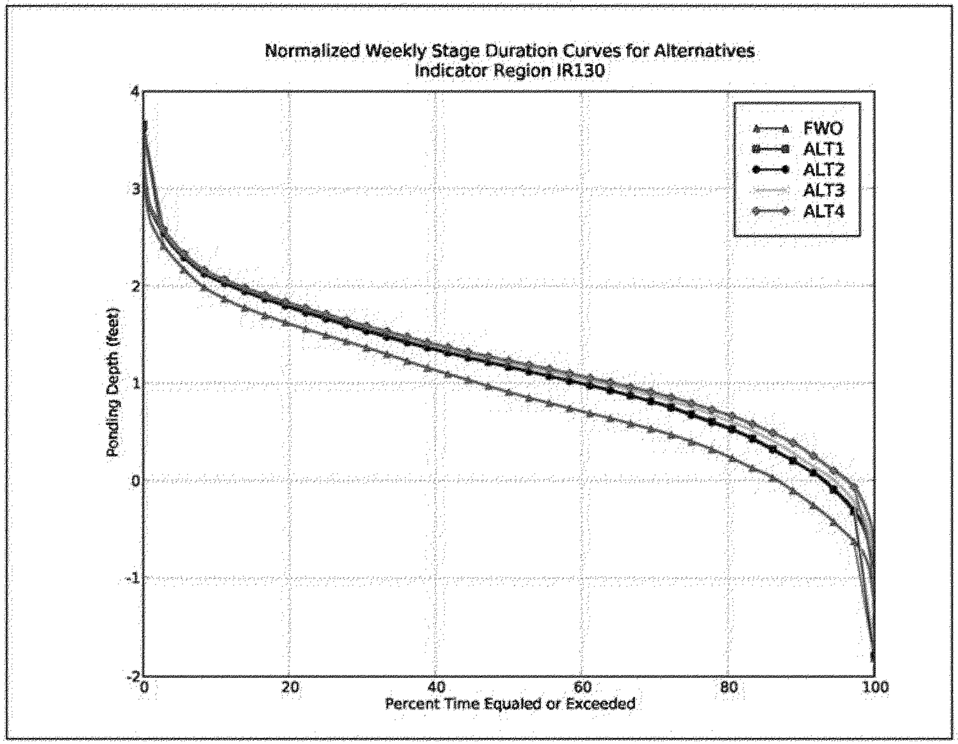


Figure G-23. Normalized Weekly Stage Duration Curve for Indicator Region 130 for Alternatives 1-4

Table G-17. Number and Duration of Dry Events in Northeast Shark River Slough for Alternatives 1-4 (Raw Performance Measure Scores)

Zone	Indicator Region	Metric	FWO	ALT1	ALT2	ALT3	ALT4
Zone ENP-N	129	Number	18	6	5	4	4
		Average Duration (Weeks)	20	8	7	7	6
Zone ENP-S	130	Number	16	11	10	8	7
		Average Duration (Weeks)	17	14	15	16	9
	131	Number	20	15	16	14	14
		Average Duration (Weeks)	16	14	13	14	12
	132	Number	22	18	20	21	19
		Average Duration (Weeks)	12	13	12	11	12

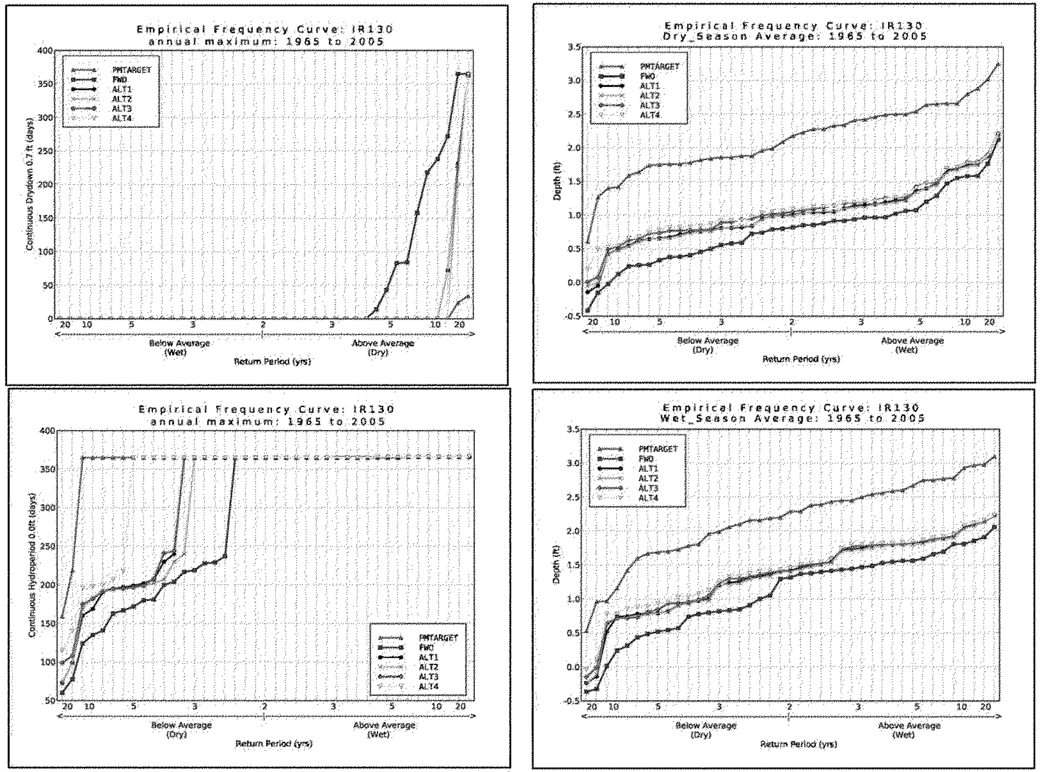


Figure G-24. Slough Vegetation Empirical Frequency Curves Indicator Region 130 for Alternatives 1-4

G.2.3 Florida Bay (Alternatives 1-4)

Florida Bay is the main receiving waterbody of the Greater Everglades system and is heavily influenced by changes in the timing, distribution and quantity of freshwater flows. Water management actions that result from CEPP have the potential to reduce the intensity, frequency, duration and spatial extent of hypersaline events in Florida Bay and establish a persistent and resilient estuarine zone that extends further into the bay than currently exists. This is expected to restore the bay to more natural conditions and increase biomass and diversity of bay flora and fauna.

In Florida Bay, the ECB scored better in terms of meeting the desired performance measure targets relative to the FWO (**Table G-18**). Compared to the ECB, combined average annual overland flows from southern ENP to Florida Bay at Transect 27 are decreased by 8,000 acre-feet (ac-ft) under the FWO. Transect 27 is used to measure southward flow in central SRS. Transect 23 is used to measure southward flow in Taylor Slough. Compared to the ECB, combined average annual overland flows from Taylor Slough at Transect 23 are decreased by 14,000 ac-ft under the FWO.

Alternatives 1-4 improved hydrologic conditions in Florida Bay in comparison to the FWO by significantly increasing overland flows. Water flowing through SRS reaches Florida Bay through the following routes: 1) surface water that enters the near-shore waters at the mouth of Whitewater Bay may flow around Cape Sable and into western Florida Bay, 2) surface water that flows north and west of the Rocky Glades may seep into southeastern Florida Bay, and 3) surface water can enter Florida Bay via Taylor Slough by seeping under the central and eastern Rocky Glades. Freshwater deliveries through each of these routes have decreased with drainage of the Everglades over the last century. Only the first of these routes likely has influence on salinities in Florida Bay today. Alternatives 1-4 provided increased flows within central SRS in comparison to the FWO with annual flow increases above the FWO ranging from 262,000 ac-ft on average per year for Alternative 4 to 192,000 ac-ft on average per year for Alternative 2 (**Figure G-25**). Alternatives 1-4 provided increased flows within Taylor Slough in comparison to the FWO; however, increases in flow were not as significant as increases in observed flows in SRS. Annual flow increases above the FWO in Taylor Slough ranged from 7,000 ac-ft on average per year for Alternatives 1, and 2 to 9,000 and 10,000 ac-ft per year for Alternatives 3 and 4 respectively. Improved hydrologic conditions in central SRS directly resulted in improved salinity conditions in Florida Bay.

Performance of Alternatives 1-4 in Florida Bay was measured by evaluating improvements in salinity conditions in both the wet (June through November) and dry season (December though May). The regime overlap metric compares the distribution of salinities in the paleo-adjusted NSM record (target) to the predicted distribution (CEPP alternative) of results between the 25th and 75th percentiles (hereafter referred to as the "mid-range"). The overlap between the mid-range distributions is determined on a seasonal basis and is reported as a proportion of the mid-range values of each CEPP alternative model output that falls within the mid-range of the target. This provides a "regime overlap score" for each month on a 0 to 1 scale (See **Section G.1.5.3.1**). **Figure G-26** depicts results for this performance measure for the wet season and dry season. Complete overlap with the target would yield a value of 1.0. Differences between alternatives were modest relative to the differences of the alternatives to the FWO. Alternatives 1-4 scored the highest in terms of meeting the desired targets during the wet season. Improvements in salinity conditions relative to the FWO were of greater magnitude in the east central, central, south, and west Florida Bay zones. Alternative 4 scored the highest in all Florida Bay zones.

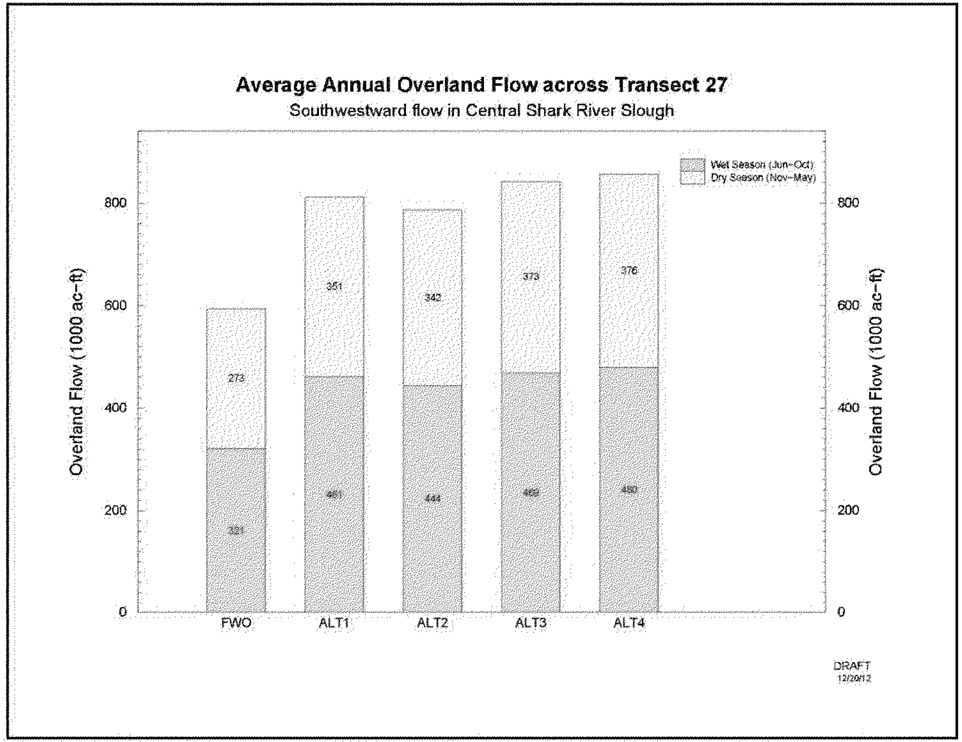


Figure G-25. Average Annual Overland Flow (1000 ac-ft) Across Transect 27 for Alternatives 1-4

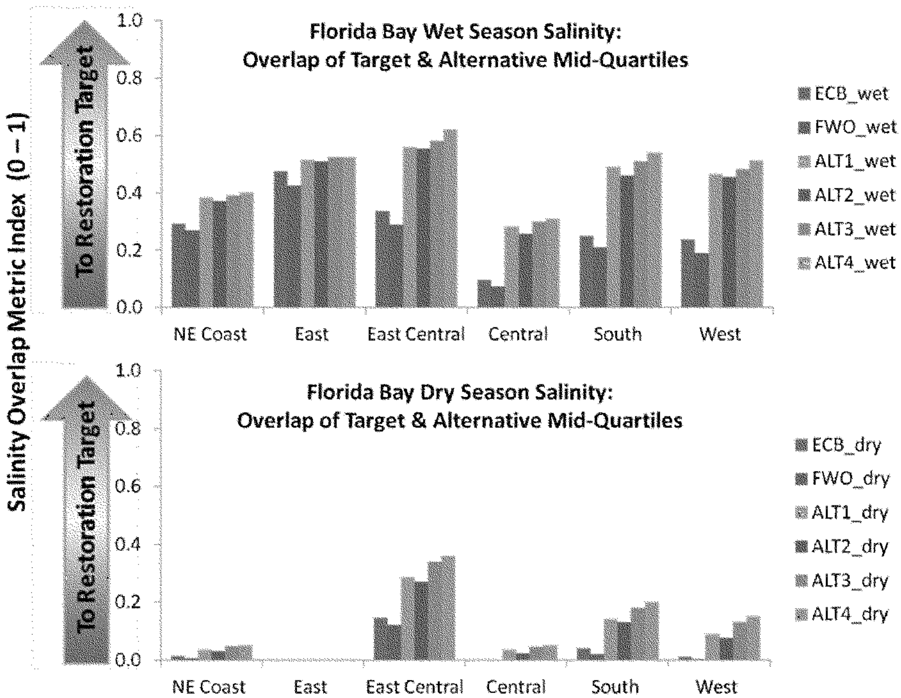


Figure G-26. Wet Season and Dry Season Regime Overlap Performance Measure for Florida Bay for Alternatives 1-4. Salinity Overlap Index (Dry Season) Equivalent to Zero for East Florida Bay.

The high salinity metric focuses on the frequency of unnatural and harmful high salinity conditions. The high-salinity threshold is calculated using the period of record for the paleo-adjusted NSM. The 90th percentile value is determined separately for each MMN station and used as the high-salinity threshold. The high salinity target is for high salinity threshold exceedances in the CEPP alternative model output to be no more frequent than occurs in a comparable paleo-adjusted NSM time period (here called "target exceedances"). Target exceedances are calculated on a monthly and seasonal basis. The desired metric score is 1.0 (See **Section G.1.5.3.2**). **Figure G-27** depicts the results for this performance measure for the wet season and dry season. Similar patterns were observed to that of the regime overlap performance measure. Differences between Alternatives 1-4 were modest relative to the differences of the alternatives to the FWO. Alternatives 1-4 scored the highest in terms of meeting the desired targets during the wet season. Improvements in salinity conditions relative to the FWO were of greater magnitude in the east central, central, south, and west Florida Bay zones. Alternative 4 scored the highest in all Florida Bay zones.

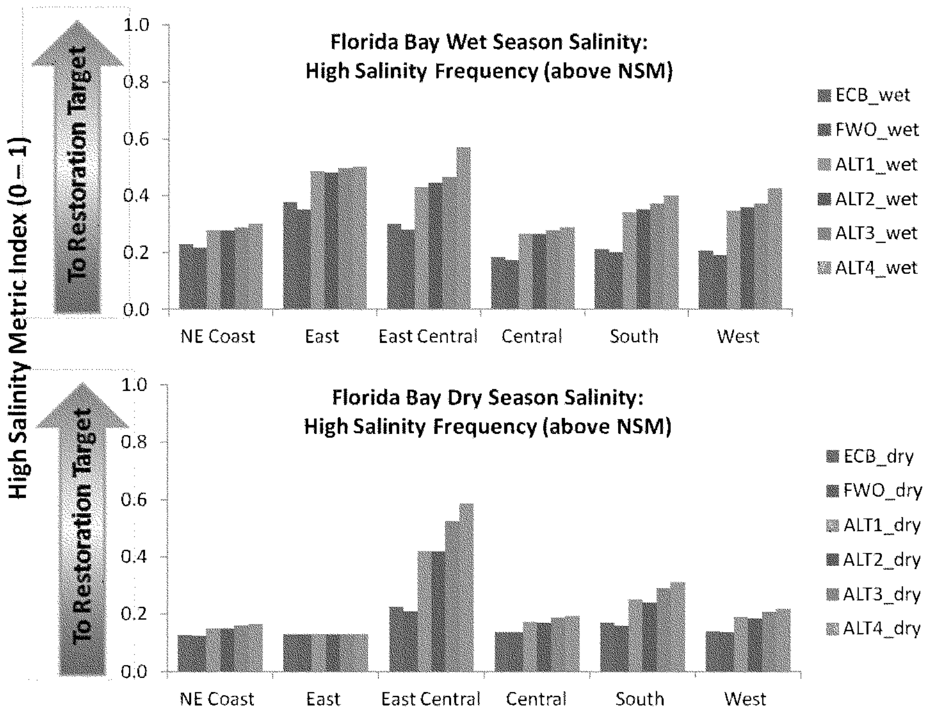


Figure G-27. High Salinity Performance Measure for Florida Bay for Alternatives 1-4

Table G-18 provides the percentage of target HUs resulting from the performance measure scores for each zone in Florida Bay. Alternative 4 is consistently the best performer, followed by Alternatives 3, 1 and 2. This pattern is consistent with alternative performance in ENP. While the mean salinities for all alternatives are still higher than target conditions, implementation of Alternatives 1-4 brings salinities in Florida Bay closer to target conditions CEPP does not reconnect SRS to Taylor Slough or Florida Bay as it was historically, but it does allow additional surface water to flow southeastward around Mahogany Hammock towards West Lake, the Lungs, and Garfield Bight helping to negate the harmful buildup of hypersalinity. Similarly, the improved timing and volume of water flowing southwest out of the Shark River, plumes into the coastal zone water and bends southeastward to enter Florida Bay from the west, causing a slight, but perceptual decline in central basin salinities, especially around Whipray Basin, where hypersaline conditions can be extreme. Given the large area of Florida Bay, even a small decrease in salinity can translate into a substantial increase in improved Habitat Units. Habitat quantity and quality (in this case, seagrass habitat) are expected to improve with improvements in salinity. Likewise, animal populations (particularly fish) that depend on this habitat are expected to improve because of improved habitat and decreased salinity stress. Additional freshwater flows of 500,000 to 700,000 ac-ft per year, annual average, may be necessary to bring Florida Bay to full restoration.

Table G-18. Percentage of Target HU (HSI x 100) for Florida Bay for Alternatives 1-4

Florida Bay Zone	ECB	FWO	ALT1	ALT2	ALT3	ALT4
Florida Bay West	15	13	27	27	30	33
Florida Bay Central	10	10	19	18	21	21
Florida Bay South	17	15	31	30	34	36
Florida Bay East Central	25	23	42	42	48	53
Florida Bay North Bay	17	16	21	21	22	23
Florida Bay East	25	23	28	28	29	29

G.2.4 Conclusions (Alternatives 1-4)

Alternatives 1-4 provided improvements in hydrology relative to the FWO in each region of the project area. **Table G-19** displays HU lift for Alternatives 1-4. Alternative performance in the Northern Estuaries was equivalent between Alternatives 1-4 as project components did not differ between alternatives within that region of the project area. Alternative 4 provided the greatest project benefits relative to the FWO project condition for WCA 3, ENP, and Florida Bay while Alternative 2 provided the least. Alternatives 3 and 1 provided more project benefits than Alternative 2. Alternative 3 provided more project benefits than Alternative 1.

Table G-19. Habitat Unit Lift Results for Alternatives 1-4

Project Region (Zone)	ALT1*	ALT2*	ALT3*	ALT4*
Caloosahatchee Estuary (CE-1)	4,968	4,968	4,968	4,968
St Lucie Estuary (SE-1)	2,399	2,399	2,399	2,399
Total Northern Estuaries	**7,367**	**7,367**	**7,367**	**7,367**
WCA 3A Northeast (3A-NE)	66,677	66,677	66,677	66,677
WCA 3A Miami Canal (3A-MC)	30,501	29,719	28,937	29,719
WCA 3A Northwest (3A-NW)	24,636	23,228	23,228	23,228
WCA 3A Central (3A-C)	4,117	4,117	4,117	4,117
WCA 3A South (3A-S)	0	-825	-825	0
WCA 3B (3B)	9,426	10,283	8,569	5,998
ENP North (ENP-N)	47,547	46,296	48,798	47,547
ENP South (ENP-S)	42,946	42,946	50,104	62,034
ENP South East (ENP-SE)	1,351	1,351	1,351	2,702
Total WCA 3 and ENP	**227,201**	**223,792**	**230,956**	**242,022**
Florida Bay West (FB-W)	22,113	22,113	26,852	31,590
Florida Bay Central (FB-C)	7,384	6,564	9,025	9,025
Florida Bay South (FB-S)	15,637	14,659	18,569	20,523
Florida Bay East Central (FB-EC)	16,708	16,708	21,984	26,381
Florida Bay North Bay (FB-NB)	633	633	760	887
Florida Bay East (FB-E)	1,888	1,888	2,265	2,265
Total Florida Bay	**64,363**	**62,565**	**79,455**	**90,671**
Total All Regions	**298,931**	**293,724**	**317,778**	**340,060**

* HU lift values for ALT 1 through ALT 4 represent those calculated in the year 2072.

G.2.5 Northern Estuaries (Alternatives 4R and 4R2)

Modeling results of Alternatives 4R and 4R2 indicate a reduction in the number of high discharge events from Lake Okeechobee to the Northern Estuaries (**Table G-20** and **Table G-21**). Within the Caloosahatchee Estuary, the number of times mean monthly flows greater than 2,800 cfs were not met decreased from 81 in the FWO to 70 with implementation of Alternatives 4R and 4R2 (**Figure G-28**). Within the St. Lucie Estuary, the number of times biweekly flows greater than 2,000 cfs from Lake Okeechobee regulatory releases were not met decreased from 65 in the FWO to 37 for Alternative 4R and 36 for Alternative 4R2 (**Figure G-29**). Alternatives 4R and 4R2 decreased the number of low discharge events to the Caloosahatchee Estuary in comparison to the FWO. The number of low discharge events to the Caloosahatchee Estuary decreased from 27 in the FWO to 24 and 23 for Alternatives 4R and 4R2 respectively. Alternatives 4R and 4R2 also decreased the number of low discharge events to the St. Lucie Estuary relative to the FWO. Alternative 4R improved the number of low discharge events to 90 and Alternative 4R2 to 65 (**Figure G-29**). Improvements in performance within the St. Lucie Estuary between Alternatives 4R and 4R2 can be attributed to operational refinements of the Indian River Lagoon-South Project. Operational refinements emphasized base flow through Ten Mile Creek. Better utilization of local basin water improved low flow conditions to the St. Lucie Estuary and allowed more water to be retained in Lake Okeechobee by back flowing water from the C-44 Reservoir to the Lake. Implementation of Alternatives 4R and 4R2 would achieve 55% of the target HUs for the Caloosahatchee Estuary and 34-55% of the target HUs for the St. Lucie Estuary (**Table G-20** and **Table G-21**). The FWO would achieve 48% of the target HUs for the Caloosahatchee Estuary and 16% for the St. Lucie Estuary (**Table G-20** and **Table G-21**). Implementation of the recommended plan provides an increment of the benefits envisioned in CERP and builds upon those achieved in the Northern Estuaries with implementation of other CERP projects (i.e. C-43 West Basin Storage Reservoir and Indian River Lagoon South Project).

Table G-20. Rescaled Performance Measure Scores (Zero to 100 Scale) for Caloosahatchee Estuary (Zone CE-1) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
6.1	Low Flow (< 450 cfs)	4	78	80	81
6.2	High Flow (>2800 cfs)	4	17	29	29
	Percentage of Target HU (HSI x 100)	**4**	**48**	**55**	**55**

Table G-21. Rescaled Performance Measure Scores (Zero-100 Scale) for St. Lucie Estuary (Zone SE-1) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
7.1	Low Flow (< 350 cfs)	14	9	12	52
7.2	High Flow (>2000 cfs)	14	22	56	57
	Percentage of Target HU (HSI x 100)	**14**	**16**	**34**	**55**

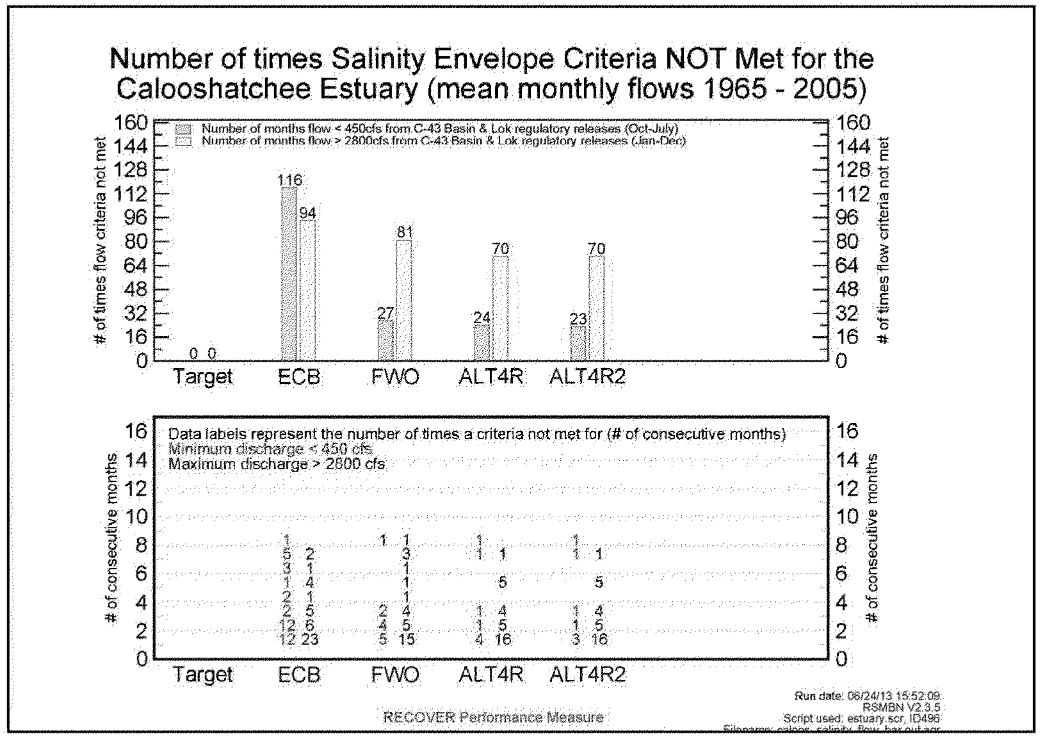


Figure G-28. Number of Times Salinity Criteria Not Met for the Caloosahatchee Estuary for Alternatives 4R and 4R2

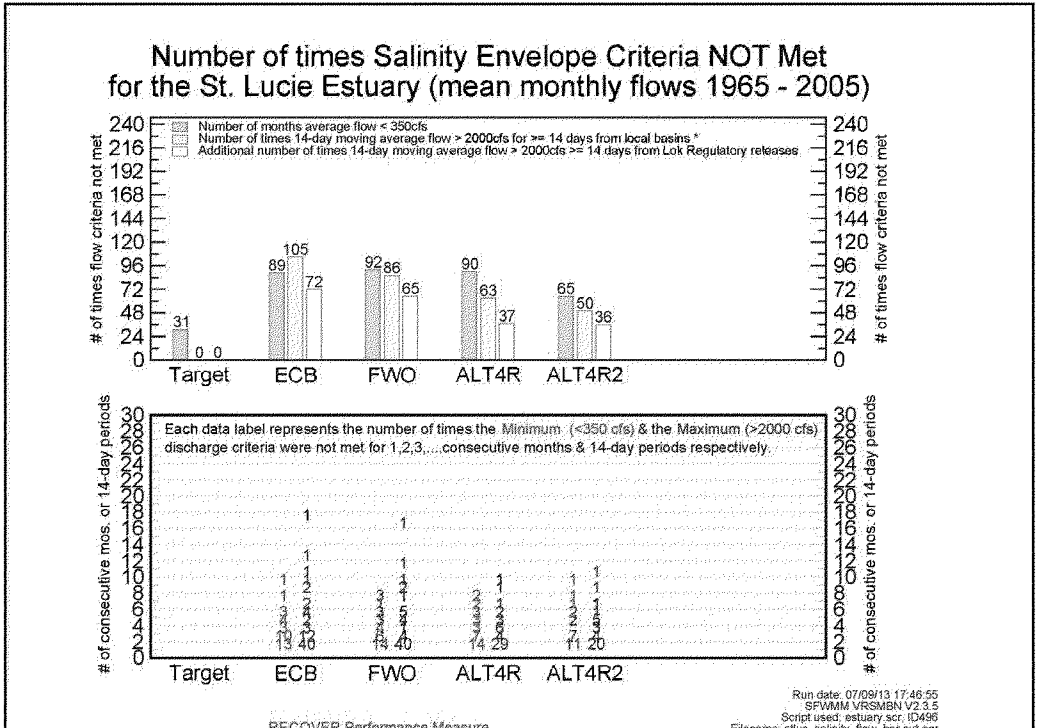


Figure G-29. Number of Times Salinity Criteria Not Met for the St. Lucie Estuary for Alternatives 4R and 4R2

G.2.6 WCA 3 and ENP (Alternatives 4R and 4R2)

G.2.6.1 Northern WCA 3A (Zones 3A-NW, 3A-MC, 3A-NE) (Alternatives 4R and 4R2)

Alternatives 4R and 4R2 improved hydrologic conditions in northern WCA 3A in comparison to the FWO by increasing depths and resulting hydroperiods within the area. Alternatives 4R and 4R2 scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation suitability (**Table G-22**, **Table G-23**, and **Table G-24**). Pertaining to slough vegetation suitability, greater performance was noted with regard to maximizing continuous hydroperiods (days with depth ≥ 0.0 ft) and minimizing dry down events below 0.7 ft. Scores for these performance measures ranged from 66 to 97. Alternatives 4R and 4R2 were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing and distribution of sheetflow. Scores for these performance measures ranged from 30 to 68.

Table G-22. Rescaled Performance Measure Scores (Zero to 100 Scale) for Northwestern WCA 3A (Zone 3A NW) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	63	61	94	95
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	20	19	34	34
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	4	4	62	61
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	24	18	67	68
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	63	63	96	97
5.1	Slough Vegetation Suitability -- Hydroperiod	46	46	79	79
5.2	Slough Vegetation Suitability -- Dry down	51	48	85	85
5.3	Slough Vegetation Suitability -- Dry Season Depth	22	19	38	38
5.4	Slough Vegetation Suitability -- Wet Season Depth	22	20	46	46
	Percentage of Target HU (HSI x 100)	**44**	**43**	**77**	**77**

Table G-23. Rescaled Performance Measure Scores (Zero to 100 Scale) for Miami Canal (Zone 3A MC) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	55	45	89	88
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	18	17	32	32
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	4	4	62	61
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	28	23	62	62
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	52	44	75	75
5.1	Slough Vegetation Suitability -- Hydroperiod	42	35	73	73
5.2	Slough Vegetation Suitability -- Dry down	63	50	86	85
5.3	Slough Vegetation Suitability -- Dry Season Depth	37	32	50	49
5.4	Slough Vegetation Suitability -- Wet Season Depth	40	32	51	50
	Percentage of Target HU (HSI x 100)	**42**	**35**	**70**	**70**

Table G-24. Rescaled Performance Measure Scores (Zero to 100 Scale) for Northeastern WCA 3A (Zone 3A NE) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	40	25	95	94
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	16	15	30	30
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	6	4	59	59
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	18	17	58	57
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	50	26	94	93
5.1	Slough Vegetation Suitability -- Hydroperiod	38	27	68	66
5.2	Slough Vegetation Suitability -- Dry down	58	51	84	82
5.3	Slough Vegetation Suitability -- Dry Season Depth	35	30	46	45
5.4	Slough Vegetation Suitability -- Wet Season Depth	30	26	42	41
	Percentage of Target HU (HSI x 100)	**36**	**24**	**75**	**74**

Slight differences occurred between zones within northern WCA 3A. Alternatives 4R and 4R2 scored the highest in terms of meeting the desired performance measure targets in northwestern WCA 3A (Zone 3A-NW) in comparison to northeastern WCA 3A (Zone 3A-NE) and in areas adjacent to the Miami Canal (Zone 3A-MC). Differences in hydrologic improvements within northern WCA 3A may be a direct consequence of the location at which inflows into northern WCA 3A are delivered. Alternatives 4R and 4R2 includes removal of the L-4 levee approximately 3 miles west of S-8. Inundation duration for Alternatives 4R and 4R2 ranged from 91% of the period of record to 96% of the period of record in northwestern WCA 3A (Zone 3A-NW) (**Table G-24**). Inundation duration for the FWO within this same region varied from 73% to 93% of the period of record (1965-2005) (**Table G-9**). Alternatives 4R and 4R2 generally produced higher depths within northwestern WCA 3A relative to the FWO as depicted by the normalized weekly stage duration curve for IR 114 (**Figure G-30**); an example IR for Zone 3A-NW. Depths were significantly increased on average by 0.6 to 0.8 ft relative to the FWO at this location. Improvements in depth of water below ground surface were also significant. Drought intensity for Alternatives 4R and 4R2 ranged from -450 ft-days below ground to -145 ft-days over the period of record (**Table G-25**) for Zone 3A-NW. Drought intensity for the FWO within this same region varied from -1431 ft days to -256 ft-days over the period of record (**Table G-10**). Improved inundation patterns in northwestern WCA 3A resulted in better suitability for slough vegetation for Alternatives 4R and 4R2 (**Figure G-31**). Ranges of inundation duration and drought intensity for northeastern WCA 3A (Zone 3A-NE) and in areas adjacent to the Miami Canal (Zone 3A-MC) are also shown in **Table G-25**. Slight reductions in performance within Zone 3A-NE between Alternatives 4R and 4R2 can be attributed to a change in the distribution of flows within northern WCA 3A from the L-6 diversion east to S-7 to address potential impacts to water depths in WCA 2B and Service Area 2 of the LEC. Alternative 4R2 produced slightly lower depths within northeastern WCA 3A (Zone 3A-NE) relative to Alternative 4R. Hydrology in all of northern WCA 3A would be significantly affected by the implementation of Alternatives 4R and 4R2. Implementation of Alternatives 4R and 4R2 would achieve 77% of the target HUs for Zone 3A-NW (**Table G-22**), 70% of the target HUs for Zone 3A-MC (**Table G-23**), and 74-75% of the target HUs for Zone 3A-NE (**Table G-24**).

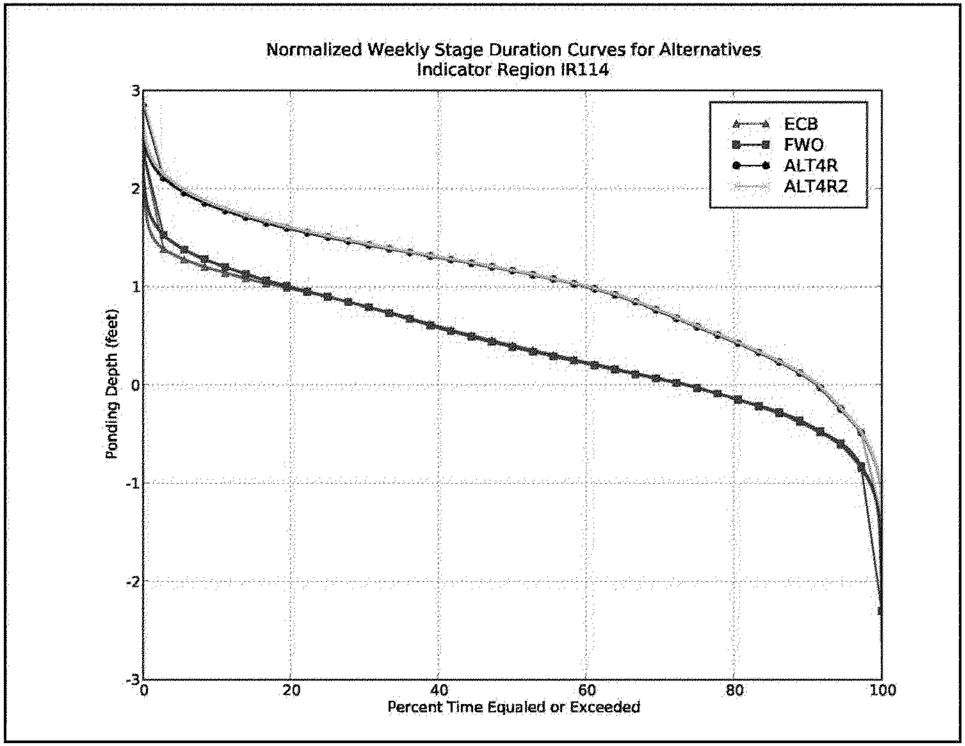
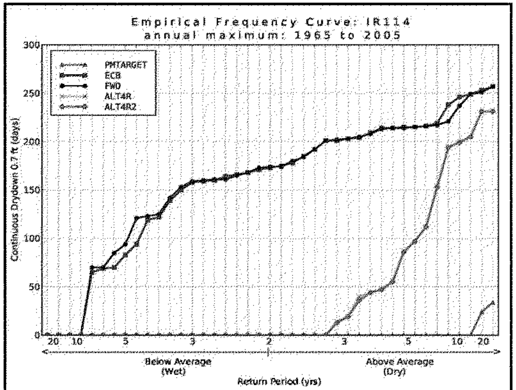
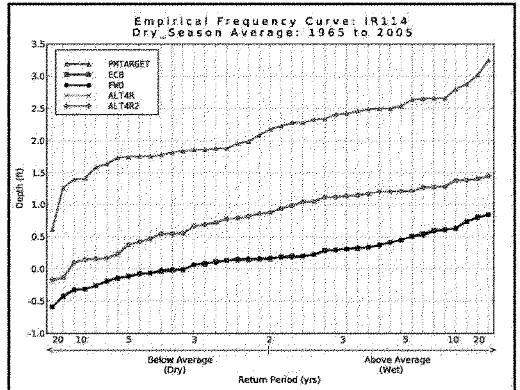
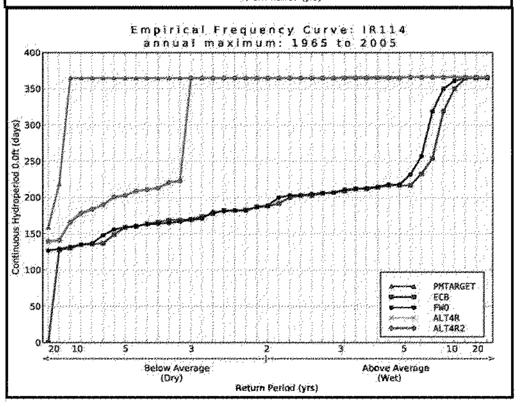


Figure G-30. Normalized Weekly Stage Duration Curve for Indicator Region 114 for Alternatives 4R and 4R2


Empirical Frequency Curve: IR114
annual maximum: 1965 to 2005
PMTARGET
ECB
FWO
ALT4R
ALT4R2
Continuous Drydown 0.7 ft (days)
Below Average (Wet)
Above Average (Dry)
Return Period (yrs)


Empirical Frequency Curve: IR114
Dry_Season Average: 1965 to 2005
PMTARGET
ECB
FWO
ALT4R
ALT4R2
Depth (ft)
Below Average (Dry)
Above Average (Wet)
Return Period (yrs)


Empirical Frequency Curve: IR114
annual maximum: 1965 to 2005
PMTARGET
ECB
FWO
ALT4R
ALT4R2
Continuous Hydroperiod 0.0ft (days)
Below Average (Dry)
Above Average (Wet)
Return Period (yrs)

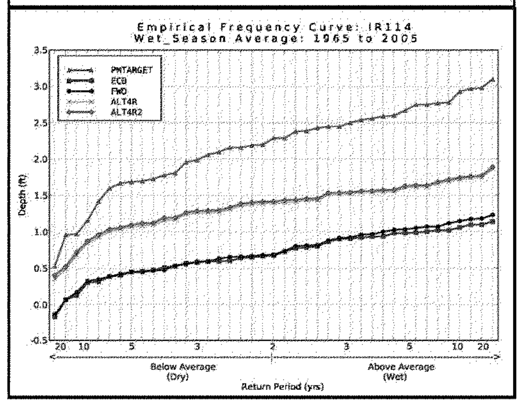

Empirical Frequency Curve: IR114
Wet_Season Average: 1965 to 2005
PMTARGET
ECB
FWO
ALT4R
ALT4R2
Depth (ft)
Below Average (Dry)
Above Average (Wet)
Return Period (yrs)

Table G-25. Percent Period of Record of Inundation Duration and Hydrologic Surrogate for Soil Oxidation (Water Depth Relative to Land Surface Elevation Ft-Days Below Ground) for Alternatives 4R and 4R2 (Raw Performance Measure Scores)

Zone	Indicator Region	PPOR of Inundation ALT4R	PPOR of Inundation ALT4R2	Cumulative Drought Intensity (ft-days) ALT4R	Cumulative Drought Intensity (ft-days) ALT4R2
Zone 3A-NW	IR 114	91	91	-450	-438
	IR 117	95	95	-248	-247
	IR 121	96	96	-147	-145
Zone 3A-MC	MC NE 1	93	93	-317	-360
	MC NE 2	95	95	-198	-227
	MC NW 1	93	93	-335	-380
	MC NW 2	90	90	-596	-624
	MC CE 1	92	92	-415	-443
	MC CE 2	87	87	-1530	-1525
	MC CW 1	92	92	-566	-578
	MC CW 2	94	94	-277	-276
	MC SE 1	91	91	-584	-570
	MC SE 2	88	88	-1490	-1430
	MC SW 1	91	91	-675	-657
	MC SW 2	93	93	-359	-355
Zone 3A-NE	IR 115	92	92	-370	-432
	IR 116	88	88	-633	-681
	IR118	88	87	-789	-819
	IR 119	92	92	-403	-384
	IR 190	90	89	-515	-552

G.2.6.2 Central and Southern WCA 3A (Zone 3A-C, 3A-S) (Alternatives 4R and 4R2)

In central WCA 3A, Alternatives 4R and 4R2 provided slight improvements in hydrologic conditions in comparison to the FWO (**Table G-26**). Alternatives 4R and 4R2 produced slightly higher depths than the FWO as depicted by the normalized weekly stage duration curve for IR 122 (**Figure G-32**); an example IR for Zone 3A-C. Increases in depth within central WCA 3A were not as significant as increases in observed depths relative to the FWO in northern WCA 3A. Depths were generally increased by 0.1 to 0.2 ft during average to dry conditions, with a slight depth reduction during the wettest 10% of conditions, and no significant change during extreme dry conditions. Inundation duration for Alternatives 4R and 4R2 ranged from 92% of the period of record to 98% of the period of record in central WCA 3A. Inundation duration for the FWO was similar, ranging from 92% to 96% of the period of record. Drought intensity for Alternatives 4R and 4R2 ranged from -331 ft-days below ground to -72 ft-days over the period of record. Drought intensity for the FWO within this same region varied from -308 ft days to -142 ft-days over the period of record. Improved inundation patterns in central WCA 3A resulted in better suitability for slough vegetation for Alternatives 4R and 4R2. As previously stated, maintenance of existing conditions within this region of the project area is desirable as ridge and slough habitat is well conserved. Alternatives 4R and 4R2 would achieve 80-81% of the target HUs for Zone 3A-C; a difference of 3-4% from the FWO (**Table G-26**).

Table G-26. Rescaled Performance Measure Scores (Zero to 100 Scale) for Central WCA 3A (Zone 3A C) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	100	100	100	100
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	42	43	47	47
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	63	60	65	66
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	74	72	80	81
5.2	Slough Vegetation Suitability -- Dry down	88	85	90	91
5.3	Slough Vegetation Suitability -- Dry Season Depth	42	37	43	43
5.4	Slough Vegetation Suitability -- Wet Season Depth	42	38	47	47
	Percentage of Target HU (HSI x 100)	**79**	**77**	**80**	**81**

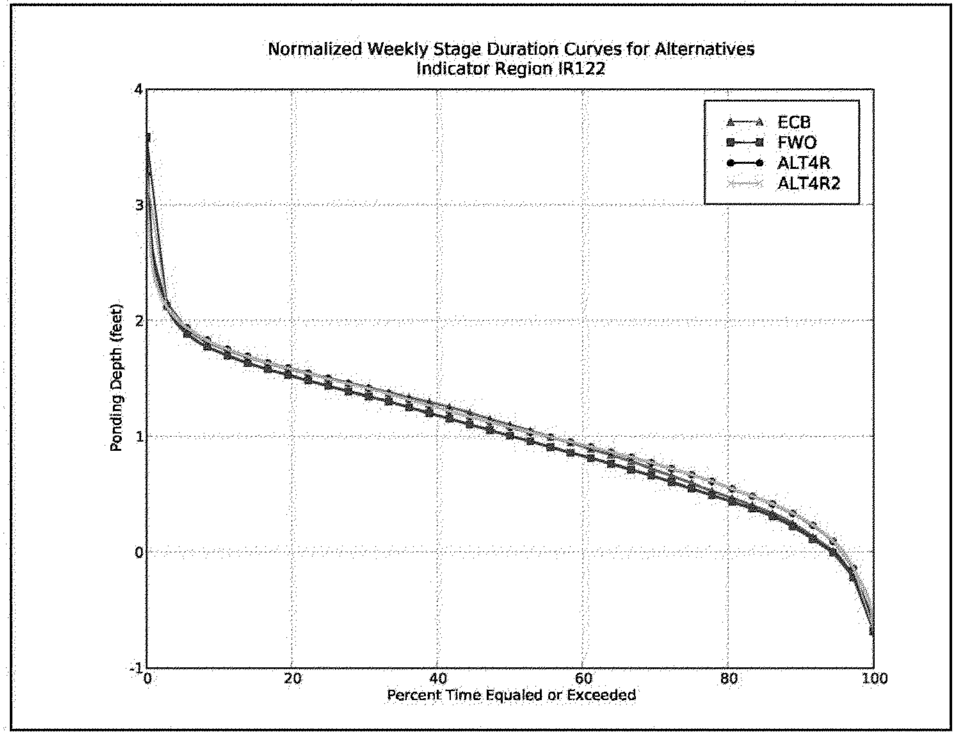


Figure G-32. Normalized Weekly Stage Duration Curve for Indicator Region 122 for Alternatives 4R and 4R2

Alternatives 4R and 4R2 produced the same performance within southern WCA 3A (Zone 3A-S). Within southern WCA 3A, Alternatives 4R and 4R2 scored similarly to the FWO in terms of meeting the desired targets for each of the performance measures (**Table G-27**). Alternatives 4R and 4R2 produced similar depths to the FWO as depicted by the normalized weekly stage duration curve for IR 124 (**Figure G-33**); an example IR for Zone 3A-S. Depths are slightly decreased by 0.1 to 0.2 ft during the wettest 5% of conditions and slightly decreased during normal to dry conditions. It should be noted that Alternatives 4R and 4R2 performed slightly worse for measures of slough vegetation suitability relative to the FWO (**Figure G-34**). As previously stated, performance with respect to this metric can best be explained by the operational targets that were used during plan formulation. Southern WCA 3A would remain largely unaffected by the implementation of Alternatives 4R and 4R2 due to the extended ponding of deep water which would continue to occur. See **Section G.2.2.2 [(Central and Southern WCA 3A (Alternatives 1-4)]**.

Table G-27. Rescaled Performance Measure Scores (Zero to 100 Scale) for Southern WCA 3A (Zone 3A S) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	100	100	100	100
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	45	47	50	50
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	60	59	61	61
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	84	82	81	81
5.2	Slough Vegetation Suitability -- Dry down	100	95	93	93
5.3	Slough Vegetation Suitability -- Dry Season Depth	82	73	72	72
5.4	Slough Vegetation Suitability -- Wet Season Depth	71	64	61	61
	Percentage of Target HU (HSI x 100)	**84**	**83**	**83**	**83**

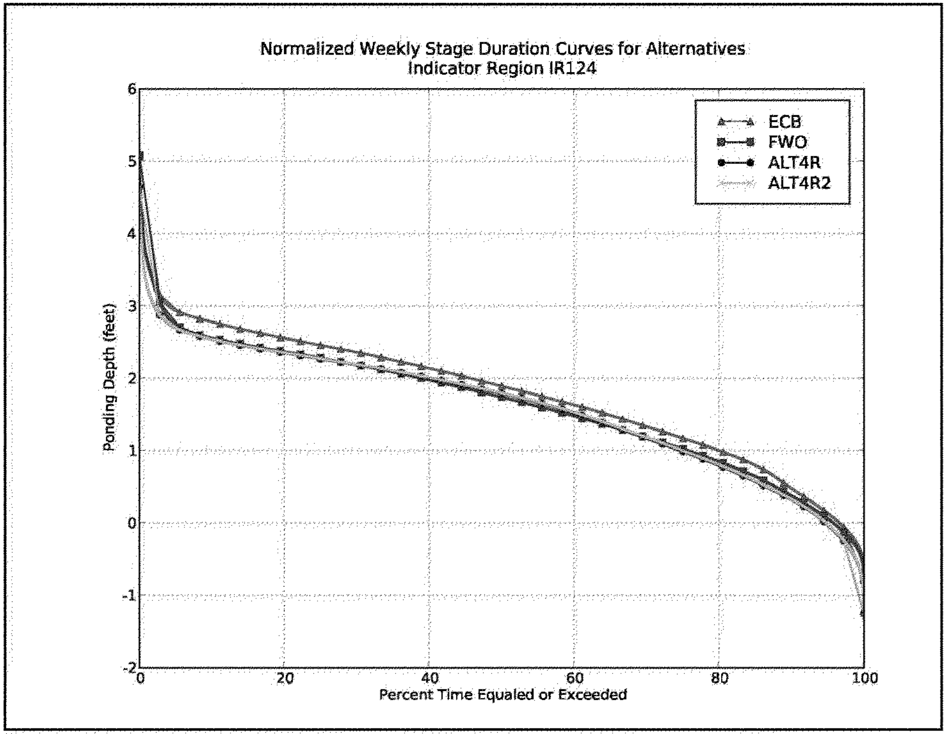


Figure G-33. Normalized Weekly Stage Duration Curve for Indicator Region 124 for Alternatives 4R and 4R2

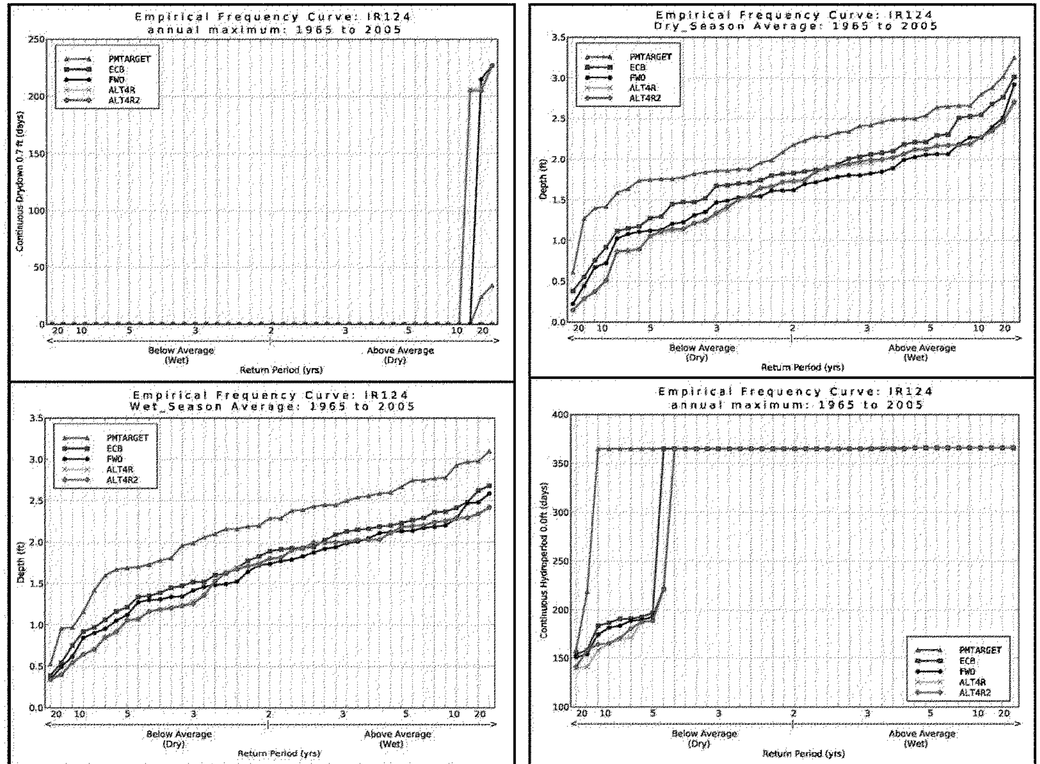


Figure G-34. Slough Vegetation Empirical Frequency Curves Indicator Region 124 for Alternative 4R and 4R2

G.2.6.3 WCA 3B (Zone 3B) (Alternatives 4R and 4R2)

Alternatives 4R and 4R2 improved hydrologic conditions in WCA 3B in comparison to the FWO by increasing depths and resulting hydroperiods within the area. Alternatives 4R and 4R2 scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation suitability (**Table G-28**). Pertaining to slough vegetation suitability, greater performance was noted with regard to maximizing continuous hydroperiods (days with depth ≥ 0.0 ft) and minimizing dry down events below 0.7 ft. Scores for these performance measures ranged from 76 to 94. Alternatives 4R and 4R2 were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing and distribution of sheetflow. Scores for these performance measures ranged from 0 to 46. Poor performance was especially noted for measures of sheetflow.

Table G-28. Rescaled Performance Measure Scores (Zero to 100 Scale) for WCA 3B (Zone 3B) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	86	76	92	93
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	0	0	0	0
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	41	35	39	40
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	56	58	45	46
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	84	71	93	94
5.1	Slough Vegetation Suitability -- Hydroperiod	72	63	75	76
5.2	Slough Vegetation Suitability -- Dry down	86	80	89	89
5.3	Slough Vegetation Suitability -- Dry Season Depth	45	38	42	43
5.4	Slough Vegetation Suitability -- Wet Season Depth	28	23	32	33
	Percentage of Target HU (HSI x 100)	**65**	**57**	**68**	**69**

Overland flow directionality generally showed poor alignment with landscape patterning. Alternatives 4R and 4R2 maintained the directionality of overland flow seen in the FWO shown in (**Figure G-17**) which is oriented to the southeast corner of WCA 3B. Overland flow directionality was improved west of the Blue Shanty levee where vectors were more aligned in a north to south direction. Sheetflow plays an essential role in maintaining the directionality, and spatial extent of ridges and sloughs. Poor alignment of overland flow with landscape patterning would have potential effects on what ridge and slough landscape currently remains within WCA 3B. .Implementation of Alternatives 4R and 4R2 would reestablish the connection through WCA 3B and ENP, providing the longest uninterrupted flow-way by removal of a portion of the L-67 C and L-29 levees.

Inundation duration for Alternatives 4R and 4R2 ranged from 91% of the period of record to 96% of the period of record in WCA 3B. Inundation duration for the FWO within this same region varied from 84% to 93% of the period of record. Alternatives 4R and 4R2 generally produced higher depths within WCA 3B relative to the FWO under all hydrologic conditions as depicted by the normalized weekly stage duration curve for IR 128 (**Figure G-35**); an example IR for WCA 3B. Alternative 4R2 produced slightly higher depths within WCA 3B. Depths are increased by 0.1 ft during the upper 20% of the duration curve and increased by 0.2 to 0.5 ft for normal to dry conditions (**Figure G-35**). Increases in depth within WCA 3B were not as significant as increases in observed depths relative to the FWO in northern WCA 3A. Construction of the L-29 levee divides WCA 3B into two separate compartments allowing restoration of sheetflow to the maximum extent practicable while preventing undesirably high water depths east of the Blue Shanty levee. Water depths were greater west of the Blue Shanty levee (**Figure G-36**) in comparison to the remainder of WCA 3B (**Figure G-35**).

Alternatives 4R and 4R2 improved the severity of drought intensity. Drought intensity for Alternatives 4R and 4R2 ranged from -463 ft-days below ground to -170 ft-days over the period of record. Drought intensity for the FWO varied from -1101 ft days to -328 ft-days over the period of record. Improved inundation patterns in WCA 3B resulted in better suitability for slough vegetation for both alternatives (**Figure G-36**). Implementation of Alternatives 4R and 4R2 would achieve 68-69%% of the target HUs for Zone 3B (**Table G-28**).

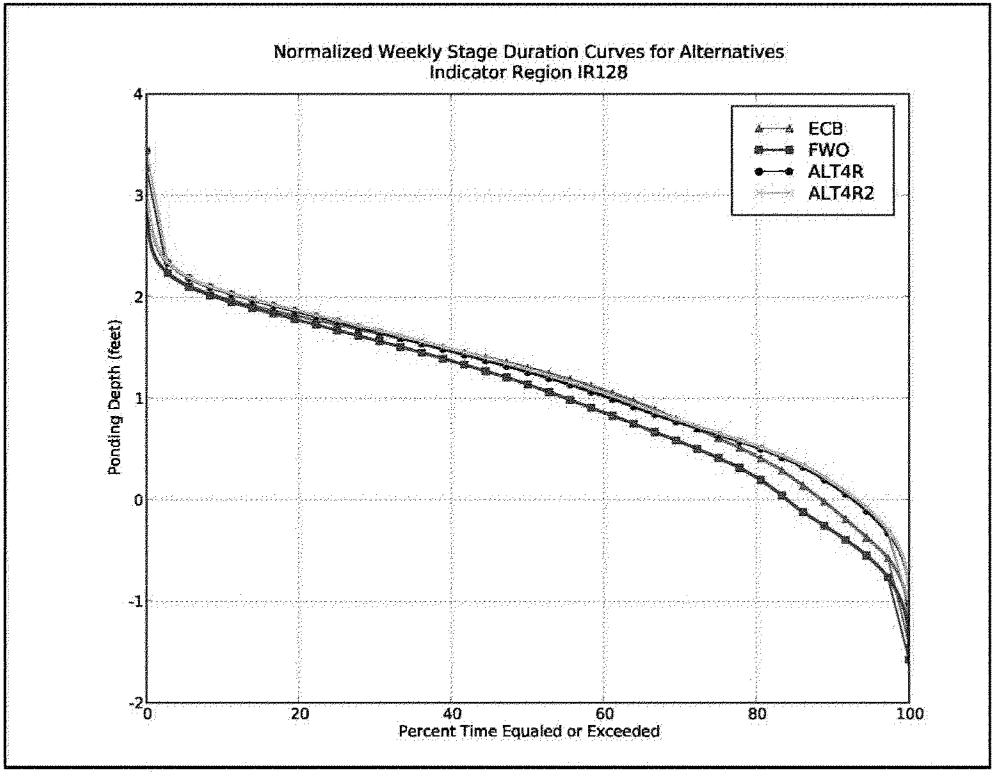


Figure G-35. Normalized Weekly Stage Duration Curve for Indicator Region 128 for Alternatives 4R and 4R2

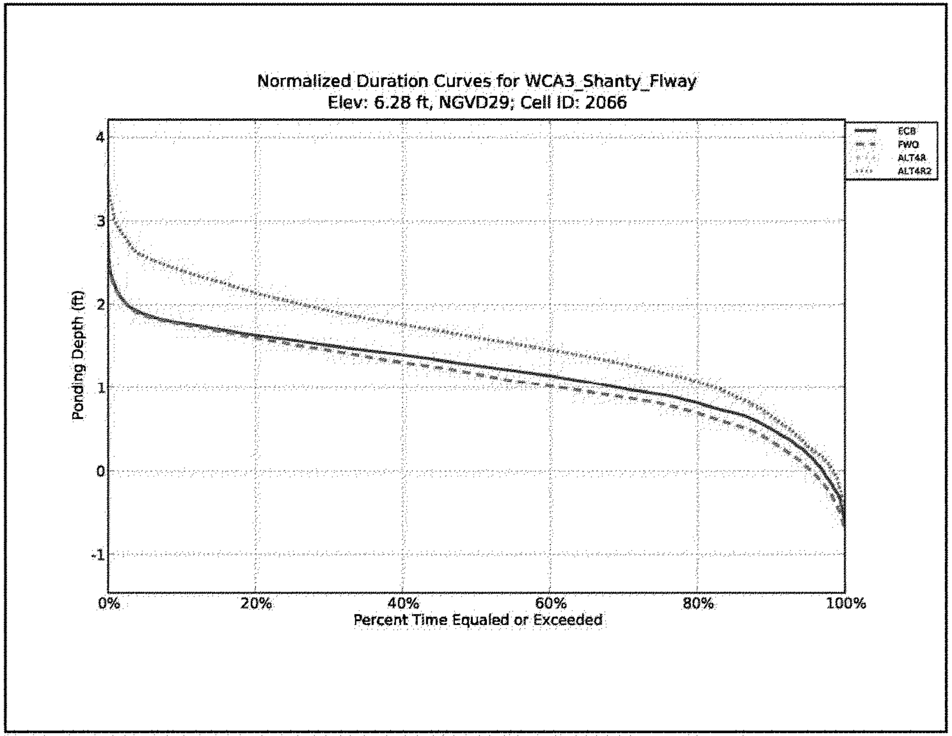


Figure G-36. Normalized Weekly Stage Duration Curve for Gage in Blue Shanty Flow-Way for Alternatives 4R and 4R2

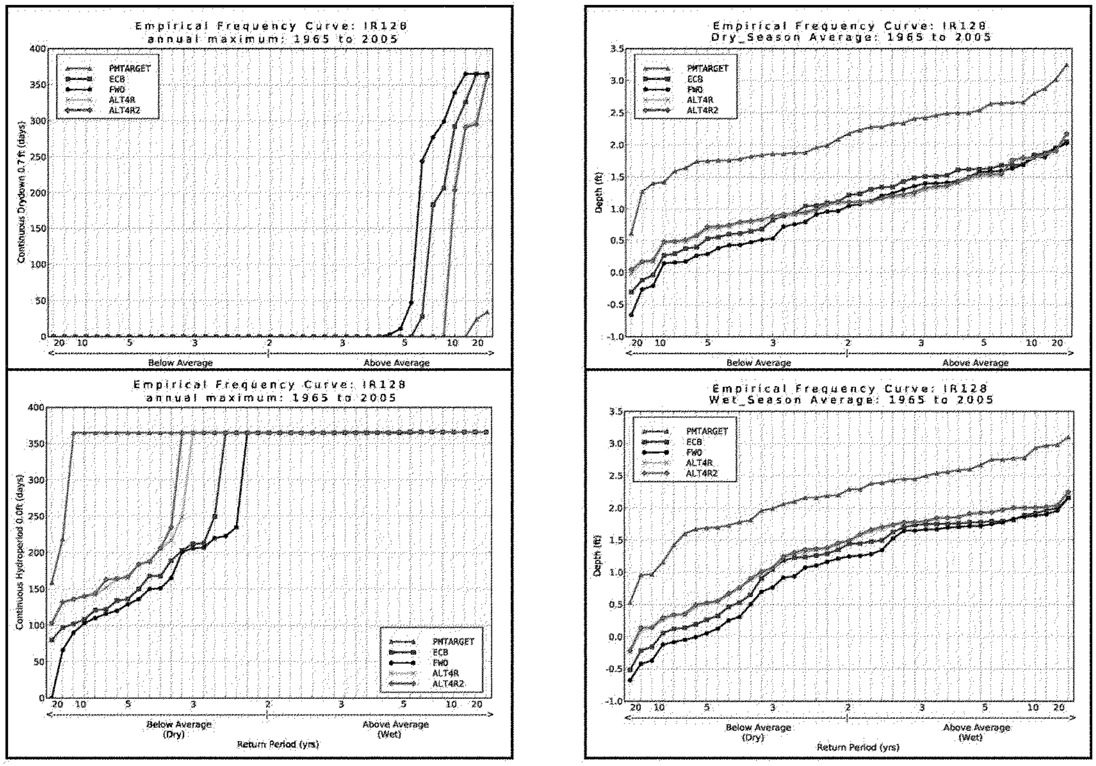


Figure G-37. Slough Vegetation Empirical Frequency Curves Indicator Region 128 for Alternatives 4R and 4R2

G.2.6.4 ENP (Zones ENP-N, ENP-S, ENP-SE) (Alternative 4R and 4R2)

Alternatives 4R and 4R2 improved hydrologic conditions in ENP in comparison to the FWO by significantly increasing depths and resulting hydroperiods in NESRS. Slight differences occurred between zones within ENP. Alternatives 4R and 4R2 scored the highest in terms of meeting the desired performance measure targets relative to the FWO in northern (Zone ENP-N) and southern ENP (Zone ENP-S) in comparison to southeastern ENP (Zone ENP-SE) (**Table G-29**, **Table G-30**, and **Table G-31**). Alternatives 4R and 4R2 scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation suitability. Alternatives 4R and 4R2 also consistently improved the number and duration of dry events in NESRS in comparison to the FWO (**Table G-32**). Scores for these performance measures ranged from 65 to 100 for northern ENP (Zone ENP-N) and southern ENP (ENP-S). Alternatives 4R and 4R2 were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing of sheetflow. Scores for these performance measures ranged from 30 to 63. In southeastern ENP (Zone ENP-SE), Alternatives 4R and 4R2 scored the highest in meeting desired performance measure targets for inundation duration and drought intensity (*i.e.* scores of 100). Other performance measure (slough vegetation suitability, and sheetflow) scored notably low.

Table G-29. Rescaled Performance Measure Scores (Zero to 100 Scale) for Northern ENP (Zone ENP-N) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	70	68	93	94
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	19	21	30	30
2.2	Sheetflow in the Ridge and Slough Landscape -- Continuity	41	35	39	40
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	50	46	53	53
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	52	50	89	89
4.1	Number and Duration of Dry Events -- Number	68	60	85	85
4.2	Number and Duration of Dry Events -- Duration	18	26	100	100
4.3	Number and Duration of Dry Events -- PPOR	1	2	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	59	53	86	86
5.2	Slough Vegetation Suitability -- Dry down	69	69	95	98
5.3	Slough Vegetation Suitability -- Dry Season Depth	24	23	56	56
5.4	Slough Vegetation Suitability -- Wet Season Depth	15	12	63	63
	Percentage of Target HU (HSI x 100)	**46**	**44**	**79**	**79**

Table G-30. Rescaled Performance Measure Scores (Zero to 100 Scale) for Southern ENP (Zone ENP-S) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	66	65	82	82
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	30	35	52	53
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	53	51	75	75
4.1	Number and Duration of Dry Events -- Number	61	62	69	70
4.2	Number and Duration of Dry Events -- Duration	74	75	98	95
4.3	Number and Duration of Dry Events -- PPOR	51	52	95	92
5.1	Slough Vegetation Suitability -- Hydroperiod	58	58	65	66
5.2	Slough Vegetation Suitability -- Dry down	82	86	96	96
5.3	Slough Vegetation Suitability -- Dry Season Depth	31	32	39	39
5.4	Slough Vegetation Suitability -- Wet Season Depth	26	24	35	35
	Percentage of Target HU (HSI x 100)	**52**	**53**	**71**	**71**

Table G-31. Rescaled Performance Measure Scores (Zero to 100 Scale) for Southeastern ENP (Zone ENP-SE) for Alternatives 4R and 4R2

Metric #	Performance Measure Metric	ECB	FWO	ALT4R	ALT4R2
1.1	Inundation Duration in the Ridge and Slough Landscape	100	100	100	100
2.1	Sheetflow in the Ridge and Slough Landscape -- Timing	13	20	25	25
2.3	Sheetflow in the Ridge and Slough Landscape -- Distribution	48	48	49	49
3.1	Hydrologic Surrogate for Soil Oxidation -- Drought Intensity Index	100	100	100	100
5.1	Slough Vegetation Suitability -- Hydroperiod	14	11	19	18
5.2	Slough Vegetation Suitability -- Dry down	5	4	28	25
5.3	Slough Vegetation Suitability -- Dry Season Depth	1	0	3	3
5.4	Slough Vegetation Suitability -- Wet Season Depth	4	4	6	5
	Percentage of Target HU (HSI x 100)	**59**	**60**	**63**	**62**

Table G-32. Number and Duration of Dry Events in Northeast Shark River Slough for Alternatives 4R and 4R2 (Raw Performance Measure Scores)

Zone	Indicator Region	Metric	FWO	ALT4R	ALT4R2
Zone ENP-N	129	Number	18	8	8
		Average Duration (Weeks)	20	10	9
Zone ENP-S	130	Number	16	13	12
		Average Duration (Weeks)	17	12	13
	131	Number	20	17	17
		Average Duration (Weeks)	16	13	13
	132	Number	22	20	20
		Average Duration (Weeks)	12	12	12

Inundation duration for Alternatives 4R and 4R2 ranged from 76% of the period of record to 96% of the period of record in northern ENP (Zone ENP-N) and from 91% to 93% in southern ENP (ENP-S). Inundation duration for the FWO within this same region varied from 78% to 83% of the period of record in northern ENP (Zone ENP-N) and from 86% to 91% in southern ENP (ENP-S). Alternatives 4R and 4R2 produced significantly higher depths than the FWO as depicted by the normalized weekly stage duration curve for IRs 129 (**Figure G-38**) and IR 130 (**Figure G-39**); example IRs for northern (Zone ENP-N) and southern (Zone ENP-S) ENP. Depths are significantly increased by 0.5 to 0.9 ft under all hydrologic conditions at IR 129 and by 0.1 to 03 ft at IR 130. Alternatives 4R and 4R2 improved the severity of drought intensity. Drought intensity for the Alternatives 4R and 4R2 varied from -3841 ft days to -350 ft-days over the period of record in northern ENP (Zone ENP-N) and from -750 ft-days to -395 ft-days in southern ENP (ENP-S). Drought intensity for the FWO varied from -3341 ft days to -1562 ft-days over the period of record in northern ENP (Zone ENP-N) and from -917 ft-days to -801 ft-days in southern ENP (ENP-S). Improved inundation patterns resulted in better suitability for slough vegetation for Alternatives 4R and 4R2 in both locations of ENP. Implementation of Alternatives 4R and 4R2 would achieve 79% of the target HUs for Zone ENP-N (**Table G-29**), 71% of the target HUs for Zone ENP-S (**Table G-30**), and 63-62% of the target HUs for Zone ENP-SE (**Table G-31**).

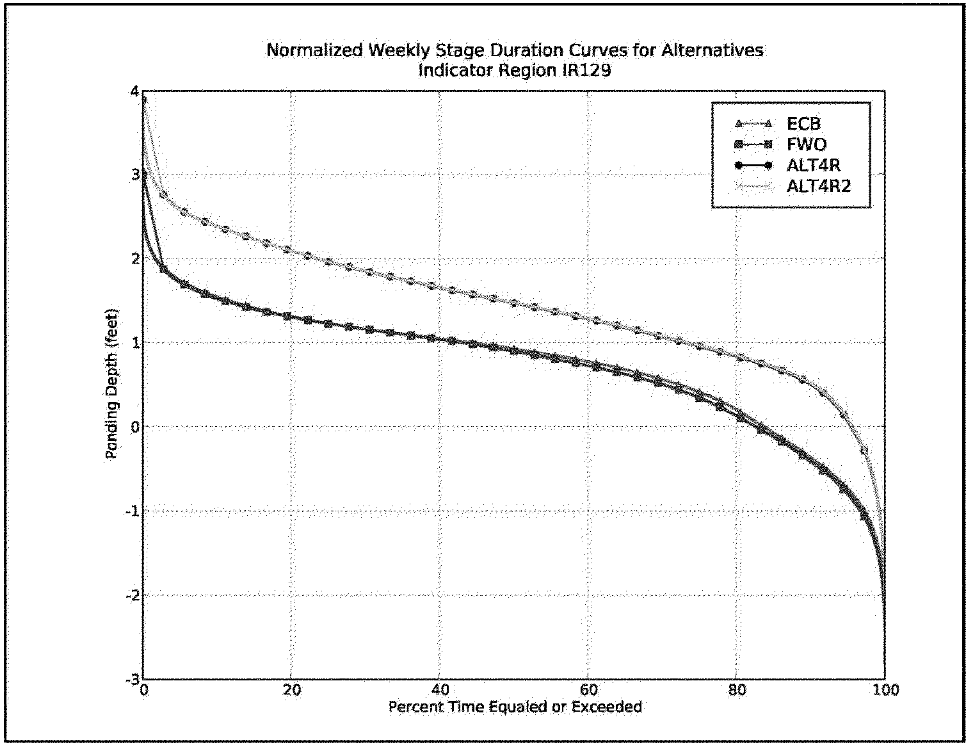


Figure G-38. Normalized Weekly Stage Duration Curve for Indicator Region 129 for Alternatives 4R and 4R2

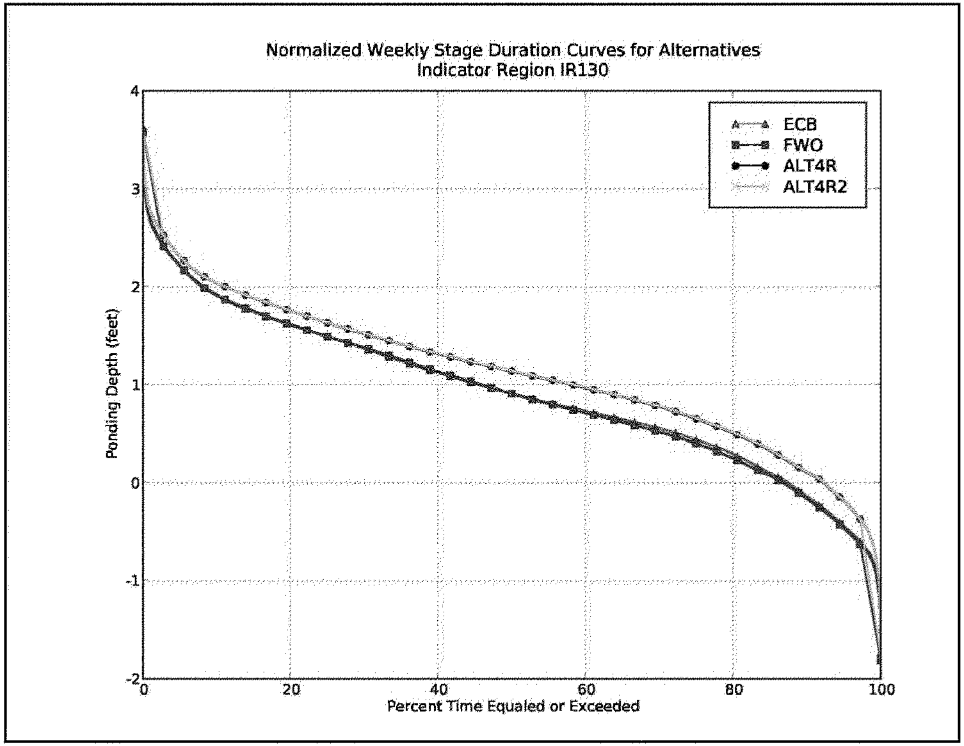


Figure G-39. Normalized Weekly Stage Duration Curve for Indicator Region 130 for Alternatives 4R and 4R2

G.2.7 Florida Bay (Alternatives 4R and 4R2)

Performance between Alternative 4R and 4R2 was similar. Alternatives 4R and 4R2 improved hydrologic conditions in Florida Bay in comparison to the FWO by increasing overland flows. Alternatives 4R and 4R2 provided increased flows within SRS in comparison to the FWO with annual flow increases above the FWO of 164,000 to 168,000 ac-ft on average per year (**Figure G-40**). Alternatives 4R and 4R2 provided increased flows within Taylor Slough in comparison to the FWO; however, increases in flow were not as significant as increases in observed flows in SRS. Alternative 4R provided annual flow increases of 27,000 ac-ft on average per year; Alternative 4R2 provided increases of 23,000 ac-ft per year. Improved hydrologic conditions in central SRS directly resulted in improved salinity conditions in Florida Bay. **Figure G-41** and **Figure G-42** depict results for the regime overlap and high salinity performance measures for the wet season and dry season. Alternatives 4R and 4R2 scored the highest in terms of meeting the desired targets during the wet season for each of the metrics. Improvements in salinity conditions relative to the FWO were of greater magnitude in the east central, central, south, and west Florida Bay zones.

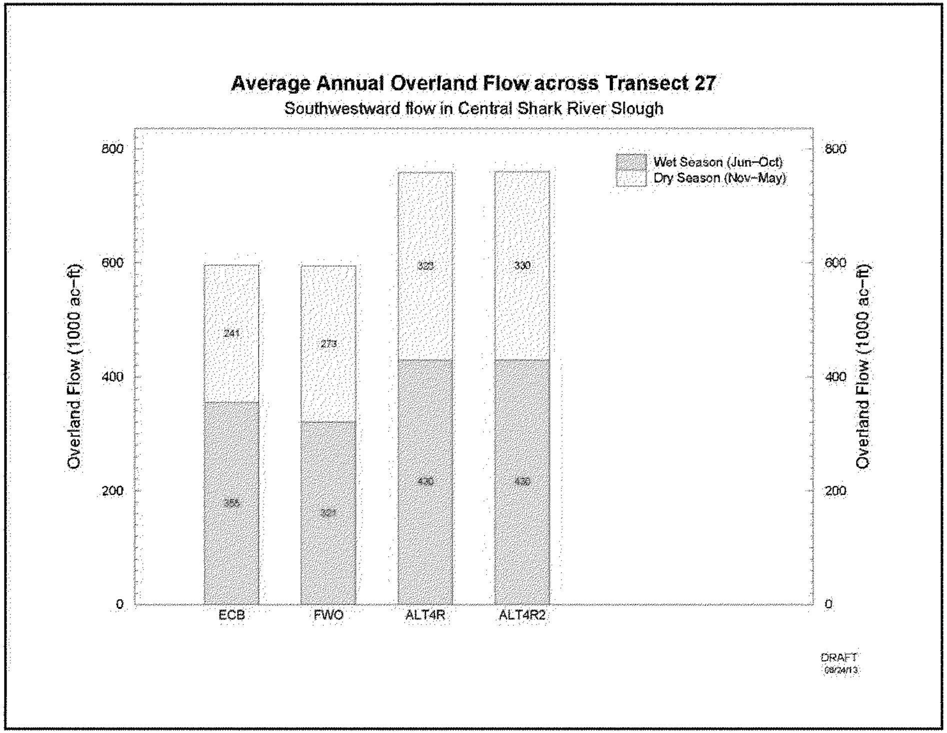


Figure G-40. Average Annual Overland Flow (1000 ac-ft) Across Transect 27 for Alternatives 4R and 4R2

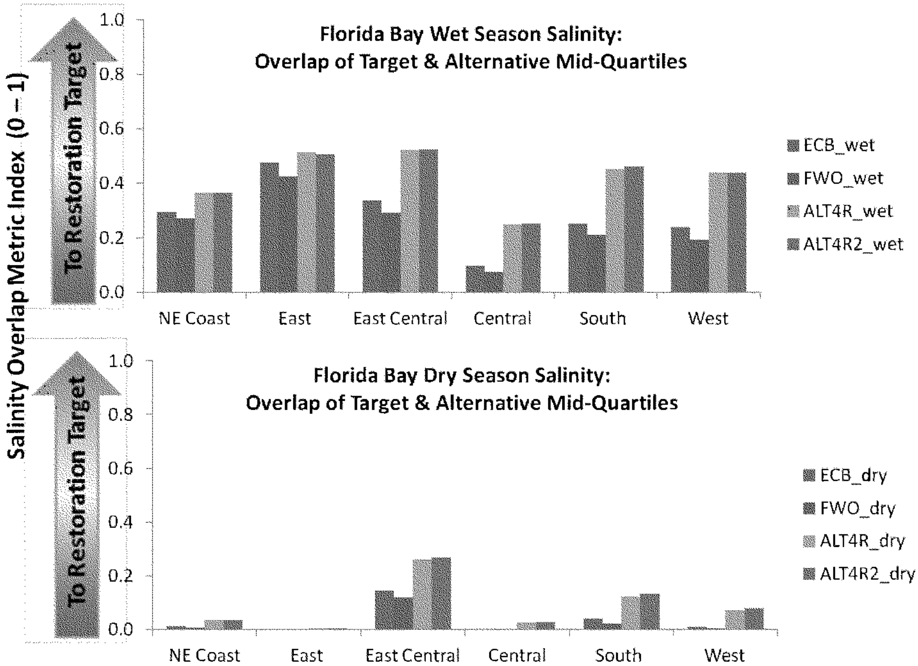


Figure G-41. Wet Season and Dry Season Regime Overlap Performance Measure for Florida Bay for Alternatives 4R and 4R2. Salinity Overlap Index (Dry Season) Equivalent to Zero for East Florida Bay.

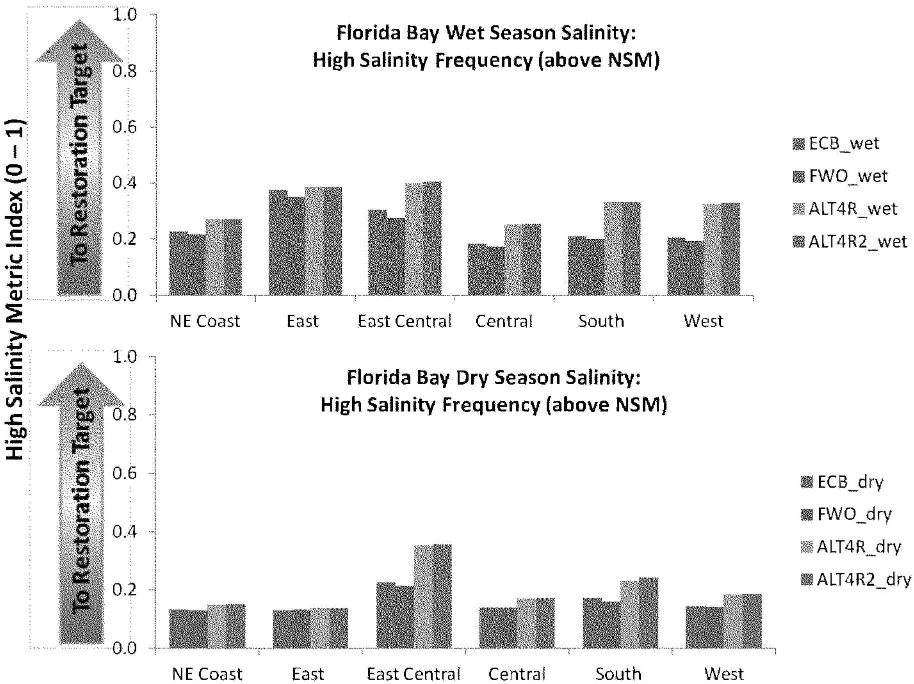


Figure G-42. High Salinity Performance Measure for Florida Bay for Alternatives 4R and 4R2

Table G-33 provides the percentage of target HUs resulting from the performance measure scores for each zone in Florida Bay. While the mean salinities for all alternatives are still higher than target conditions, implementation of CEPP brings salinities in Florida Bay closer to target conditions. Implementation of Alternatives 4R and 4R2 would achieve 17 to 39% of the target HUs for Florida Bay. The FWO would achieve 10% to 23% of the target HUs.

Table G-33. Percentage of Target HU (HSI x 100) for Florida Bay for Alternatives 4R and 4R2

Florida Bay	ECB	FWO	ALT4R	ALT4R2
Florida Bay West (Zone FB-W)	15	13	25	26
Florida Bay Central (Zone FB-C)	10	10	17	18
Florida Bay South (Zone FB-S)	17	15	28	29
Florida Bay East Central (Zone FB-EC)	25	23	38	39
Florida Bay North Bay (Zone FB-NB)	17	16	20	21
Florida Bay East (Zone FB-E)	25	23	26	26

G.2.8 Conclusions (Alternatives 4R and 4R2)

Alternatives 4R and 4R2 provided improvements in hydrology relative to the FWO in each region of the project area. **Table G-34** displays HU lift for Alternatives 4R and 4R2. Alternative 4R2 has been identified as the recommended plan. Alternative 4R2 provides for other water related needs to the LOSA and LEC while maintaining ecosystem benefits identified in Alternative 4R. See **Section 4(Evaluation and Comparison of Alternative Plans)** of the main report.

Alternative 4R2 addresses the need to restore ecosystem function in the Caloosahatchee and St. Lucie Estuaries by reducing the number and severity of events where harmful amounts of freshwater from Lake Okeechobee are discharged into the estuaries. Unnatural surges of freshwater have reduced estuarine salinity levels triggering die offs of sea grasses and oysters, species that are indicators of the estuary's overall health. A reduction in the number of high volume freshwater discharges to the estuaries would help to moderate unnatural changes in salinity which is extremely detrimental to estuarine communities.

Within the Greater Everglades, altered hydroperiods have led to declines in prey bases for numerous macrofauna including migratory birds. Untimely marsh dry outs deplete populations of fish and amphibians that are necessary to sustain the massive colonies of birds that used to inhabit the area. Fires that once would have contributed to the maintenance of the ecosystem now serve only to burn off layers of organic material and detritus that are imperative to maintaining proper nutrient levels. The resulting soil subsidence severely alters the composition of plant species in the natural communities, increasing the likelihood of invasion by aggressive, exotic vegetation. Results of the evaluation of Alternative 4R2 indicate that hydrology in WCA 3A, 3B and ENP would be significantly improved by the implementation of Alternative 4R2. Due to changes in the quantity, quality, distribution, and timing of water entering the Greater Everglades ecosystem, beneficial effects on wetland hydrology and vegetation would occur. The delivery of additional flow to the Everglades would return many of the currently dehydrated areas to a level of hydration which moves toward the pre-drainage, natural system condition. Improvements in the volume and distribution of flows to the Greater Everglades are a step towards restoring natural landscape patterns and native flora and fauna.

Changes in the hydrology of the freshwater systems have led to effects on the estuarine and marine environments of Florida Bay. Implementation of Alternative 4R2 is expected to improve the volume of overland flow to Florida Bay. The increase in overland flow to Florida Bay is a step toward reducing the intensity, frequency, duration, and spatial extent of hypersaline events in Florida Bay that have negatively impacted native bay flora and fauna.

Table G-34. Habitat Unit Lift Results for Alternatives 4R and 4R2

Project Region (Zone)	ALT4R*	ALT4R2*
Caloosahatchee Estuary (CE-1)	4,968	4,968
St Lucie Estuary (SE-1)	2,699	5,848
Total Northern Estuaries	**7,667**	**10,816**
Northeast WCA 3A (3A-NE)	62,972	61,738
WCA 3A Miami Canal (3A-MC)	27,373	27,373
Northwest WCA 3A (3A-NW)	23,932	23,932
Central WCA 3A (3A-C)	4,117	5,490
Southern WCA 3A (3A-S)	0	0
WCA 3B (3B)	9,426	10,283
Northern ENP (ENP-N)	43,793	43,793
Southern ENP (ENP-S)	42,946	42,946
Southeast ENP (ENP-SE)	4,054	2,702
Total WCA 3 and ENP	**218,613**	**218,257**
Florida Bay West (FB-W)	18,954	20,534
Florida Bay Central (FB-C)	5,743	6,564
Florida Bay South (FB-S)	12,705	13,682
Florida Bay East Central (FB-EC)	13,191	14,070
Florida Bay North Bay (FB-NB)	506	633
Florida Bay East (FB-E)	1,133	1,133
Total Florida Bay	**52,232**	**56,616**
Total All Regions	**278,512**	**285,689**

* HU lift values for ALT 4R and 4R2 represent those calculated in the year 2072.

G.3 TECHNICAL QUALITY OF THE CEPP PLANNING MODEL

The CEPP is highly dependent on the results of dynamic regional hydrologic and ecologic simulation models. The CEPP planning model based its calculation of environmental benefits on inputs derived from the NSM, the RSM-GL, the RSM-BN and the working hypotheses set forth in the Northern Estuaries, Greater Everglades Ridge and Slough, and Florida Bay Conceptual Ecological Models (CEMs) (Barnes 2005, Sime 2005, Ogden 2005a, Rudnick et. al. 2005). These models are considered to be appropriate tools for planning for the CERP. The NSM, RSM-GL, and RSM-BN have been validated through the Corps Engineering Model Certification process established under the Engineering and Construction (E&C) Science and Engineering Technology (SET) initiative. Each of the project performance measures for the CEPP planning effort described above were derived from those performance measures approved for use by RECOVER. The scientists of RECOVER have extensive experience working in south Florida and Everglades wetlands ecosystems. These members are considered by their peers to be the experts in their fields. In addition, the CEMs from which the CEPP performance measures were developed have been extensively peer reviewed and provide the framework for the planning and assessment of the CERP.

G.4 STATEMENT ON THE CAPABILITIES AND LIMITATIONS OF THE CEPP PLANNING MODEL

Significant effort has been invested in the development and calibration of regional and sub-regional hydrologic models. However, recognition of model uncertainty is needed when interpreting the ecological significance of model output. There is uncertainty in the predictions derived from these models that stems from input variability and measurement errors, parameter uncertainty, model structure uncertainty and algorithmic (numerical) uncertainty as outlined in the CERP Model Uncertainty Workshop Report (RECOVER 2002), the CERP Model Needs Report (RECOVER 2005), and CERP System-Wide Performance Measure Report (RECOVER 2007a). These uncertainties are translated into uncertainty as to whether the specific performance indicators and measures used to characterize the overall system performance actually capture that overall performance.

The likelihood of capturing all the processes occurring in a system as complex as the Everglades within simulation models is low. There is uncertainty in predicting environmental benefits associated with any CERP project because of the size and complexity of the Everglades ecosystem and limitations on our scientific understanding of its physical and biological processes. However, the outputs of the sub-regional hydrologic models and performance measures used to quantify ecosystem benefits for the CEPP utilized the best data available to predict the most-likely hydrologic and ecological changes as a result of the project.

Performance measures have been extensively peer reviewed and are considered to be the best available to the project for evaluating alternative performance. The performance measures reflect our current understanding of 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. Increased scientific understanding of the Greater Everglades system and its attributes has been incorporated into these performance measures during the RECOVER review process. The performance measures are not intended to provide a measure of absolute performance at a small scale, but do provide for relative comparisons of alternatives. Performance measures were selected to measure project performance at key locations selected by design to provide the best overall measure of system wide benefits when aggregated into a single HU score. The method used for aggregation of performance measures provided a fair, un-biased evaluation of alternative performance that avoids subjective planning-level decision-making in selecting the best performing plan.

CEPP project team members have reviewed the CEPP planning model and its constituent performance measures to develop an assessment of uncertainty in the overall benefits quantification. This was conducted to ensure that decision-makers are informed about uncertainties that affect interpretation of the CEPP planning model outputs. Five questions about model uncertainty were investigated.

1. Are there performance measures that do not differentiate between alternatives and should these performance measures be removed from the CEPP planning model?

All performance measures were realistically sensitive to differences between modeled alternatives. Differences in the magnitude of performance between alternatives varied by approximately ± 5 points on a zero to 100 scale. This was not a result of intrinsic insensitivity of the performance measures because the alternatives showed as much as a 74 point difference relative to the FWO for several regions of the project area. Similarity in the range of performance measure scores between alternatives is more likely a consequence of plan formulation efforts. During plan formulation efforts, the CEPP project team optimized operations within WCA 3A, 3B and ENP to best achieve targets throughout the system. Similar performance in northern WCA 3A was expected as alternative configurations were similar in structure. Alternative configurations differed with respect to the L-67 A/C and L-29 levees in WCA 3B; stage constraints in WCA 3B dictated the amount of available water that could be delivered to this area, forcing hydrologic improvements in this area to be similar among alternatives even though the number and size of operational structures differed.

2. Are there performance measures that could be influencing the overall benefits score?

No one performance measure was identified as disproportionately influencing the overall benefits score within a given zone. Alternative performance in the Northern Estuaries was measured by evaluating the frequency and magnitude of freshwater inflows from Lake Okeechobee and the estuary watersheds. Flow targets were outlined under the RECOVER salinity performance measure. Performance measures for the Northern Estuaries showed differences between alternatives in their ability to meet the desired high and low flow targets. Alternative performance in WCA 3 and ENP was measured by evaluating the depth, distribution, and duration of surface flooding, and the timing and distribution of flows. Alternatives scored the highest in terms of meeting the desired targets for measures of inundation duration, drought intensity, and slough vegetation. Pertaining to slough vegetation suitability, greater performance was noted with regard to maximizing continuous hydroperiods (days with depth ≥ 0.0 ft) and minimizing dry down events below 0.7 ft. Alternatives were not as effective in maintaining appropriate dry and wet season depths for slough vegetation or in maintaining the timing and distribution of sheetflow however improvements in these performance measures were apparent over the FWO for many regions of the project area. Alternative performance in Florida Bay was measured by evaluating the magnitude of salinities in Florida Bay in response to inflows from ENP. Performance measures for Florida Bay showed differences between alternatives in their ability to meet the desired salinity targets.

3. Are there indicator regions and/or transects within each zone that could be influencing the overall benefits score?

Performance measures within WCA 3 and ENP were generated from hydrologic output from the RSM-GL using indicator regions (IRs) and/ or flow transects. No one IR and/or transect was identified as disproportionately influencing the overall benefits score within a given zone. Generally speaking, observed differences in alternative performance were similar across IRs and/or transects within a given zone; the ranking of alternatives did not change. The magnitude of the difference in alternative performance did change based on the relative distance of the IR and/or transect from the location at which additional flow was introduced. For example, within northern WCA 3A significant differences in alternative performance in comparison to the FWO primarily occurred at IRs and transects located near the L-4/L-5 boundary where additional flow was introduced into WCA 3A (*i.e.* IRs 114, 115, 116, 117, 118, 190, MC NE1, MC NE2, MC NW1, MC NW2, MC CE1, MC CE2, MC CW1, MC CW2, Transect 5, Transect 6, Transect MC 1, MC 2, MC 3). Hydrologic improvements over the FWO were less significant as the distance from the L-4/L-5 boundary increased (*i.e.* IRs 119, 121, MC SE1, MC SE2, MC SW1, MC SW2, Transect 7, Transect 8, Transect MC 4, MC 5). Similar patterns were apparent in IRs and/or transects in ENP as the distance from introduction of additional flow at Tamiami Trail (L-29) increased.

4. Is there the potential for trade-offs within the project area? (*i.e.* Do benefits to northern WCA 3A come at the expense to southern WCA 3A?).

The CEPP planning model reported the partition of HU into contributions from each zone within the Northern Estuaries, WCA 3, ENP, and Florida Bay. This enables evaluators and decision-makers to consider how differences between alternatives are distributed spatially, including potential trade-offs in benefits between sub-regions of the project area. Benefits were observed in each zone of the project area. Alternative 4 provided the greatest project benefits for WCA 3, ENP, and Florida Bay while Alternative 2 provided the least. Alternatives 3 and 1 provided more project benefits than Alternative 2. Results of the CE/ICA identified Alternative 4M as providing the greatest overall benefits with the least cost per habitat unit. See **Section 4 (Evaluation and Comparison of Alternative Plans)**. However, within WCA 3B, this alternative was consistently the worst performer. Operational refinements were subsequently proposed to Alternative 4 to address project constraints and provide improved water depths to WCA 3B.

5. How does error within the regional hydrologic models influence performance measure output?

The CEPP planning model implemented an assumption that performance measure results used as inputs to the planning model were of equal credibility and reliability. The CEPP planning model assumed that each of the performance measures used within the project area could be extrapolated from the point locations modeled by the regional hydrologic models to the larger areas they represent. This approach assumed that the results of the hydrologic models were similar across spatial scales within these geographic regions. Due to differences in each hydrologic model's accuracy and precision (within and among regions of each model's domain), and differences in sensitivities of each performance measure to changes in hydrologic conditions, an assumption that all performance measure results are of equal credibility may be viewed as faulty. To address this concern, the CEPP project team consulted individuals involved in the development, calibration, and application of the hydrologic models being used to conduct alternative analyses to verify that observed differences between alternatives were not the results of differential exploitation of hydrologic model error/bias. Results of the calibration and validation of RSM-GL were reviewed to address how error in the hydrologic model could influence alternative results within WCA 3 and ENP. A brief summary of the pertinent results of the calibration and validation report (SFWMD 2010) are provided below as well as an overview of RSM-GL and its suitability for CEPP application. Analyses conducted to evaluate how error in RSM-GL could influence alternative performance within the CEPP planning model is described below.

Overview of the RSM-GL and Suitability for CEPP Application

The RSM-GL provides daily, detailed estimates of hydrology across the 41 year period of record. The regional hydrologic model encompasses an area of 5,825 square miles. The model simulates all major water budget components that are relevant to South Florida. These include evaporation, transpiration, overland and groundwater flows, levee seepage, and canal flows. The area of the model-domain includes Everglades National Park, Water Conservation Areas, Big Cypress National Preserve, and the Lower East Coast Service Areas south of the C-51 canal in Palm Beach County. The southern, eastern and southwestern boundaries of the model comprise Florida Bay, the Atlantic Ocean/Biscayne Bay and the Gulf of Mexico.

The RSM-GL application of the RSM was developed by the SFWMD and the RSM-GL was specifically calibrated to support the evaluation of proposed project features for the CERP WCA-3 Decompartmentalization and Sheetflow Enhancement project (Decomp). Prior to initiation of the CEPP project, the RSM-GL model was previously first applied by the SFWMD/USACE to support base condition modeling and evaluations of the final array of alternatives for the Decomp Project Implementation Report 1 (PIR 1) during 2010-2011. Both the Decomp and CEPP projects are components of the CERP and the features of the prior Decomp project are central components to the CEPP. Following the CEPP announcement in October 2011, the USACE SAJ and the SFWMD decided to integrate the previous Decomp planning effort into the CEPP.

Since the Decomp project represented the inaugural USACE project application of the RSM-GL, the Decomp project team had planned to submit the RSM-GL for USACE Engineering software validation evaluation following the completion of the RSM-GL model calibration and validation report and the completed simulations/documentation for the initial suite of alternatives with the RSM-GL, when sufficient model documentation could be readily provided to facilitate the review. Since the requisite documentation was not available until December 2011, the RSM-GL request for USACE Engineering software validation evaluation was deferred to the CEPP.

The USACE model certification process distinguishes between "Engineering" and "Planning" models. One of the goals of the Scientific and Engineering Technology (SET) initiative is to inventory and evaluate the software used by the Corps' scientific and engineering community, to ultimately achieve a manageable and cost-effective USACE corporate tool set. Each piece of software is inventoried, reviewed, and ultimately listed in one of five categories: Enterprise Tools, Community of Practice (CoP) Preferred, Allowed for Use, Retired, and Not Allowed for Use. It is expected that the lists will continue to evolve as new software is introduced.

Current USACE guidance (ES-0801: June 2011) regarding software validation for the Hydrology, Hydraulics, and Coastal Community of Practice (HH&C CoP) indicate that both the District and Division need to recommend the software for evaluation for inclusion within the inventory. The recommendation should state whether the software will be used nationally, regionally, or locally, and should include why the software is needed, an explanation as to what it does and how it does it, why any of the other corporate software already on the list doesn't meet the needs, who within the Corps has knowledge of this software, what type of peer review has it received, what Area of Expertise (AoE) software list should it be included with, and what documentation, training and support can be found. The goal of the SET program is to manage the number of pieces of software so the Corps doesn't have to support multiple pieces of software that do roughly the same thing. The USACE should use "well-known and proven" software unless a new piece of software does something one of the "validated" pieces of software does not.

Based on ES-0801 guidance and coordination between SAJ and SAD, the following comprehensive suite of information (items 1 through 9) is typically requested to support a request for USACE "Engineering" model validation evaluation:

1) Model Classification (Area of Expertise);
2) Requested Model Application Area;
3) General model documentation/description of model capabilities (include web site links or documentation reports);
4) Why the model software is needed? (consider other approved corporate software);
5) External peer review (requested by?; Conducted by?; Model version and date?; final reports should be provided);
6) Internal technical review by Interagency Modeling Center (model version and date?; final report should be provided);
7) Previous applications of the model (specific projects and sponsor agency);
8) Additional applicable reports or documentation, if any (other agency peer reviews, project specific applications of model, model users' guide, etc.);

9) USACE knowledge base for this software.

The request for RSM software validation included significant reliance on the USACE modeling strategy that was executed for Decomp, which included primary reliance on the RSM-GL. An extensive modeling strategy development and review effort was used by the Decomp project delivery team (PDT) to identify the RSM-GL model as the preferred sub-regional modeling tool to support Decomp PIR 1 alternative evaluations. The comprehensive Decomp modeling strategy was further endorsed by the CERP Interagency Modeling Center (IMC) in June 2008; the IMC, under its responsibility to serve as a central point to coordinate Comprehensive Everglades Restoration Program (CERP) and CERP-related modeling activities, is routinely consulted to implement peer reviews of models and their applications. In addition, IMC peer review of the available sub-regional hydrologic modeling tools for Decomp resulted in an IMC endorsement for the RSM-GL model. The IMC peer review report (May 2008) recognized the RSM-GL as: (1) an improvement over the Regional South Florida Water Management Model (SFWMM) with respect to model methodology (surface flow, canal flow, sub-surface flow, evaporation, evapotranspiration, infiltration and seepage), especially when considered as a sub regional tool for implementation of the hydrologic portion of the Decomp modeling strategy; (2) an improvement over the SFWMM with respect to the model grid density and local grid refinement capabilities, and modeler control of adding, removing, or modifying canals, structures, and structure operation rules; (3) able to distinguish between spatial and temporal differences in water depths/stage (including recession rates), and overland and canal flow adequately for CERP evaluations; and (4) if used with caution and adequate interpretation of the model output, able to show some important differences between the varying degrees of Miami Canal backfill or plugging that may be proposed for Decomp PIR 1 alternatives. Key priority recommendations from the IMC peer review panel for enhancements to the RSM-GL model and the calibration/validation report content, as agreed upon following a May 2008 meeting with SFWMD, USACE, IMC managers, and the IMC peer review panel, were implemented for the final version of the RSM-GL that was applied for Decomp and, ultimately, CEPP.

For the CEPP project, the previously-listed USACE software validation evaluation information was compiled and submitted through SAD to the HH&C CoP for evaluation in June 2012. In August 2012, SAJ received notification that the RSM model (including the RSM-BN and RSM-GL sub-regional applications of RSM, which are both utilized for CEPP) was added to the SET inventory of approved engineering software as "Allowed for Use" for South Florida applications.

Summary of Performance for RSM-GL (Review of Calibration/Validation Results)

Two goodness-of-fit statistics, bias and root mean square error (RMSE), were utilized for the calibration of the RSM-GL. These two goodness-of-fit statistics are commonly used in the calibration of surface water models. The model was calibrated until the following two criteria were met: 1) a bias value of ± 1.0 feet (ft) for all stage stations; and 2) an RMSE value smaller than 2.0 ft for all stage stations. These threshold values are well within the data error and uncertainty tolerances for the modeled area. These targets were used to determine the minimum acceptable threshold value requirements for an acceptable calibration.

A total of 336 and 321 measured stage time-series data sets were used for the calibration and validation of RSM-GL, respectively. The model is calibrated using historical stage data from 1/1/1984 to 12/31/1995. Out of the 336 gages used for stage calibration, 100% of the gages meet the acceptability criterion for both bias (1.0 ft) and RMSE (2.0 ft). None of the gages violated the pre-set bias and RMSE threshold considerations. Overall, the mean and the standard deviation of absolute bias for the calibration period were 0.21 ft and 0.18 ft, respectively. Similarly, the mean and standard deviation values of RMSE for the calibration period were 0.54 ft and 0.25 ft, respectively.

Historical stage data from 1/1/1981 to 12/31/1983, and 1/1/1996 to 12/31/2000 are used for model validation. In general, the model performed extremely well during the two validation periods. For the two validation periods, these percentages changed to 98.4% and 99.4 %, respectively. Overall, the mean and the standard deviation of absolute bias for the validation period were 0.26 ft and 0.29 ft, respectively. Similarly, the mean and standard deviation values of RMSE for the validation period were 0.59 ft and 0.35 ft respectively. For the validation period, five gages exceeded the bias threshold value of ± 1.0 feet. Two gages exceeded the RMSE threshold value of 2.0 ft. Two of the gages exceeded both criteria. The actual reasons that contributed to these deviations are not easy to identify and isolate. However, it is very likely that errors in the measured historical data may have contributed to these deviations.

Additional Analyses to Address Performance of CEPP Alternatives

The calibration/validation results mentioned above show that output from RSM-GL provides the best data available to predict the most-likely hydrologic changes as a result of the project. These above calibration/validation results show that the RSM-GL is capable of simulating with an acceptable error tolerance, the stage and other stage dependent variables such as flow, flow vectors, ponding depth and hydroperiods within the model-domain. However, it is recognized that the RSM-GL calibration results (in terms of RMSE) vary spatially across the model domain, potentially giving a rise to a concern of model performance consistency. Areas with high RMSE scores may be deemed less reliable than those with low RMSE scores. Although this is an inherent problem in all models, users of regional hydrologic models often wish to utilize a measure of model relative performance to reflect such calibration variability within the study area. Ideally, uncertainty measures should be developed as a standalone metric for model reliability. Given the inherent complexity of the subject matter, the CEPP project team proposed a simple approach that reflects the model's relative performance based on the RMSE scores.

To specifically evaluate how error in the hydrologic model could reflect alternative results' reliability (henceforth called importance), results of the RMSE utilized for the calibration of RSM-GL were used to calculate a relative importance score for each IR within the CEPP planning model. Indicator regions with a higher RMSE were generally given a lower importance score. The RMSE was noted for those gages that were located either within or directly adjacent to each of the IRs used in the CEPP planning model. Of the 33 IRs used, RMSE scores were available for 17 out of the 33 IRs, ranging from 0.29 to 0.95 ft. Best professional judgment was used to interpolate RMSE scores for the remaining 16 IRs. Using the RMSE scores at all 33 IR locations, the following equation was used to calculate the relative importance score (RIS) for each IR. **Table G-35** presents the RMSE used for each IR and the IRs relative importance score.

$$RIS_i = \frac{\left(\frac{1}{RMSE}\right)^{\alpha}}{\sum_{i=1}^{n}\left(\frac{1}{RMSE}\right)^{\alpha}} * n$$

Where *RMSE is the root mean square error for each IR, α is a power constant and n is the number of IRs used in the CEPP planning model. α is a measure of the performance variability steepness across the RMSE values (2 is recommended).*

Table G-35. Root mean square error statistics and relative importance scores for each Indicator Region used in the CEPP Planning Model

Indicator Region	Root Mean Square Error (RMSE)	Relative Importance Score
IR 114	0.58	0.53
IR 115	0.65	0.43
IR 116	0.84	0.25
IR 117	0.47	0.81
IR 118	0.52	0.66
IR 119	0.43	0.99
IR 120	0.37	1.34
IR 121	0.33	1.64
IR 122	0.29	2.13
IR 123	0.37	1.31
IR 124	0.30	1.99
IR 125	0.38	1.24
IR 126	0.39	1.21
IR 128	0.39	1.18
IR 129	0.32	1.81
IR 130	0.40	1.15
IR 131	0.42	1.02
IR 132	0.42	1.02
IR 133	0.47	0.81
IR 140	0.54	0.61
IR 190	0.95	0.20
MC_NE1	0.65	0.43
MC_NE2	0.65	0.43
MC_NW1	0.34	1.55
NC_NW2	0.57	0.55
MC_CE1	0.53	0.64
MC_CE2	0.53	0.64
MC_CW1	0.53	0.64
MC_CW2	0.50	0.72
MC_SE1	0.41	1.09
MC_SE2	0.39	1.20
MC_SW1	0.37	1.32
MC_SW2	0.35	1.47

Performance measure scores were based on the hydrologic conditions in IRs and flow transects, however, only one of the five Greater Everglades performance measures was based on transect flow metrics. The RSM-GL was calibrated to stage, but not transect flows. Although flow is a stage dependent variable and transect flow weighting could potentially be estimated from the relative importance scores for each IR, the decision was made to not assign importance values to transects in the CEPP planning model. Transect scores which were also included in the CEPP planning model were not assigned a relative importance factor.

Habitat unit results for Alternatives 1-4 are displayed in **Table G-36**. Scores denoted with an asterisk include the addition of the relative importance score within the CEPP planning model. Inclusion of a relative importance score did not influence the overall rank of alternative performance. **Table G-36** indicates that in both instances (weighted versus un-weighted) Alternative 4 provides the greatest lift for WCA 3 and ENP while Alternative 2 provides the least lift relative to the FWO. Alternatives 3 and 1 provide more lift in comparison to Alternative 2. Differences in HU scores between the weighted and un-weighted scores occurred primarily in northern WCA 3A with the ECB and FWO project condition. Overall, a 5% change occurred between the weighted versus un-weighted total HU scores for the ECB. A 7% change occurred between the weighted versus un-weighted total HU scores for the FWO. A 1% or less percent change occurred between weighted versus un-weighted total HU scores for the alternatives. Some locations where the FWO scored poorly and the alternatives received high scores were down-weighted the most when the importance weighting was applied, resulting in a greater change in the FWO scores. An alternative score will increase if poor scores are down-weighted and higher scores within a zone are not. The process of deciding appropriate weights raises challenging questions about methods for assigning those weights. Given this result, the CEPP project team decided to use the current default weight of 100% for all IRs within each zone. The results of this additional analysis to address the performance of CEPP alternatives indicate that the developed methodology is robust.

For Florida Bay, simulated hydrology produced by the RSM-GL at marsh gages in ENP is post-processed using multiple linear regression statistical models to predict salinities at all MMN stations in Florida Bay. Given that alternative performance in Florida Bay is dependent on upstream hydrology, and the overall rank of alternatives in WCA 3 and ENP did not change with inclusion of a relative importance score, weighting of the Florida Bay performance measure was not pursued.

An additional analysis similar to the one above was not performed for performance measures within the Northern Estuaries. Alternatives 1-4 were the same within the Northern Estuaries.

Table G-36. Habitat Unit Results for Project Alternatives 1-4

Project Region (Zone)	ECB*	ECB#*	FWO**	FWO#**	ALT 1***	ALT 1#***	ALT 2***	ALT 2#***	ALT 3***	ALT 3#***	ALT 4***	Alt 4#***
Northeast WCA 3A (3A-NE)	44,451	56,799	29,634	45,686	96,311	97,545	96,311	97,545	96,311	97,545	96,311	98,780
WCA 3A Miami Canal (3A-MC)	32,847	39,886	27,373	34,412	57,874	59,438	57,092	58,656	56,310	57,874	57,092	58,656
Northwest WCA 3A (3A-NW)	30,970	38,713	30,266	38,009	54,902	55,606	53,494	54,902	53,494	54,902	53,494	54,902
Central WCA 3A (3A-C)	108,414	107,042	105,669	105,669	109,786	109,786	109,786	109,786	109,786	109,786	109,786	109,786
Southern WCA 3A (3A-S)	69,247	69,247	68,423	68,423	68,423	68,423	67,598	67,598	67,598	67,598	68,423	68,423
WCA 3B (3B)	55,697	55,697	48,842	49,699	58,268	58,268	59,125	59,125	57,411	57,411	54,840	55,697
Northern ENP (ENP-N)	57,557	67,566	55,054	65,064	102,601	102,601	101,350	102,601	103,852	105,103	102,601	103,852

Project Region (Zone)	ECB*	ECB#*	FWO**	FWO#**	ALT 1***	ALT 1#***	ALT 2***	ALT 2#***	ALT 3***	ALT 3#***	ALT 4***	Alt 4#***
Southern ENP (ENP-S)	124,068	124,068	126,454	124,068	169,400	169,400	169,400	169,400	176,558	176,558	188,488	188,488
Southeast ENP (ENP-SE)	79,711	79,711	81,062	81,062	82,413	82,413	82,413	82,413	82,413	8,2413	83,764	83,764
Total HU WCA 3 and ENP	602,962	638,729	572,777	612,092	799,978	803,480	796,569	802,026	803,733	809,190	814,799	822,348

* Denotes instances in which indicator regions were assigned a relative importance weight.
** HU values for the ECB represent those calculated in the year 2010.
*** HU values for the FWO and ALT 1 through ALT 4 represent those calculated in the year 2072.

G.5 ASSUMPTIONS OF THE CEPP PLANNING MODEL

There is no standardized methodology for predicting ecosystem benefits that result from habitat restoration projects. For the Corps planning process, the most apparent adverse risks of employing a given benefit estimation methodology are: 1) the most effective project alternative is not selected for implementation, 2) the selected project provides significantly fewer benefits than estimated, or 3) the selected project significantly harms the resource. Assumptions used in the CEPP planning model that may influence the accuracy of its results are described below.

1. **Equal Weighting:** Metrics may contribute equally or unequally to a final evaluation. The process of deciding appropriate weights raises challenging questions about methods for assigning those weights. The CEPP planning model assumed that each project performance measure would carry equal weight in the overall benefits calculation. One performance measure was not assumed to be more "important" than another. In addition, all project objectives were considered equally important restoration targets and were assumed to carry equal weight in the overall benefits calculation.

   The CEPP planning model was developed during prior plan formulation efforts under CERP. The model was developed during planning efforts for the Decompartmentalization (Decomp) and Sheet flow Enhancement of WCA 3 (Project Implementation Report I). This component of the CERP is now a part of CEPP. A number of weighting options were used in alternative evaluations for Decomp PIR 1; however the weights chosen by that planning team did not influence the overall ranking of project alternatives. The planning effort for Decomp used several of the same performance measures, had similar project objectives and was located within the CEPP project domain. Because of the similarity between planning efforts, the CEPP project team chose not to use similar weighting options.

2. **Spatial Extrapolation:** The CEPP planning model assumed that each of the performance measures used within the Northern Estuaries, WCA 3, ENP, and Florida Bay could be extrapolated from the point locations modeled by RSM-BN and RSM-GL to the larger areas they represent. This approach assumed that the results of the RSM-BN and RSM-GL performance measures were similar across spatial scales within these geographic regions.

   It is acknowledged that performance may vary across the hydrologic model domain; however, the CEPP project team considers the current approach to be acceptable for the purposes of evaluating relative performance between alternatives. Indicator regions and transects were used within WCA 3 and ENP in part because there is greater confidence in the hydrologic model results at these locations than at other locations within the model domain. Furthermore, while extrapolation of performance measures from IRs and/or transects to larger zones can potentially impact model accuracy; a sufficient number of IRs and transects have been used within each zone to address this concern.

3. **Reference Degraded Areas:** For those performance measures used within WCA 3 and ENP, reference areas within the existing system were used to set the minimum value from which each project performance measure was re-scaled. The environmental conditions in northern WCA 3A were assumed to be an accurate measure of the current degraded ecologic condition of WCA 3A. Indicator regions and transects (under existing conditions) within northwest WCA 3A consistently produced the lowest performance measure scores as a result of the modeled water

depths and hydroperiods. The results showed this to be the most degraded location within WCA 3 and ENP and are consistent with field observations.

It is recognized that this computation may be viewed as a limitation of the CEPP planning model to mask trade-offs by embedding an assumption that conditions can be made no worse than the values used to set the minimum score (ECB); however the CEPP project team considers the current approach to be acceptable for the purposes of evaluating relative performance between alternatives. Increasing the range between the minimum and the target to include conditions worse than "fully degraded" artificially compresses the range in scores and makes it difficult to distinguish the relative differences between alternatives. It should also be noted that improperly decreasing the range between the minimum and target artificially expands the relative differences between alternative scores. Inconsistent re-scaling between performance measures indirectly alters the weight given to each performance measure when the scores are aggregated. Scores that are compressed by improper re-scaling will have less influence over the final aggregated scores and the computed lift. The intent of this scoring method is to provide consistent re-scaling analogous to habitat suitability indices (HSIs), in that the scores are scaled between the points of zero suitability (for the given metric) and target conditions.

The CEPP planning model provides scores which show increasingly degraded conditions up to the point that the location is considered "fully degraded". In this instance, the term "fully degraded" references a habitat type that has degraded so poorly that it has converted to a different type of habitat. For example, a ridge and slough type habitat may degrade to a habitat type similar in elevation with a significantly different hydroperiod and species composition. At this point, the habitat suitability score would fall to zero as it is no longer a ridge and slough type habitat. A score of zero does not imply that the area is in the worst possible condition according to any scale, it means that the area no longer ranks as a ridge and slough type habitat. Again, this is consistent with the concept used by habitat suitability indices; indices are not intended to drop below zero.

A review of the CEPP planning model was conducted to evaluate instances in which the methodology used to rescale performance measure sub-metric scores potentially masked cases when the un-scaled sub-metric score is higher than the target or the un-scaled sub-metric score is lower than the score used to set the minimum value for purposes of rescaling. **Table G-37** and **Table G-38** illustrate instances in which the un-scaled sub-metric score for a given performance measure, achieved less than 95% of the score used to set the minimum value for the ECB, FWO and alternatives. Instances in which this occurred were few in comparison to the amount of data that is produced for each of the performance measure sub-metrics and occurred primarily with the ECB or FWO in northern WCA 3A. In total there are 267 scores per alternative, of which (for the alternatives) 13 or fewer were scores below the ECB score at the reference degraded site. In other words, only about 1% of the alternative scores were set to zero when the score could be considered negative relative to the base (reference) condition.

Resetting values less than zero to zero with the FWO provided a more conservative calculation of habitat unit lift calculations (*i.e.* HU Alternative – HU FWO) by reducing the magnitude of lift calculated between the alternatives and the FWO for instances in which project alternatives scored higher than the score used to set the minimum value. The influence of this calculation would affect all alternatives similarly.

Instances in which an alternative contributed to further departure from sought hydrologic conditions below what is considered a "fully degraded" ridge and slough habitat occurred primarily in WCA 3B at Transect T 15 for *PM. 2.1 Timing of Sheetflow* and at Transect T18N for PM 2.3 *Distribution of Sheetflow*.

Table G-37. Instances in which the un-scaled sub-metric score achieve less than 95% of the score used to set the minimum value for the ECB and FWO.

Performance Measure Metric	Zone	Location	Baseline	Raw Score	Score Used to Set 0 Value
1.1	Zone 3A-NE	115	FWO	68	73
1.1	Zone 3A-MC	MCNE1	FWO	64	73
1.1	Zone 3A-MC	MCNE2	FWO	60	73
2.1	Zone 3A-NW	T5	FWO	0.26	0.30
2.1	Zone 3B	T15	ECB	0.22	0.30
2.1	Zone 3B	T15	FWO	0.26	0.30
2.1	Zone ENP-N	ENP3	ECB	0.08	0.30
2.1	Zone ENP-N	ENP3	FWO	0.10	0.30
3.1	Zone 3A-NE	115	FWO	-1861.11	-1478.60
3.1	Zone 3A-NE	116	FWO	-1705.22	-1478.60
3.1	Zone 3A-MC	MCCE2	ECB	-1901.56	-1478.60
3.1	Zone 3A-MC	MCNE1	ECB	-1643.56	-1478.60
3.1	Zone 3A-MC	MCNE1	FWO	-2172.00	-1478.60
3.1	Zone 3A-MC	MCNE2	ECB	-4206.67	-1478.60
3.1	Zone 3A-MC	MCNE2	FWO	-6218.08	-1478.60
3.1	Zone 3A-MC	MCNW1	ECB	-1625.22	-1478.60
3.1	Zone 3A-MC	MCNW2	FWO	-1752.06	-1478.60
3.1	Zone 3A-MC	MCCE2	FWO	-2911.12	-1478.60
5.1	Zone 3A-MC	MCNE1	ECB	5.77	7.32
5.1	Zone 3A-MC	MCNE1	FWO	0	7.32
5.1	Zone 3A-MC	MCNE2	ECB	1.03	7.32
5.1	Zone 3A-MC	MCNE2	FWO	0.77	7.32
5.1	Zone 3A-MC	MCCE2	FWO	3.96	7.32
5.1	Zone 3A-MC	MCNW1	FWO	6.64	7.32
5.2	Zone 3A-MC	MCNW2	ECB	7.45	9.76
5.2	Zone 3A-MC	MCNW2	FWO	7.32	9.76

Table G-38. Instances in which the un-scaled sub-metric score achieve less than 95% of the score used to set the minimum value for each project alternative.

Performance Measure Metric	Zone	Location	ALT	Raw Score	Score Used to Set 0 Value
2.1	Zone 3B	T 15	ALT 1	0.24	0.30
2.1	Zone 3B	T 15	ALT 2	0.01	0.30
2.1	Zone 3B	T 15	ALT 3	0.16	0.30
2.1	Zone 3B	T 15	ALT 4R	0.27	0.30
2.1	Zone 3B	T 15	ALT 4R2	0.22	0.30
2.3	Zone 3B	T18N	ALT 2	2.29	1.93
2.3	Zone 3B	T18N	ALT3	2.14	1.93
3.1	Zone 3A-MC	MCCE2	ALT 4R	-1529.56	-1478.60
3.1	Zone 3A-MC	MCSE2	ALT 4R	-1489.22	-1478.60
7.1	SE-1	Associated water control structures	ALT 1	37.80	31.15
7.1	SE-1	Associated water control structures	ALT 2	37.80	31.15
7.1	SE-1	Associated water control structures	ALT 3	37.80	31.15
7.1	SE-1	Associated water control structures	ALT 4	37.80	31.15

Instances in which the un-scaled sub-metric score exceeded target conditions occurred primarily with three Greater Everglades performance measures; *PM 1.1 Percent Period of Record of Inundation, PM 3.1 Drought Intensity Index,* and *PM 4.1-4.3 Number and Duration of Dry Events in Shark River Slough.* These performance measures are intended to measure the occurrence of undesirable dry hydrologic conditions. For these performance measures there is no penalty for exceeding the target. Exceeding the target would not increase the severity of dry downs and result in potential for further unnatural loss of organic soils.

4. **Inferring Ecosystem Response from Hydrologic Change:** The CEPP planning model also assumed that ecosystem health can be assessed with hydrologic conditions only. The quantification of benefits for a restoration project essentially measures desired hydrologic changes which act as a surrogate for ecological suitability or habitat units. The restoration of natural landscape patterns and native flora and fauna within the project area may be affected by a multitude of other parameters and the interactions of such factors including water quality, fire patterns, disturbance and meteorological conditions including climate change among others. The basic premise of the CERP is to restore the quantity, quality, timing, and distribution of water within the south Florida ecosystem. The fundamental role and importance of

hydrology in Everglades restoration is expressed in the CEMs developed early in CERP. Even though uncertainty is recognized, ecological benefits derived from hydrologic performance measure metrics, calculated from model output, are useful in making planning-level decisions as they provide a quantitative means for comparing alternatives to determine the best performing alternative. CEPP has addressed other factors critical to ecosystem restoration in the main body of the Final PIR/EIS including assessments of potential effects of alternatives on water quality, invasive and native nuisance species, listed species and other wildlife and their habitat.

5. **Accuracy of the FWO Project Condition:** The FWO project condition is the projection and forecast of what is "most likely" to occur in the study area over the planning horizon. The FWO project condition is used as a baseline in plan formulation and benefits calculations to calculate HU lift. Incorrect assumptions related to the FWO project condition have the potential to have bearing on the amount of ecosystem benefits derived from the project. The project team for CEPP has established consistent assumptions for the FWO project conditions in the study area, including items such as land use, water supply demands, and operations of the C&SF project. First and second generation CERP projects will be included in the FWO project condition.

G.6 PLAN IMPLEMENTATION

Implementation of CEPP will occur over many years and include many actions by USACE and SFWMD. Multiple Project Partnership Agreements (PPAs) will be executed prior to construction. Each PPA will cover a separable element that groups inter-related project features to provide hydrologic and ecological benefits. These PPAs include the construction of logical groupings of plan elements, agreed upon by the USACE and SFWMD, that maximize benefits to the extent practicable consistent with project dependencies and the Adaptive Management and Monitoring Plans (see **Annex D**). The text below is in support of information that appears in **Section 6.7** (**Plan Implementation**) of the main report. Rationale for the percent gain in project benefits for each PPA using both the volume based approach and consensus approach as described in **Section 6.7** (**Plan Implementation**) are provided below.

Table G-39 shows four sets of cost and benefit information, one for each of the proposed three PPAs as stand-alone elements, and one with the costs and benefits gained from implementation of PPA New Water subsequent to the completion of features included in PPA North and PPA South. For additional information see **Section 6.7.1.2** (**Multiple Project Partnership Agreements**) and **6.7.1.3** (**Approach Taken to Estimating Phased Benefits**) in the main report.

Table G-39. Benefits Achieved with Implementation of PPAs.

PPA First Cost $Million	Benefits of the Recommended Plan	Relationship to CEM	Acres Improved	Benefits: Volume Based	Benefits: Consensus Based NE	WCA 3A	WCA 3B	ENP	Florida Bay	Non-CEPP Dependencies	CEPP Internal Dependencies
PPA North Only $567	The Miami Canal functions as unnatural source of drainage for WCA 3A; effectively overdraining area. Benefits gained from construction of features that re-distribute inflows into northern WCA 3A include localized improvements in • water depths and durations • suitability for slough vegetation • patterns of sheetflow • reductions in the risk of peat fires • beneficial shifts in habitat for wildlife species Southern WCA 3A would continue to be impounded by the L-67 A/C, and L-29 canal until outlet capacity is improved.	*Stressors:* Improved hydroperiods Increased Sheetflow *Ecological* Effects: Reduced fire risk and soil oxidation Peat Accretion *Attributes:* Improved fish, alligator, wading bird conditions, Maintain sawgrass Restore ridge and slough	Northern WCA 3A 272,070	Maximum Potential Hydrologic Benefits 41% of Alt 4R2*	0%	3A-NE: 25-50% 3A-NW: 40-70% 3A-MC: 40-70% 3A-C: 0% 3A-S: 0%	0%	ENP-N: 0% ENP-S: 0% ENP-SE: 0%	0%	A-1 FEB & Restoration Strategies (WQBEL) Appendix A Water Quality Compliance 8.5 SMA and Existing S-356 C-111 South Dade MWD 1-Mile Bridge & Road Raising	L-4 levee degrade and L-5 canal improvements generate primary source of fill for backfilling Miami Canal. Implementation of PPA North is not dependent on PPA South.
PPA South Only $454	WCA 3B has become a rain-fed compartment dominated by sawgrass. Remaining tree islands have been reduced in elevation. Flows through NESRS are reduced resulting in lower wet season depths and more frequent and severe dry downs. Over-drainage along the eastern flanks of NESRS has resulted in shifts in vegetative community structure and invasion by exotic woody species. Increased capacity of S-356 and S-333, degradation of the L-29 levee, and construction of the Blue Shanty Levee would increase flows to NESRS and provide minor benefits to Florida Bay. Florida Bay is the main receiving waterbody of the Greater Everglades and is heavily influenced by changes in the timing, distribution, and quantity of freshwater flows upstream. Benefits gained from construction of features that re-introduce flows in WCA 3B, NESRS and Florida Bay include improvements in • water depths and durations • suitability for slough vegetation • patterns of sheetflow • reductions in the risk of peat fires • reductions in the intensity, frequency, and duration of hypersaline events • beneficial shifts in habitat for wildlife species Construction of these features will ready the system for additional inflows from Lake Okeechobee, providing outlet capacity for WCA 3.	*Stressors:* Improved hydroperiods Increased sheetflow *Ecological Effects:* Reduced fire risk and soil oxidation Peat accretion Improved salinities *Attributes:* Improved fish, alligator, wading bird conditions Maintain sawgrass Restore ridge and slough, Increased seagrass	WCA 3A C 173,233 WCA 3A S 82,437 WCA 3B 85,688 ENP 498,819 Florida Bay 476,096	Minimum Potential Hydrologic Benefits 12% of Alt 4R2 WCA 3B** Maximum Potential Hydrologic Benefits 45% of Alt 4R2 NESRS and Florida Bay***	0%	3A-NE: 0% 3A-NW: 0% 3A-MC: 0% 3AC: 70-90% 3AS: 70-90%	70-90%	ENP-N: 40-70% ENP-S: 10-20% ENP-SE: 10-20%	10-20%	BCWPA C-11 Impoundment TTNS Bridging & Road Raising	Evaluation of results from introducing flows into WCA 3B through L-67 A Structure 1 would determine whether additional L-67 A inflow structures could be implemented prior to construction of Blue Shanty levee. (Annex D) L-67 C, L-67 Ext and L-29 levee removals generate source of fill for Blue Shanty levee. Old Tamiami Trail can be completed at any time during implementation, but must precede backfilling of L-67 Extension Canal. Construction of Blue Shanty levee would occur after increase in capacity of S-356. Implementation of PPA South is not dependent on PPA North.

PPA First Cost $Million	Benefits of the Recommended Plan	Relationship to CEM	Acres Improved	Benefits: Volume Based	Benefits: Consensus Based					Non-CEPP Dependencies	CEPP Internal Dependencies
					NE	WCA 3A	WCA 3B	ENP	Florida Bay		
PPA New Water Only $879	The A-2 FEB decreases high volume freshwater discharges from Lake Okeechobee to the Northern Estuaries. Additional water sent south from the Northern Estuaries to the A-2 FEB would provide limited benefits to northern WCA 3A as the Miami Canal would continue to function as a source of drainage for WCA 3A. Limited benefits will be provided to ENP due to construction of the seepage barrier wall. Florida Bay may benefit as it is largely influenced by changes in freshwater flows upstream. Benefits gained from construction of the A-2 FEB and seepage barrier wall include • improvements water depths and durations •improvements in optimal salinity ranges for estuarine communities • decreased turbidity and sedimentation in the estuaries • maintain level of service for flooding Without additional outlet capacity provided by PPA South, only limited water could be introduced to WCA 3A. The A-2 FEB would remain full and reduce the opportunities to divert water away from the Northern Estuaries that the full CEPP plan provides.	*Stressors:* Improved hydroperiods, Increased sheetflow, Reduced high flows *Ecological Effects:* Reduced fire risk and soil oxidation Peat accretion Improved salinities *Attributes:* Improved fish, alligator, wading bird conditions Maintain sawgrass Restore ridge and slough Increased oyster and seagrasses	~ 1.2 Million Acres Northern Estuaries, WCA 3A, ENP, and Florida Bay	Slight increases in freshwater flowing into Everglades	0-5%	0-5%	0%	0-5%	0-5%	IRL-S C-44 Reservoir LO Regulation Schedule Revisions	Seepage Barrier along L-31 N needs to be completed prior to the A-2 FEB. Implementation of PPA New Water is dependent on features in PPA South
PPA New Water (After PPA North and South features are built) $879	The A-2 FEB decreases high volume freshwater discharges from Lake Okeechobee to the Northern Estuaries. New water from Lake Okeechobee is sent south to achieve the full extent of ecological benefits for CEPP. Benefits gained from construction of the A-2 FEB and seepage barrier wall include • improvements in optimal salinity ranges for estuarine communities • decreased turbidity and sedimentation in the estuaries • increases in the amount of water available for municipal and industrial uses in LECSA 2 (Broward County) and LECSA 3 (Miami-Dade County) by ~ 12 and 15 MGD/day. • maintain level of service for flooding • landscape improvements (i.e., large-scale connectivity and reduced compartmentalization) associated with the restoration of hydroperiods and sheetflow from the Northern Estuaries to coastal mangroves of ENP.	*Stressors:* Improved hydroperiods Increased sheetflow Reduced high flows *Ecological Effects:* Reduced fire risk and soil oxidation Peat accretion Improved salinities *Attributes:* Improved fish, alligator, wading bird conditions Maintain sawgrass Restore ridge and slough Increased oyster and seagrasses	~ 1.5 Million Acres Northern Estuaries, WCA 3, ENP, and Florida Bay	Significantly increases freshwater flowing into Everglades ~ 210,000 Acre Feet per Year On Average	100%	3A-NE: 50-75% 3A-NW: 30-60% 3A-MC: 30-60% 3A-C: 10-30% 3A-S: 10-30%	3B:10-30%	ENP-N: 30-60% ENP-S: 80-90% ENP-SE: 80-90%	FB: 80-90%	IRL-S C-44 Reservoir LO Regulation Schedule Revisions	Seepage Barrier along L-31 N needs to be completed prior to the A-2 FEB. Implementation of PPA New Water is dependent on features in PPA South.

*Minimum benefits were not determinable for WCA 3A (PPA New Water Only) **Maximum benefits were not determinable for WCA 3B (PPA South Water Only) ***Minimum benefits were not determinable for ENP and Florida Bay (PPA South Water Only).

G.6.1 PPA North Only

See Section 6.7.1.4 (PPA North Only) of the main report.

G.6.1.1 Benefit Calculation – Volume Based Approach

The recommended plan provides a combined average annual increase of 210,000 ac-ft per year in the quantity of freshwater that is redirected south from Lake Okeechobee to the central portion of the Everglades across the Redline to WCA 2A and WCA 3A, based on comparison between the recommended plan and the future without project baseline used for CEPP formulation (FWO). Following identification of the recommended plan in June 2013, the CEPP base condition assumptions were subsequently revisited and updated to represent the most current information for the analysis of Savings Clause requirements and Project-Specific Assurances (refer to **Section 6.8** of the main report, **Appendix A**, and **Annex B** for additional details). Based on comparison between the updated future without project baseline (IORBL1) and the recommended plan the combined average annual increase of freshwater redirected across the Redline from Lake Okeechobee to WCA 2A and WCA 3A is slightly higher at 214,000 ac-ft per year (2% increase). Due to treatment capacity considerations for STA 2 and STA 3/4 and the recommended plan L-6 diversion operations, the net volume flow increases provided with the recommended plan are not uniformly distributed between WCA 2A and WCA 3A. The average annual WCA 3A inflows are significantly increased by 362,000 ac-ft, and average annual WCA 2A inflows (STA 2 and S-7) are correspondingly significantly decreased by 148,000 ac-ft. The IORBL1 provides more water than WCA 2A needs, and the recommended plan utilizes some of this excess IORBL1 water, in addition to the additional flows redirected south from Lake Okeechobee, to increase the hydroperiods and achieve restoration objectives in WCA 3 and ENP through the L-6 diversion operations. The L-6 diversion operations shift an average annual volume of 148,000 ac-ft of water from WCA 2A to WCA 3A.

The benefits provided by the recommended plan to WCA 3A is based on an average annual increase of 362,000 ac-ft per year in the quantity of freshwater flowing across the Redline to WCA 3A, assuming comparison to the updated IORBL base condition. Surface water inflows along the Redline to WCA 3A correspond to the sum of structure inflows from S-8 pump station discharges to the Miami Canal and discharges to the S-8A gated culvert (which diverts water to the L-4 Levee degrade), in addition to S-150 and STA-5/STA-6 outflows to WCA 3A. Based on consideration of average annual structure flows only, the maximum potential hydrologic benefits provided by PPA North (L-6 diversion; no additional flows redirected south from Lake Okeechobee) to WCA 3A are estimated to be 41% of the recommended plan (148,000 ac-ft /362,000 ac-ft per year, on average). This estimate is characterized as a maximum since the recommended plan L-6 diversion quantities cannot be achieved with PPA North only due to the need to maintain preferred hydrology in WCA 2 and the limited storage capacity of the A-1 FEB. This simplified approach does not account for potential hydrologic changes within eastern WCA 3A associated with the reduction of flow volumes from the S-11 structures located adjacent to northeastern WCA 3A along the North New River Canal that would accompany the reductions in inflow to WCA 2 and the L-6 diversion operations; in general, however, reductions in flows through the S-11 structures would be beneficial to WCA 3A since inflows from the S-11 structures currently contribute to undesirable ponding conditions in northeastern WCA 3A east of the Miami Canal and North of the L-67 A Canal.

The maximum 41% gain in potential hydrologic benefits estimated for WCA 3A with PPA North was then multiplied by the proportion of overall CEPP benefits by WCA 3A (WCA 3A produces 41% of overall CEPP benefits), producing a single maximum benefit value of approximately 17% for this approach. Since this preliminary approach could not provide a minimum percent gain for WCA 3A benefits and does not account for the additional portion of overall benefits that are attributable to improved intra-annual timing of flows and the spatial variability across benefit zones, this estimate was recognized as incomplete and considered only as a reference point during the more-detailed consensus method (refer to **Section G.6.1.2**).

G.6.1.2 Benefit Calculation – Consensus Approach

As part of screening alternatives for distribution and conveyance in northern WCA 3A, CEPP considered previously conducted plan formulation, screening and modeling data from the Decompartmentalization and Sheeflow Enhancement of WCA 3 (Decomp) Documentation Report, which helped provide a basis for identification of the initial array of options to be analyzed through the CEPP formulation process (See **Appendix E**). This initial array utilized the existing water budget entering WCA 3A, and provided invaluable insight and information on the performance of different distribution and backfilling options. Although the detailed assumptions for the Decomp modeling effort differ from the recommended plan, several of the alternatives from Decomp are structurally similar to the recommended plan features in PPA North. Furthermore, the CEPP Planning Model used for benefits (habitat unit) computation was developed during prior plan formulation efforts for Decomp. The Decomp model used several of the same performance measures, project zones, had similar project objectives, and was located within the CEPP project domain. Comparisons across models with different assumptions and applicable versions are generally not recommended; however results from the Decomp modeling effort can be used to gain insight into the benefits gained from construction of the distribution and conveyance features in northern WCA 3A under the existing water budget.

Decomp Alternative H included a hydropattern restoration feature and full backfill of the Miami Canal from S-8 to Interstate-75 (I-75). Alternative H is similar to the recommended plan in that the backfill length is the same and the distribution of flow is focused in the northwest corner of WCA 3A. Habitat unit (HU) results for Alternative H indicated that hydrologic improvements were apparent in northern WCA 3A, north of I-75, and were primarily associated with Zones 3A-NE, 3A-NW, and 3A-MC. Alternative H included a hydropattern restoration feature that was longer in length than that identified in the features of the recommended plan and extended east of S-8 to the G-205 structure located south of the Holey Land Wildlife Management Area and west of STA 3/4. Hydrologic improvements were also seen in Zone 3A-C; however the magnitude of improvement was small relative to the benefits gained in the northern WCA 3A zones. The percent of HU lift for Alternative H relative to the CEPP recommended plan was calculated for each zone in northern WCA 3A (Maximum Benefits Zone 3A-NW 71%, Zone 3A-MC 64%, Zone 3A-NE 71%). These percentages were used as a reference to estimate the percent of performance achieved from implementation of PPA North. Performance estimates for northeastern WCA 3A were lowered relative to the remaining portions of northern WCA 3A as Alternative H included a longer hydropattern restoration feature that was able to distribute flow to this area.

Percent of performance estimates using the consensus approach, range from 40% to 70% for northwestern WCA 3A (Zone 3A-NW), 40-70% for areas directly adjacent to the Miami Canal (Zone 3A-MC), and 25-50% for northeastern WCA 3A. The proportion of each zone's (i.e. Zone 3A-NW, 3A-MC, 3A-NE) habitat unit lift within WCA 3A relative to the respective total habitat unit lift for WCA 3A was then determined and multiplied by the minimum and maximum ranges for each zone. These adjusted ranges were then summed to calculate a minimum and maximum range for WCA 3A. Implementation of PPA North would yield an overall performance of approximately 30-56% of WCA 3A benefits based on the consensus approach. The values representing the minimum and maximum range for each region developed using the consensus approach were averaged to determine a midpoint (43%). The midpoint was then multiplied by the proportion of overall CEPP benefits provided in WCA 3A (41%), producing a single value of approximately 18% for this approach. Implementation of PPA North would not benefit the remaining regions of the CEPP study area.

G.6.2 PPA South Only

See Section 6.7.1.5 (PPA South Only) of the main report.

G.6.2.1 Benefit Calculation – Volume Based Approach

Alternative 2 as modeled in the final array of alternatives, was used as a surrogate to estimate the minimum potential hydrologic benefits provided by PPA South for WCA 3B. Alternative 2 considered conveyance features in the L-67A Canal and associated gaps in the L-67C canal similar to the recommended plan. Alternative 2 did not include construction of the Blue Shanty Flow way, but included the construction an additional gravity structure out of WCA 3B, allowing water to flow from WCA 3B to NESRS within the flow way footprint. Both alternatives included an increase in the capacity of the S-333 and S-356 structure. Alternative 2 included a shorter seepage barrier wall than the recommended plan south of Tamiami Trail. It is expected that full recommended plan water level depths within the Blue Shanty Flowway would not be able to be realized under PPA South without the PPA New Water additional seepage management feature and due to the need to maintain preferred hydrology in WCA 3A with existing inflows (prevent increased dry outs). Under PPA South operations, the degraded L-29 segment in the recommended plan was assumed to discharge a similar flow volume as the three total L-29 gravity outlet structures from Alternative 2.

The estimated minimum potential hydrologic benefits to WCA 3B was calculated by dividing the average annual increased volume of outflows along the L-29 Canal for Alternative 2 (~28,000 ac-ft per year on average, as compared to the future without condition (IORBL1)) by that of the recommended plan (~239,000 ac-ft per year on average) to arrive at a minimum project benefit of approximately 12%. This estimate assumed that L-29 outflows provide more applicable comparison criteria than other potential volume-based metrics, such as WCA 3B inflows, WCA 3B net inflows, or WCA 3B total outflows. This estimate does not include or account for inflow volumes to WCA 3B, and similar to the habitat unit calculations, does not separately take into account the hydrology of the Blue Shanty Flowway. The average annual overall flow for WCA 3B was used to inform the consensus approach for WCA 3B east.

The estimated maximum potential hydrologic benefits provided by PPA South for NESRS and Florida Bay were estimated by comparing between the 2008 MWD Tamiami Trail Modifications LRR and the recommended plan. The maximum percent gain in hydrologic benefits (45%) was calculated by dividing the average annual volume of inflows to NESRS along the L-29 Canal demonstrated by the LRR relative to that of the recommended plan (341,000 ac-ft per year /761,000 ac-ft per year). This estimate assumed that the LRR analysis, which was based on an L-29 maximum operating stage of 8.5 feet NGVD and analyzed with a different spreadsheet modeling tool and assumptions, provides a indicative (albeit not equivalent) approximation of NESRS inflows with PPA South.

The minimum percent gain in potential hydrologic benefits estimated for WCA 3B (12%) and the maximum percent gains in hydrologic benefits for ENP (45%) and Florida Bay (45%) were then multiplied by the proportion of overall CEPP benefits by the respective region (WCA 3B produces 4%, ENP produces 31% and Florida Bay produces 20% of overall CEPP benefits). Based on the volume approach, a combined 23% of overall CEPP benefits result from PPA South implementation. Since this preliminary approach could not provide a maximum percent gain for WCA 3B benefits or a minimum percent gain for ENP and Florida Bay benefits, and the approach does not account for the additional portion of overall benefits that are attributable to improved intra-annual timing of flows and the spatial variability across benefit zones, this estimate was recognized as incomplete and considered only as a reference point during the more-detailed consensus method (refer to **Section G.6.2.2**).

G.6.2.2 Benefit Calculation – Consensus Approach

Percent of performance estimates from the implementation of PPA South range from 70% to 90% for central (Zone 3A-C) and southern WCA 3A (Zone 3A-S), and WCA 3B (Zone 3B), 40% to 70% for northern ENP (Zone ENP-N), and 10% to 20% for southern and southeastern ENP and Florida Bay (Zones ENP-S, ENP-SE, and FB-W, C, FB-S, FB-EC, FB-NB, FB-E). A similar approach to calculate the overall performance of CEPP benefits for PPA South was done as described in **Section 6.7.1.4.2**. Implementation PPA South would yield an overall performance of approximately 3-4% of WCA 3A benefits, 70-90% of WCA 3B benefits, 25-44% of ENP and 10-20% of Florida Bay. The values representing the minimum and maximum range for each region developed using the consensus approach were averaged to determine a midpoint (4%, 80%, 34% and 15% respectively). Theses midpoints were then multiplied by the proportion of overall CEPP benefits by region and combined to produce 18% of overall CEPP benefits based on the consensus approach.

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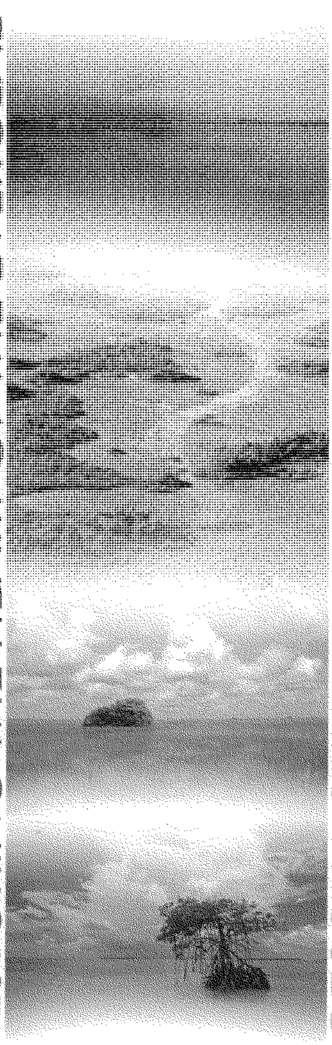
RESTORING THE HEART OF THE EVERGLADES

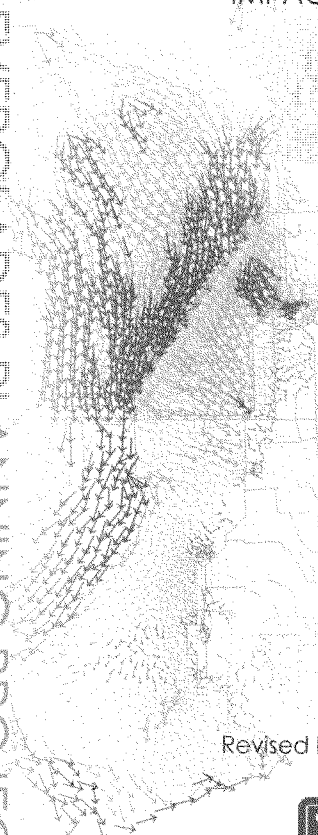


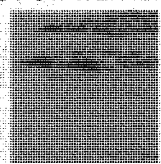
CENTRAL EVERGLADES PLANNING PROJECT

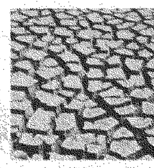
COMPREHENSIVE EVERGLADES RESTORATION PLAN

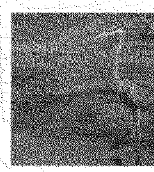
CENTRAL EVERGLADES PLANNING PROJECT

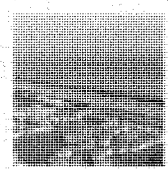
FINAL INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT











July 2014
Revised December 2014

Annex A

Cover insets (left to right):

Landscapes: Lake Okeechobee, Water Conservation Area 3, Everglades National Park, Florida Bay; **Map:** Depicts Average Annual Overland Flow across the period of record (1965-2005) for existing conditions, as modeled by the CEPP regional hydrologic model (the coloration of the arrows represents the relative volume of flow, while the direction of the arrows represents the movement of flow across the landscape); **Small Landscapes:** Ponding, soil oxidation (peat reduction), dry area of Everglades National Park, juxtaposition of urban development.

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

A.1 Planning Aid Letters

Planning Aid Letters (PAL) were received from U.S. Fish and Wildlife Service (FWS) on January 20, 2012, March 27, 2012 and December 12, 2012.

United States Department of the Interior

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

January 20, 2012

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

Dear Colonel Pantano:

The U.S. Fish and Wildlife Service (Service) has prepared this Planning Aid Letter (PAL) to assist in developing the Central Everglades Planning Project (CEPP), an expedited planning process to implement portions of the Comprehensive Everglades Restoration Plan (CERP) located in the central Everglades. This PAL is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), and section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This PAL does not constitute the report of the Secretary of Interior as required by section 2(b) of the FWCA, nor does it constitute a biological opinion under section 7 of the Act. The purpose of this PAL is to provide the U.S. Army Corps of Engineers (Corps) with recommendations regarding several aspects of the planning process including but not limited to the project goals and objectives, management actions that should be considered (*e.g.*, project components), ecological performance measures, and to provide a list of Threatened and Endangered species that may be encountered within the Study Area.

BACKGROUND

Project Purpose

While CERP has made considerable progress on projects on the periphery of the remaining Everglades, less has been achieved in the most critical areas of the central Everglades. Construction has begun on the first generation of CERP project modifications already authorized by Congress. These include the Picayune Strand, Indian River Lagoon South and Site 1 projects. Project Implementation Reports have been completed, or are nearing completion, for the second generation of CERP projects for Congressional authorization. These include the Biscayne Bay Coastal Wetlands, Broward County Water Preserve Area, Caloosahatchee River (C-43) West Basin Storage Reservoir, and C-111 Spreader Canal Western projects.

The next step for implementation of the Plan, and the main focus of CEPP, is to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south. This will allow for restoration of natural habitat conditions and water flow in the central Everglades and re-connect the central Everglades ecosystem with Everglades National Park (ENP) and Florida Bay. The Corps, who is leading the planning effort in partnership with the South Florida Water Management District (SFWMD), has recommended that the Everglades Agricultural Area Storage and Treatment (EAA), Decompartmentalization of Water Conservation Area 3 (Decomp PIR 1), and Everglades Seepage Management (ESM) projects form the core of CEPP. These are highly interdependent features of the Plan that must be formulated and optimized in a comprehensive and integrated manner.

Planning Process

The CEPP will be one of five nationwide pilot projects to utilize a streamlined planning process with the goal of significantly reducing the amount of time it takes to plan projects. Over the last decade it has become apparent that the current Corps planning process is perceived by sponsors, State and Federal partners, Congress and the public as taking too long, being too cumbersome, too detailed, too expensive and does not lead to a better product or decision commensurate with the added years of effort to an already long process. The Corps and senior leadership at the Office of the Assistant Secretary of the Army (Civil Works) have initiated a pilot program for candidate planning studies designed to assess the effectiveness of transforming the Civil Works Planning Program to better meet the needs of the nation's water resources challenges.

Based on the above, the proposed approach for the CEPP is to incorporate the new science and understanding of the hydrology of the ecosystem and build upon the information and tools developed by SFWMD in support of a more streamlined planning process that utilizes the concepts for transformation of the Corps planning process. A general outline of the proposed process for CEPP is shown in Figure 1.

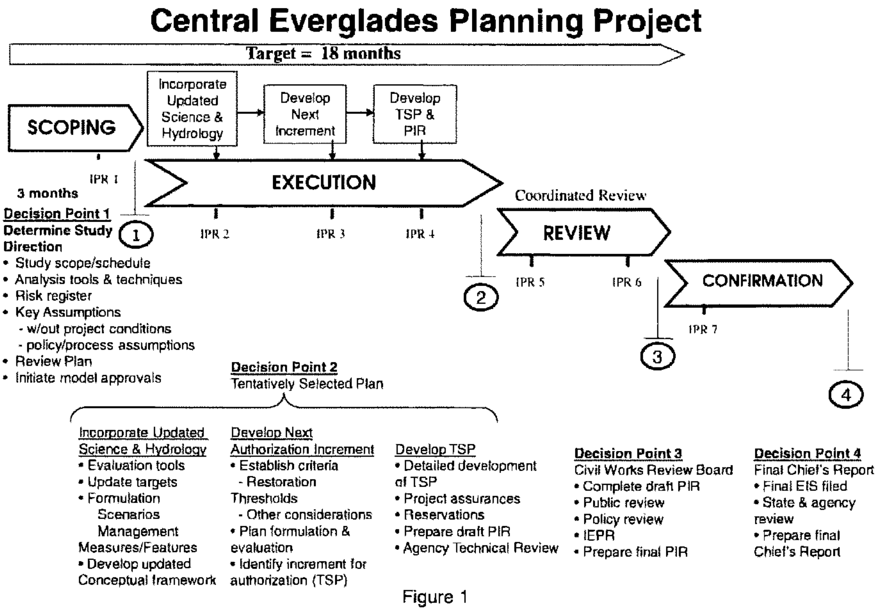

Figure 1: General outline of the proposed process for CEPP.

Project Objectives

The major goal of the project, as stated by project managers, is to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south, allowing for restoration of natural habitat conditions and water flow in the central Everglades. This will re-connect the central Everglades ecosystem with ENP and Florida Bay. This portion of the Plan will include those components that provide for storage, treatment and conveyance south of Lake Okeechobee, removal of canals and levees within central Everglades and seepage management features to protect the urban and agricultural areas to the east from the increased flow of water through the central portion of the system. An integrated study effort on these components is needed to set the direction for the next decade of implementation of the Plan. The goal of the study effort would be to develop an integrated, comprehensive technical plan for delivering the right quantity, quality, timing and distribution of water needed to restore and reconnect the central Everglades ecosystem. The study area for the CEPP has been defined to include Lake Okeechobee, Caloosahatchee and St. Lucie Estuaries, EAA, Greater Everglades, ENP, and Biscayne and Florida Bays (Figure 2).

To achieve the goals stated above, the Corps and SFWMD have drafted preliminary project objectives as follows:

- Restore seasonal hydroperiods and freshwater distribution that support a natural mosaic of wetland and upland habitat in the Everglades System.

- Improve sheet flow patterns and surface water depths and durations in order to reduce soil subsidence, frequency of damaging fires, and decline of tree islands.

- 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 predicted by project modeling that will promote plant and animal diversity and habitat function.

- Increase oyster habitat and sea grass populations in the Northern Estuaries by reducing salinity fluctuations from freshwater regulatory pulse discharges.

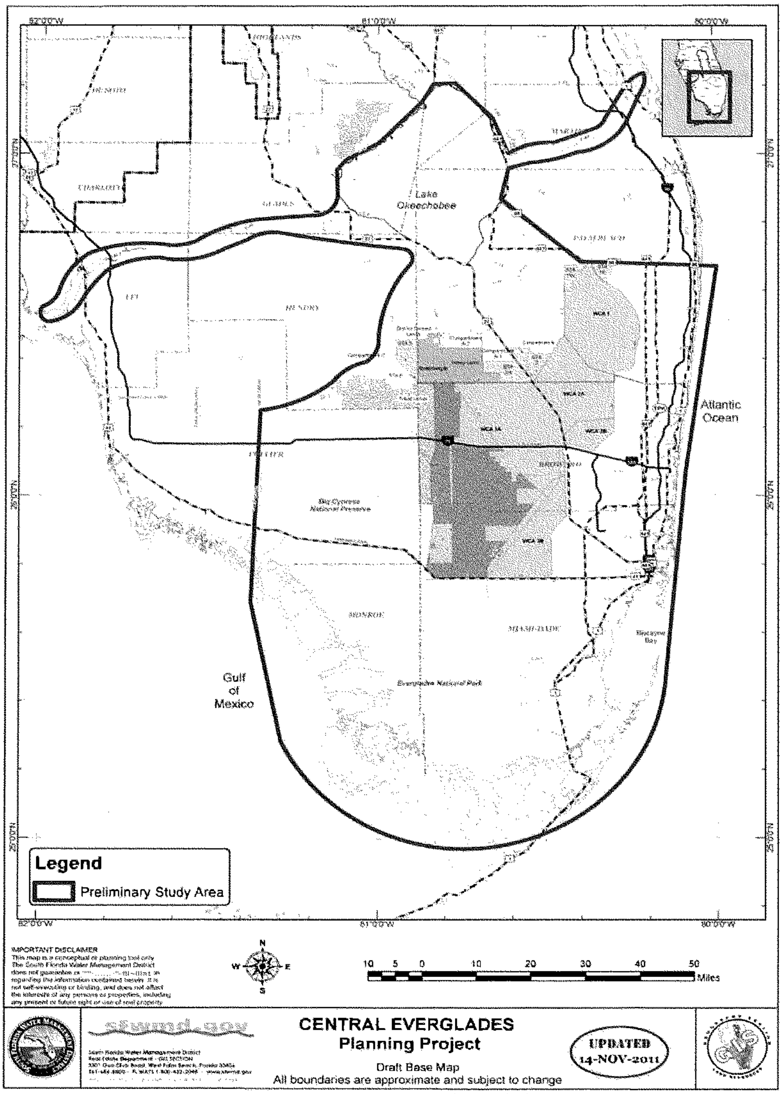

Figure 2. Central Everglades Planning Project Study Area.

Performance Measures

An interagency environmental sub-team of the Project Delivery Team (PDT), composed of scientists, engineers and planners, have drafted a list of hydrology based Performance Measures (PM) listed below. The group concentrated on Restoration Coordination and Verification (RECOVER)-approved PMs to avoid delays associated with having controversial PMs vetted. While these PMs are familiar to most and have been used in the past they will need to be adapted, in most cases, to work with the primary hydrologic model being utilized in CEPP, the Regional Simulation Model (RSM). Additionally, they are hydrologic PMs and reflect hydrologic benefits and not necessarily the desired ecological and other environmental benefits expected to result from the project. To remedy this, an interagency team led by Department of Interior scientists has drafted a list of additional environmental tools and PMs to be run separately and interjected into the planning process. A list of these tools appears below the Primary PMs. Some ecological tools that the team agreed, were not ready for use at this time, have not been included in the list (see meeting minutes available from Corps for additional information).

Preliminary List of Performance Measures

1. Lake Okeechobee Performance Measure - Lake Stage.
2. Northern Estuaries Performance Measure - Salinity Envelopes.
3. Greater Everglades Performance Measure - Inundation Duration in the Ridge and Slough Landscape.
4. Greater Everglades Performance Measure - Sheet flow in the Everglades Ridge and Slough Landscape.
5. Greater Everglades Performance Measure - Number and Duration of Dry Events in Shark River Slough.
6. Greater Everglades Performance Measure - Slough Vegetation Suitability.
7. Greater Everglades Performance Measure - Hydrologic Surrogate for Soil Oxidation.
8. Greater Everglades Aquatic Trophic Levels Small-Sized Freshwater Fish Density (RECOVER Greater Everglades #1).*
9. Everview Viewing Windows (refer to Section 2.2 of River of Grass document, page 23)*.

* Denotes Performance Measures that will be used as planning tools.

Additional Ecological

1. Everglades Landscape Vegetation Succession Model (ELVeS.)
2. Wood Stork Foraging Probability.
3. Cape Sable Seaside Sparrow Hydrologic Indicator.
4. Apple Snail Population Model.
5. Oyster Habitat Suitability Index for Northern Estuaries.

The ecological sub-team is advising the PDT to use all available ecological tools that will provide additional useful information. Two models that may be completed in time for use on this project are the amphibian community index, alligator production index and alligator population model. These indices may appear on the list above in the future.

The PMs and tools listed above are for evaluating alternative performance as it relates to environmental restoration, however there are PMs for other concerns that the Corps should include in its planning process. Examples of these would be agriculture and water supply metrics.

Models

The primary application of models in the CEPP will be in the assessment of regional-level hydrologic planning. More detailed models will also be brought to bear on specific questions related to hydraulic and water quality constraints. At this time, the modeling strategy does not consider the application of detailed flood event modeling (or hydrodynamic levee assessment) or water quality fate/succession modeling within the Everglades Protection Area given the schedule of the CEPP. Depending on the outcomes of the CEPP scoping phase and risk registry development, it is possible that key elements of this strategy may need to be revisited.

Several models will be used during the execution phase of project planning and can be categorized as screening, planning and detailed models. The Reservoir Sizing and Operations Screening (RESOPS) model is a spreadsheet application which will test alternative storage configurations that consider the interconnectivity of Lake Okeechobee, the Lake Okeechobee Service Area, the northern estuary watershed systems, and the Everglades. Models which will be used for planning include the RSM Basin, RSM Glades-LECSA, and South Florida Water Management Model (SFWMM). Detailed models include the Dynamic Model for Stormwater Treatment Areas (DMSTA) and the HEC-RAS. For more detailed information on CEPP modeling please refer to the Corps' Central Everglades Study DRAFT Modeling Strategy.

Risk Register

The risk register workshop was a good exercise for the inter-disciplinary, multi-agency PDT team. It brought the larger group into a sub-team setting to begin focusing on the risks associated with the expedited Corps planning process. Risk registers were developed by four sub-teams consisting of (1) Cultural Resources/Real Estate; (2) Environmental; (3) Engineering, Hydrology, Hydraulics, Geotech and Operations; and (4) Planning. Risks were identified and valued in a qualitative nature based on best professional judgment and agreement within each group. It is expected that a "living" document will be created by the Corps and updated on a regular basis.

SERVICE RECOMMENDATIONS

Project Purpose

While the Service fully supports this effort and approach, it is necessary to point out that there are many restoration opportunities within the Central Everglades that would not be captured by simply undertaking the three specific projects suggested: EAA storage component; Decomp PIR 1 Project; and ESM Project. Primarily, the reconnection of WCA-3B as a flow-through system connecting WCA-3A to ENP is the most critical part of Everglades restoration remaining to be planned. This component of the Modified Water Deliveries (MWD) to ENP Project was called Conveyance and Seepage and has undergone initial planning during the Combined Structural and Operational Plan. Since then, funding for MWD has been exhausted, and the Conveyance and Seepage Project set aside. The Service suggests, and will provide alternative scenarios, that this critical element be made a core component of CEPP. The initial phase of this component could be as simple as continued use of the L-67A culvert approved for the Decompartmentalization Physical Model and a new weir on the L-29 levee. The optimal approach, however, would be implementation of the original plan (1994 GDM) which consisted of 3 gates (S-349 A,B and C) in the L-67A canal, 3 weirs or culverts in the L-67 A levee, degradation of the L-67 C levee and canal, and 3 weirs on the L-29 levee to allow flow across the Tamiami Trail.

Additional opportunities that should be included in CEPP are the relaxation of the G-3273 constraint, integration of the S-356 pump station to control seepage in the L-30 and L-31N canals, and expansion of the S-333 structure to allow greater flow out of the ponded areas of WCA-3A into Northeast Shark River Slough (NESRS). Also, if the Combined Operational Plan is going to be delayed or absorbed into CEPP then an operational plan that utilizes the newly constructed 1-mile bridge should be incorporated. Other opportunities include defining environmental water regulation schedules for WCAs 2 and 3B and refining the schedule for 3A.

It is also important that the Corps and SFWMD, as quickly as possible, determine the size and type of available storage and treatment areas in the EAA to help guide the team in formulating downstream project features. There is considerable speculation as to the amount of water that the project will deliver south which is entirely predicated on the amount of storage and treatment available in the EAA. Team members and the public are initially being asked to provide comments and lay out issues for an as yet undefined project. This will hinder stakeholder and public buy-in and support. Even if tentative plans are numerous, they need to be discussed early in the process.

It may be the case that some proposed components of the project become less important (*e.g.*, seepage management) as more is learned about the quality of water delivered south. The Service does not feel that a completed seepage management project, without the delivery of additional water for the environment, constitutes a valid restoration project. The Corps should notify the Service regarding the best time to provide important information regarding the design and detailed operations of stormwater treatment areas and storage reservoirs and their effects on listed species, migratory birds, and other wildlife resources.

A project feature that should not be considered during the CEPP is further modification of the S-12 structures closure regime for protection of the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). Once the Everglades Restoration Transition Plan (ERTP) is authorized (Record of Decision scheduled late February 2012) the S-12 closure regime will be relaxed due to the addition of year-round operational capability at S-12 C. With the additional "untested" risk to the Cape Sable seaside sparrow subpopulation A and its habitat from ERTP operations, the Service strongly recommends that restoration become more focused on shifting flow eastward towards the original flow path of WCA 3B to NESRS. No further management changes to the S-12s should be considered until more flow has been restored into northeastern ENP.

Planning Process

The Service fully supports the use of an expedited planning process for the CEPP. The process used to plan CERP projects over the past decade is cumbersome and has not always resulted in a better plan. The proposed expedited process will identify issues early and elevate these issues through the vertical management team for timely decisions, reducing delay at the PDT level. The complexity previously required of project implementation reports will be reduced, thus allowing preparation of these documents in much shorter time periods. In an effort to identify and process the added risk of completing a rapid and possibly less detailed study, the Corps has implemented a risk registry procedure where team members and other public stakeholders were asked to identify major risks and suggest ways in which to mitigate the risk.

An area of concern regarding the expedited process is how PDT meetings are being conducted. As we approach the 3-month mark there have only been two PDT meetings. These were conducted as short (~3 hour) meetings prior to public workshops. Dialogue among PDT members and between the team and project management regarding critical project planning elements was restricted. Draft language, such as project objectives, on which the PDT members were asked to comment, was not shared prior to the meeting. The Service suggests that the Corps and SFWMD convene a PDT meeting in the style previously used during CERP to discuss critical project elements as soon as possible.

As noted above, the primary performance measures listed to date are hydrologic. There are a number of ecological planning tools that have been developed and are being linked to RSM output that could be used in the planning process. The Service encourages the Corps and SFWMD to seek out and use available ecological planning tools to help to ensure that evaluations include both hydrologic and ecologic information. Consideration should be given to ecological planning tools in Florida Bay and Biscayne Bay as well as Greater Everglades.

Adaptive management and the monitoring associated with it is a key part of the science strategy for CERP and should be for CEPP as well, yet there has been no discussion on development of an adaptive management plan for CEPP. The Service recommends that development of an adaptive management plan occur in conjunction with the CEPP planning process.

Project Objectives

The Service appreciates the challenging work completed by the Corps and SFWMD staff on the initial draft project objectives. This task is difficult because of the scope and enormity of the project study area. The Corps and SFWMD project managers should refine the scope and study area to more precisely fit the first increment of the CEPP as soon as possible. This will allow the team to refine the objectives and identify PMs and model applications that will be useful in determining project benefits.

Specific comments on the draft project objectives are as follows:

- "Reduce water loss out of the natural system..." We assume that this is referring to seepage loss since the Seepage Management project was identified as a core component of CEPP but it is not clear. It may refer to the loss of freshwater to tide. The seepage component is not primarily for wildlife benefit but for flood protection and the objective should reflect this. Please clarify this objective.

- "Restore more natural water level responses to rainfall predicted by project modeling..." This needs to be reworded or better explained. Does this imply that the model predicts rainfall? We assume the desire is to have the system respond more naturally to rainfall patterns.

- "Increase oyster habitat and sea-grass populations in the Northern Estuaries by reducing salinity fluctuations from freshwater regulatory pulse discharges." There is a misconception contained within this objective that by reducing salinity fluctuations you increase oyster and seagrass habitats. This is not the case as additional management actions are needed for this to occur. The Service also suggests this objective be reworded to include the restoration of the overall ecological function of the estuaries as measured by oyster and sea-grass populations. Detailed questions regarding this objective are as follow:

    - What is meant by seagrass population, species composition, density, acreage increase, etc?
    - Is *Vallisneria* included under seagrass since it is an important component of the Caloosahatchee River restoration?
    - Which Northern Estuaries will the CEPP improve (St. Lucie, Caloosahatchee, etc.)?
    - Will muck removal in estuaries or addition of artificial substrates (oyster cultch) be included in the Management Measures as part of the CEPP to claim maximum ecological benefits for Northern Estuaries oyster and seagrass health and abundance?

Performance Measures

The process used by the Ecological sub-team to select the project PMs is working well and the draft suite of PMs listed above is suitable to detect hydrologic benefits. Concerns we have at this point are whether the RECOVER approved and vetted PMs previously used in CERP can be modified to use RSM output. Additionally, the estuarine performance measures proposed utilize an array of models including the SFWMM; or 2x2. Will the SFWMM be used to evaluate project alternatives (perhaps solely in the estuaries)?

Also of concern is how output from the additional ecological tools will be used to formulate alternatives to optimize benefits for natural resources throughout the system. The Service recommends that conclusions and recommendations drawn from these specialized tools be considered between alternative runs to make the next iteration more beneficial for natural resources. Additionally, the information will be used to better relate hydrologic change to environmental lift predicted by the preferred alternative.

Examples of the resource-specific ecological tools currently under consideration are listed previously in this document and minutes from a recent Ecological sub-team meeting indicate that most of the models are ready for use. One issue that arose is whether the models can accept RSM hydrologic model output. Most of the ecological models were set up to work on a fixed grid so the RSM output needs to be manipulated to get it into a fixed-grid format. Modelers from the Corps, Joint Ecological Modeling group and other agencies are working on ways to eliminate this problem.

Models

Since the River of Grass modeling tools and PMs have been moderately peer-reviewed, their use during CEPP will be appropriate as long as the Corps' certification process is either completed or these PMs exempted from certification.

There are some concerns with using the RESOPS model in conjunction with the Regional Simulation Model – Glades Lower Ease Coast Service Area (RSM-Glades LECSA) model. RSM-Glades LECSA is a daily time-step model that will be using output from RESOPS which utilizes a monthly time-step. This will automatically create inherent errors in the model results.

The RSM Basin model covers the Kissimmee Basin, Lake Okeechobee, St. Lucie River, and Caloosahatchee River. Unfortunately, this model does not provide individual gauge data, which the Service has used previously to assess impacts and implement terms and conditions within its biological opinions. Rather than simulating gauge data, this model represents stage as an average water level condition across an entire water body. Also, model documentation for RSM Basin does not discuss ground water. The spatial extent of the RSM Basin model includes an intensive surface water / ground water interaction. This interaction in the Everglades headwaters needs to be defined and verified for accuracy. It is unclear whether the surficial aquifer is simulated in this model.

A similar concern exists for the RSM Glades-LECSA model which simulates hydrology within 1-square mile grid cells without providing individual gauge data. Since the Corps and SFWMD water management sections base their management actions on individual gauge data as the Service bases its nondiscretionary terms and conditions on gauge data, a cross-walk between simulated hydrology across a large area to that at specific gauges will be needed. The hydrologic effects of the proposed action at key gauge sites identified by the Service during this and previous consultations should be provided.

The modeling strategy for CEPP does not consider any detailed flood event modeling or levee assessments. L-29 levee concerns have presented a human health and safety constraint in WCA-3A, thus a levee assessment with flood event modeling will likely become necessary especially since more water is predicted to move south through the system into WCA-3A.

Recent water quality legal and scientific issues throughout the Everglades necessitate the need for water quality assessments and modeling. It has been noted that the DMSTA model does not allow for extreme events, such as droughts and hurricanes. Thus, DMSTA is expected to predict +/-23 percent of the mean phosphorus concentrations. DMSTA may be useful in the planning process, but it will likely need more refinement for project level simulations.

Climate Change Scenarios

Given the range of uncertainties in dealing with climate change and urbanization it is important that these be incorporated into the planning process in the best way feasible. The planning team should evaluate available tools and information that can be used to assess future impacts of climate change including sea level rise and changes in urbanization (which may affect water supply). One possible tool has resulted from work conducted by an MIT research team (Service, U.S. Geological Survey, and MIT) that developed a series of scenarios in collaboration with a wide range of stakeholders, including representatives from Federal, State, and local government. These scenarios have four top-level dimensions selected by the stakeholders: climate change, population, financial resources, and planning assumptions. Within these dimensions, stakeholders developed a bounded range of possible values from the best available science, including sea level rise, land use, agriculture, conservation lands, and transportation corridors. This climate change model covers the CEPP area and it is recommended that the team determine how best to incorporate this information into the planning process and/or identify other climate change information that can be used during planning.

Project Schedule

The following table (Table 1) highlights some issues identified with the current draft schedule as it pertains to Service activities.

Table 1. Comments on the draft schedule as it pertains to Service activities.

Activity ID	Activity Name	Start	End	Notes
1060	Prepare Draft PIR and EIS	1 May 2012	2 Oct 2012	What will be evaluated in this draft PIR/EIS? The TSP will be selected 4 months later (1110). Will the Corps be assessing all the potential TSPs that are under consideration (1400)?
1410	Complete Draft PIR/EIS Report	4 Feb 2013	7 Feb 2013	This occurs a week after the TSP Approval (1110). How does the Corps propose to evaluate the TSP for the EIS in less than 4 days?
1570	FWS Prepares Coordination Act Report	4 Feb 2013 *14 Dec 2012*	20 Mar 2013 *8 Feb 2013*	Is this the draft or final CAR? The draft CAR is usually completed about 45 days after the TSP (1120) and a couple weeks prior to the draft EIS (1420). If we are given the TSP when the EIS begins evaluating it we can start this activity earlier (see the italics dates for example).
1540	USACE Starts Biological Assessment	1 Feb 2013	22 Mar 2013	This activity lists 1550 as a successor. What is 1550? The FWS BO is activity 1560.
1560	FWS Prepares Biological Opinion	25 Mar 2013	2 Oct 2013 *12 Aug 2013*	The Service has 135 calendar days to prepare the BO under the Act. It appears that the current schedule has 135 work days. I think this makes the end date 12 Aug 2013 which lines up with 1240. The predecessor to the BO is listed as 1550. What is 1550?
	Final FWS Coordination Act Report	*9 Apr 2012*	*27 May 2013*	This activity is not included in the schedule. The end date for this is usually prior to the final EIS going to public review (see the italics dates for example).

Threatened and Endangered Species List

The Service has received a request from the Corps (email dated January 20, 2012) for a preliminary list of Threatened and Endangered Species that may be encountered within the project area. The following table (Table 2) is a preliminary list that will be finalized later when an official request from the Corps has been received.

Table 2: Threatened and Endangered species that may be present in the CEPP project area.

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	CRITICAL HABITAT
Mammals			
Florida bonneted bat	*Eumops floridanus*	Candidate	No
Florida panther	*Puma (=Felis) concolor coryi*	Endangered	No
West Indian manatee	*Trichechus manatus*	Endangered	Yes
Birds			
Northern Crested caracara	*Caracara cheriway*	Threatened	No
Bald eagle*	*Haliaeetus leucocephalus*	Delisted	No
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	Endangered	Yes
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Endangered	Yes
Piping plover	*Charadrius melodus*	Threatened	No
Red-cockaded woodpecker	*Picoides borealis*	Endangered	No
Roseate tern	*Sterna dougallii dougallii*	Threatened	No
Wood stork	*Mycteria Americana*	Endangered	No
Reptiles			
American alligator	*Alligator mississippiensis*	Threatened	No
American crocodile	*Crocodylus acutus*	Endangered	Yes
Eastern indigo snake	*Drymarchon corais couperi*	Threatened	No
Green sea turtle**	*Chelonia mydas*	Endangered	Yes
Hawksbill sea turtle**	*Eretmochelys imbricata*	Endangered	Yes
Kemp's ridley sea turtle**	*Lepidochelys kempii*	Endangered	No
Leatherback sea turtle**	*Dermochelys coriacea*	Endangered	Yes
Loggerhead sea turtle**	*Caretta caretta*	Threatened	No
Plants			
Big Pine partridge pea	*Chamaecrista lineata* var. *keyensis*	Candidate	No
Blodgett's silverbush	*Argythamnia blodgettii*	Candidate	No
Cape Sable thoroughwort	*Chromolaena frustrata*	Candidate	No
Crenulate lead-plant	*Amorpha crenulata*	Endangered	No
Deltoid spurge	*Chamaesyce deltoidea* ssp. *deltoidea*	Endangered	No
Florida brickell-bush	*Brickellia mosieri*	Candidate	No

Florida pineland crabgrass	*Digitaria pauciflora*	Candidate	No
Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	Candidate	No
Florida semaphore cactus	*Consolea corallicola*	Candidate	No
Johnson's seagrass	*Halophila johnsonii*	Threatened	No
Garber's spurge	*Chamaesyce garberi*	Threatened	No
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeensis*	Endangered	No
Pineland sandmat	*Chamaesyce deltoidea* ssp. *pinetorum*	Candidate	No
Tiny polygala	*Polygala smallii*	Endangered	No
Invertebrates			
Bartram's hairstreak butterfly	*Strymon acis bartrami*	Candidate	No
Florida leafwing butterfly	*Anaea troglodyta floridalis*	Candidate	No
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	Endangered	No
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	Endangered	No
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	Threatened	No
Fish			
Smalltooth sawfish**	*Pristis pectinata*	Endangered	No

* The bald eagle has been delisted under the Act but continues to be protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

** Species under the purview of the NMFS-NOAA Fisheries for consultation under the Act.

CONCLUSION

The guidance and recommendations that we provide in this PAL aim to assist us in our obligations to consider the effects of the project on all of the trust resources that we must address to fulfill our responsibilities under the FWCA and Act. We applaud the progress made so far by the CEPP PDT as well as the team's common vision for restoration and commitment to the expedited planning process. We look forward to continuing our working relationship with the Corps staff and other partners and stakeholders throughout the remainder of the CEPP planning process. If you have any questions regarding the contents of this PAL, please contact Kevin Palmer or Lori Miller at 772-562-3909.

Sincerely yours,

Larry Williams
Field Supervisor
South Florida Ecological Services

cc: electronic copy only
Corps, Jacksonville, Florida (Eric Bush, Eric Summa, Kimberly Vitec, Gina Ralph)
Corps, West Palm Beach, Florida (Kim Taplin, Lt Col. Michael Kinard)
DEP, Tallahassee, Florida (Greg Knecht)
District, West Palm Beach (Lisa Cannon, Matt Morrison)
ENP, Homestead, Florida (Bob Johnson, Carol Mitchell)
FWC, Tallahassee, Florida (Mary Ann Poole)
FWC, West Palm Beach, Florida (Chuck Collins)
Service, Atlanta, Georgia (David Flemming, Dave Horning)
Service, Jacksonville, Florida (Miles Meyer)

United States Department of the Interior

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

March 27, 2012

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

Dear Colonel Pantano:

The U.S. Fish and Wildlife Service (Service) has prepared this second in a series of Planning Aid Letters (PAL) to assist in developing the Central Everglades Planning Project (CEPP), an expedited planning process to implement portions of the Comprehensive Everglades Restoration Plan (CERP) located in the central Everglades. This PAL is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), and section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This PAL does not constitute the report of the Secretary of Interior as required by section 2(b) of the FWCA, nor does it constitute a biological opinion under section 7 of the Act. The purpose of this PAL is to provide the U.S. Army Corps of Engineers (Corps) with recommendations regarding several aspects of the planning process including, but not limited to, management measure screening, alternative formulation, modeling strategy, and natural resource considerations.

Review of major points from previous PAL

- Reconnection of Water Conservation Area (WCA) 3B as a flow-through system connecting WCA-3A to Everglades National Park (ENP) is the most critical part of restoration remaining to be planned. All options should be analyzed regarding how and to what extent this critical reconnection should be made.
- Relaxation of the G-3273 constraint, the integration of the S-356 pump station to control seepage in the L-30 and L-31N canals, and the expansion of S-333 structure to allow greater flow out of the ponded areas of WCA-3A into Northeast Shark River Slough (NESRS) should be included in CEPP.
- Regulation schedules for WCAs 2 and 3B should be defined and the regulation schedule for WCA-3A should be refined.
- Further modification of the S-12s should not be considered as it was screened out in the recent Everglades Restoration Transition Plan (ERTP) for protection of the Cape Sable Seaside Sparrow (CSSS) (*Ammodramus maritimus mirabilis*). Once ERTP is authorized, the S-12C closure regime will be relaxed allowing for year-round operations.

Project Status

Since the last PAL was submitted on January 24, 2012, the Corps and South Florida Water Management District (SFWMD) project managers briefed their vertical management teams on the progress of the project at a Decision Point One meeting held on January 27, 2012. The purpose of this meeting was to determine study direction and receive feedback on the study scope and schedule. The team was directed to proceed to the next phase of the project, the Execution phase. This phase will last roughly 12 months and result in development of a Tentatively Selected Plan (TSP) and Project Implementation Report for the first increment of the CEPP Project. Detail regarding the team's progress during the first 2 months of the Execution phase will follow in this letter. The next milestone will be an In-Progress Review to the Corps' vertical management team on March 29, 2012. This letter will help inform that briefing.

Management Measures and Screening

Background

A draft list of coarse or general management measures was presented to the Project Delivery Team (PDT) at a meeting on January 31, 2012 (Table 1). These measures were compiled from work other teams had completed on previous CERP projects, and grouped by geographic location (*i.e.*, above and below the red line (an imaginary line used in modeling) designating the bottom of the Everglades Agricultural Area [EAA]). The team agreed to employ a first-cut screening of these measures using information generated from the other teams that considered them (*e.g.*, partitioning Lake Okeechobee was screened out during previous project deliberations and so it would be screened out of CEPP on this basis).

Table 1. List of general management measures grouped by geographic location. Quantity and quality are located above the red line in the EAA; Conveyance and distribution measures are located in the Greater Everglades downstream of the EAA; and Seepage management measures are located between the Greater Everglades and populated areas of the Miami Rock Ridge along the protective levee.

Quantity and Quality	Conveyance and Distribution	Seepage Management
Higher lake levels	Plug or backfill canal to marsh grade	Detention area
Partition Lake Okeechobee	Shallowing of canal	New pump stations
Above-ground storage reservoir	Gated structure in canal	Groundwater wells
Ecoreservoir	Pipeline	Line/pipe canals
Operational changes	Spreader canal	Recharge area
Stormwater Treatment Area	Levee removal/degradation	Flood attenuation reservoir
Flow equalization basin	Increase flow resistance in canals	Relocate existing canals
Dry/wet flow way	Culverts within existing levees	New canals
Aquifer Storage and Recovery	Spoil mound removal	Relocate existing pump stations
	Operational changes	Operational changes
	Bridging	Raise canal stages
	Cap canals	Step-down levees
	Pumping stations	In-ground seepage barriers
	Levee/berm construction	

The management measures remaining after the first round of screening (Table 2) have been added to a spreadsheet currently being called the *CEPP Component and Alternative Development and Screening Tool (CEPP Roadmap).* This spreadsheet is a central depository of all information the team will generate and use to screen and combine management measures into components, and combine components into a final array of alternatives. The next step will be to define the process the team will use to analyze available information (model output and other data) using hydrologic and ecological targets, and screen out certain measures while combining others into functional components and alternatives. As seen in Table 2, the names and numbers of management measures in each category have changed somewhat from the original list. The Service recommends that a brief write-up be included with the matrix to show the evolution of how some of the measures were screened and others were fleshed out in detail.

Table 2. Management measures as listed in the latest version (March 7, 2012) of the CEPP Component and Alternative Development and Screening Tool (The Roadmap). These are the remaining measures after the first screening iteration.

Quantity and Quality	Conveyance and Distribution	Seepage Management
Operational Flexibility	Degrade Levees	Detention area
Shallow Reservoir (FEB)	Gap Levee	New pump stations
Deep Reservoir	Remove Levee	Raise Canal Stages
Strategic Aquifer Storage and Recovery	Spreader Canal	Flood attenuation reservoir
Stormwater Treatment Area	Pumping Stations	Relocate existing canals
	Canal Conveyance	New canals
	Focused Flows	Relocate existing pump stations
	Canal Backfill	Operational changes
	Spoil mound removal	In-ground seepage barriers
	Canal Plugging	
	Gated Control Structures	
	Culverts	
	Weirs	
	Operational Flexibility	
	DOI Bridging	
	Structural Improvements	
	Swales	
	Culvert/Canal Maintenance	
	Collector Canals	

Issues and Concerns

There is uncertainty as to how the next screening phase will be implemented. The team has been briefed by the modeling group, which indicated that some "upfront" modeling products will be used to screen and optimize management measures for compilation into components and subsequently into alternatives. The Service recommends that the Corps quickly define the methodology that will be used during this step and make sure that the modeling sensitivity, and hydrologic and ecological targets are robust enough to potentially remove or retain management measures. The Service would like to be included in discussions regarding the ecological targets that will be used during this process.

At a February 29, 2012, Core Planning Team meeting, the S-12 operational regime for protection of the CSSS was added to the *CEPP Roadmap* (second level of screening) with little discussion. The Service would like to reiterate comments from the first PAL that changes to the S-12 operations should be considered as part of the first-cut screening methodology because changes to all of the S-12 structures were considered during ERTP. In fact, the primary focus of ERTP was determining operational flexibility and optimizing the S-12 closure regime for improving WCA-3A water management while maintaining protection for the CSSS. During the recent ERTP multi-agency PDT meetings all options for change to the S-12 structures were screened out with the exception of S-12C, which became operational year round in the final plan. It is our understanding that there is no project objective in CEPP for the modification of these structures since the goal of the project is to restore flow to NESRS. It is unclear, at present, how the preliminary modeling will provide necessary information on S-12 operations to screen them out. The modeling group has indicated that the preliminary modeling will not consider impediments to flow along the Tamiami Trail or operations. The CEPP team has agreed to eliminate measures and components from other CERP projects, such as Decompartmentalization, due to the extensive study and project work done in those projects. The Service recommends the same screening process be incorporated for exclusion of the S-12 A/B, S-344, and S-343 structure operations for maintaining protection of the CSSS. We believe the team should focus on the primary goal of the project which is to restore flow from WCA-3A to WCA-3B and into NESRS.

The Service is also concerned about the process by which alternatives will be developed and evaluated. The general alternative formulation and evaluation process has been described by the Corps as a series of screening iterations using "upfront" modeling output whereby management measures are screened or combined into components which will then be screened out or combined to form the final array of alternatives. Relying on modeling products to choose alternative features for the final array of alternatives without regards to operations, adaptive management, and past experience could result in a plan with adverse impacts to the landscape and threatened and endangered species. The Service requests that we receive model output pertaining to threatened and endangered species, throughout the planning process from screening through alternative formulation, so that we may help the team identify all possible means to reduce or eliminate impacts and ensure the TSP will help restore these imperiled species [Act section 7(a)(1)].

Use of New Science in Planning

It is critical for the PDT to begin discussing the "transition strategy" for how we will slowly introduce larger volumes of water into a system which has had its spatial extent reduced by 50 percent and its biological systems acclimated to reduced water flow. For the purposes of comparing modeled alternative runs it may be appropriate to use Natural System Model-based hydrologic targets; however, it should be understood that the first increment of CEPP will probably not meet these, and they may be inappropriate for use in some areas of the system. It is likely that both species and their habitat will be impacted during the transition to full restoration and careful planning will be needed to ensure these natural resources remain on the landscape. Excessive increases in flow volumes could overwhelm the system and disrupt timing, which could be harmful to tree islands, wetland dependent bird nesting and foraging, apple snail survival and reproduction, among others. Both the landscape and species response will need time to adjust to new conditions.

In addition to the new science learned during the 2 day Science Workshop for CEPP, the team should also use information learned from other CERP projects. A good example of this is the Multi-species Transition Strategy (MSTS) used during ERTP-1. A group of interagency scientists, in coordination with species experts, compiled the latest information regarding a number of species and defined a WCA-3A water management strategy. This science-based strategy was designed for snail kites, apple snails, wading birds, and vegetation found within WCA-3A and was based on the current hydrologic system. For CEPP, this strategy can be refined and other species and locations within the project area can be added. One of the key benefits from the MSTS and ERTP-1 was opening a communication channel between regional water operators and interagency scientists responsible for managing the system for natural resources. The Periodic Scientist Calls and seasonal scientist meetings are simple and effective forms of adaptive management and should be utilized in CEPP.

The Service recommends that threatened and endangered species be considered regularly throughout the CEPP planning process, from screening through alternative formulation, to ensure species protection while restoring the ecosystem. The Service understands that the PDT would like to have definitive answers as to how threatened or endangered species will be affected by certain aspects of the project, and the Service will work with PDT to provide those answers as soon as feasible within the process. Most importantly, in the end, the CEPP water control and operational plan will have to be analyzed (by the Service) to determine any effects to threatened and endangered species.

CSSS Nesting and Habitat Criteria

CSSS inhabit the relatively short hydroperiod marl marsh which flanks the Taylor and Shark River Sloughs in the ENP. Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 60 to 180 days is optimal for the plant species important for sparrow nesting and for maintenance of sparrow habitat ([Kushlan et al. 1982]; Olmsted 1984; Kushlan 1990a; Wetzel 2001; Ross et al. 2006). Recent observed average annual hydroperiods in subpopulation A (CSSS-A), as measured at NP-205 near the sparrow's core breeding habitat in western Shark Slough, have been in the range of 240 days or more. The effect of these longer hydroperiods in consecutive years has been the conversion of short hydroperiod marsh suitable for sparrow nesting to a sawgrass-dominated, wetter, marsh-type habitat unsuitable for sparrows. While the habitat occupied by sparrows can tolerate occasional average annual hydroperiods to 240 or more days this condition should not occur in concurrent years. Hydroperiods of 60 to 180 days should be experienced at the highest frequencies (*e.g.*, 7 out of 10 years) with occasional years ranging from 210 to 240 days. The opposite is true in the eastern subpopulations where hydroperiods are shorter resulting in higher threats of catastrophic fires and woody plant encroachment. CEPP is expected to alleviate these conditions by shifting more water into NESRS.

Targets for CEPP alternative performance, with regards to sparrow nesting, in the vicinity of the six sparrow subpopulations (A-F) will remain the same as during Interim Operational Plan and ERTP-1. For all CSSS subpopulations the target is at least 60 consecutive days and preferably 80 or more consecutive days in most years during the nesting season from March 1 through July 15 with water levels at or below ground surface. For CSSS-A this equates to 60 days at or below 6.0 feet National Geodetic Vertical Datum (NGVD) at NP-205. In understanding this target, it is important to note that, due to topographic variation within the sparrow's habitat, available habitat at a higher elevation than the NP-205 reference point will remain dry for longer than habitat at the reference point elevation. Therefore this requirement, with current protective operations of S-12A/B, S-343, and S-344, should provide the 80 dry days required for completion of two successive broods over a larger percentage of habitat above 6.0 feet NGVD. At a stage elevation of 6.0 feet NGVD at NP-205, roughly 40 percent of the habitat is available for nesting by CSSS.

This requirement is less critical, though still important, in the eastern subpopulations (B, C, E, and F) because the habitat in these areas has been too dry in recent years and has become more susceptible to damaging human-induced and naturally occurring wildfires. It is anticipated that CEPP will greatly improve the habitat in these eastern populations due to the fact that a large proportion of current and new water from the project will be distributed to NESRS east of the L-67 extension. Subpopulation D, located to the east of Taylor Slough, has been maintained too wet in recent years due to its proximity to the C-111 Canal. The CERP Project, C-111 Spreader Canal, has implemented protective measures and habitat restoration actions for the benefit of this subpopulation.

Modeling

The Service recommends that the PDT not rely solely on modeling for CEPP. Values produced from modeling are not intended to be taken literally, but rather for observing trends and for making comparisons. All of the models being used in CEPP have a +/- 0.50 foot error along with inherent errors in data and topography. Best available science, best professional judgment, ecosystem observations from monitoring, and adaptive management should be the primary tools used to design and select the TSP as discussed in the PDT kick-off meeting.

It is the Service's understanding that early model runs, using preliminary performance measures and ecological targets, will be performed as a way to pre-screen alternatives. During this modeling process, the Service recommends making the model output of any screened-out scenarios available to the PDT members for their agency analyses to avoid any pre-decisional determinations. Current Everglades' performance measures and ecological targets, including those developed in the ERTP-1, should also be included as screening tools and in alternative model runs.

The Service also wants to point out that using NSM-4.6.2 targets for the entire Everglades may not be desirable. Models tend to work well in some areas of the project area and less in other areas. Some of these differences are due to current topographic information and mapping as well as resolution of the models. The CEPP planning and modeling cannot ignore micro-topography as it is extremely important to the species and their habitats.

Climate

The Service recommends that the CEPP PDT discuss and consider the current and predicted climate regimes that influence the rainfall patterns of the Florida Peninsula. Local, regional, and global regimes have important consequences for ecosystems, species, and habitats and should be a part of the planning process. Examples of regimes to be discussed are effects to land and sea breezes and tropical weather due to, but not limited to, the Atlantic Multi-Decadal Oscillation and the El Nino Southern Oscillation.

Climate Change

Climate change should also be a part of the active dialog in planning for Everglades restoration in determining the viability of recommended restoration targets and solutions with emphasis around the perimeter of the Greater Everglades. The Service recommends the use of "Addressing the Challenge of Climate Change in the Greater Everglades Landscape" research imitative that was recently completed by a group of researchers at the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (MIT) in coordination with the Service and U.S. Geological Survey. The study investigates possible trajectories of future landscape changes in and around the Greater Everglades landscape relative to four main drivers: climate change, shifts in planning approaches and regulations, population change, and variations in financial resources. This research identifies some of the major challenges to future conservation efforts and illustrates a planning method which can generate conservation strategies resilient to a variety of climatic and socioeconomic conditions (Vargas-Moreno and Flaxman 2011). CEPP needs to ensure that the theory and practice of restoration fits with the forecast of a changing environment (Harris et al. 2006). Sea level rise, especially, should be considered and planned for as it will likely affect structural operations, water management plans, ecology, and landscapes. We feel it is important to include the MIT scenarios in discussions and planning to insure we investigate the best methods to restore our resources.

In summary, the Service continues to support the strategy and vision for accomplishing this challenging but critical restoration project. We commend the Corps' sustained efforts to complete CEPP within the expedited schedule. We pledge our continuing support in planning of restoration projects to maximize opportunities and minimize potential adverse effects to the natural system. For assistance or if you have questions regarding the contents of this PAL, please contact Lori Miller or Kevin Palmer at 772-562-3909.

Sincerely yours,

Larry Williams

Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic copy only
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United States Department of the Interior

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December 12, 2012

Eric Bush
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Dear Colonel Dodd:

The U.S. Fish and Wildlife Service (Service) has prepared this third in a series of Planning Aid Letters (PAL) to assist in developing the Central Everglades Planning Project (CEPP), an expedited planning process to implement portions of the Comprehensive Everglades Restoration Plan (CERP) located in the central Everglades. This PAL is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), and section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This PAL does not constitute the report of the Secretary of Interior as required by section 2(b) of the FWCA, nor does it constitute a biological opinion under section 7 of the Act. The purpose of this PAL is to provide the U.S. Army Corps of Engineers (Corps) with recommendations regarding several aspects of the planning process including, but not limited to, management measure screening, alternative formulation, modeling strategy, and natural resource considerations.

Project Status

Since the last PAL was submitted on March 27, 2012, the interagency CEPP team has achieved several milestones including the completion of the 'screening phase' of alternative evaluation, brief introduction of the draft final array consisting of 5 alternatives, and several Internal Progress Review briefings of the vertical management teams of the Corps and South Florida Water Management District (District). The final step of the roughly 12-month long Execution phase, which started in late January 2012, will be an analysis of the final array of alternatives using the Regional Simulation Model (RSM) and RECOVER performance measures which will aid the team in selecting the Tentatively Selected Plan (TSP). The Project Implementation Report (PIR) will follow after the selection of the TSP. The focus of this letter will be on comments and recommendations regarding the conceptual design and modeling of the final array of alternatives. The Service understands that a 'hybird' alternative, or one in which contains the best components from several of the final alternatives, could be defined and selected as the TSP. It is unclear at this time if this alternative would then need a separate model run to satisfy the CERP Programmatic Regulations.

Draft Final Array of Alternatives

Background

For the past several months, the core planning team members, in conjunction with the project planning team (PDT) and participants of the Working Group-sponsored public workshops, have been analyzing screening level model output to determine which of the previously identified management measures should be retained and grouped into alternative scenarios (more detail regarding this process will be included in the Corps' PIR and Environmental Impact Statement). The latest of two tiers of screening level analyses allowed the group to reduce the number of draft alternative scenarios from 10 to 5 (Figures 1 – 5). All of these alternatives retain the same configuration above the redline but differ to varying degrees from the Hydropattern Restoration Feature (HRF) south through the green and blue lines and along the yellow line which represents the seepage management barrier along the urban boundary of the Everglades. The approach taken was to have a set of alternatives, composed of a wide array of management measures with three likely scenarios bound by "bookends" representing a minimum and maximum scenario. These alternatives will be simulated by the Regional Simulation Model (RSM) and evaluated using a set of REstoration COordination and VERification (RECOVER) performance measures. Scores from these metrics will be combined with estimated costs and entered into the Corps cost-benefit analysis to determine which of the alternatives are cost effective.

General Comments about the Alternatives

- All of the alternatives state that the A-2 Flow Equalization Basin (FEB) will be integrated with the FEB on A-1, which is now in the Future Without Project condition for CEPP; however, the operation of these basins is unclear at this time. Will the A-1 be used to collect up to 60,000 acre/feet of runoff from the Everglades Agricultural Area while the A-2 handles the 200,000 acre/feet of "new water" produced by CEPP?

- There are certain aspects about the project that have been shelved for decisions to be made at a later date. These include: conveyance capacity from Lake Okeechobee to the FEBs, operational plan for the entire project, L-6 diversion, eastern Hydropattern Restoration Feature (HRF), Miami Canal backfill method, planted spoil mound retention, L-28 cuts, C-11 Extension cuts, etc. It is unclear whether the RSM modeling of the final array will help us make these decisions.

- The Service suggests that an assumptions category be included for each alternative that would contain separable elements of the project such as retention of the Decompartmentalization Physical Model (DPM) Project and any modifications to the Tamiami Trail which the Department of Interior (DOI) would make under the Tamiami Trail Next Steps Project.

- There is no discussion of plugs in the L-67A Canal associated with the gated structures to help channel the flow into the pocket. Additionally, there is no discussion of cutoff walls to prevent short-circuiting of water down the pocket. The Service assumes that enough length of L-67 C canal and levee will be degraded to allow the water to flow into Water Conservation Area (WCA)-3B.

- The Service suggests that climate change scenarios be run on all of the alternatives instead of just the TSP.
- The Service is concerned about flow effects to Biscayne Bay under CEPP. Blue Line model sensitivity runs conducted in August 2012 indicated significant reduction in flows to the bay for several scenarios that are likely due to CEPP seepage management features. Total freshwater flow volumes currently entering Biscayne Bay are required for the protection of fish and wildlife resources in the bay, including threatened and endangered species. The Service believes that any CEPP alternative that causes reduction in flows to Biscayne Bay should be re-evaluated and potentially revised to maintain current or greater flows to the bay.
- The preliminary RECOVER analysis, of CEPPs effects on Lake Okeechobee, indicate that there is little difference between the FEB scenario and the existing condition base and future without project condition. However, the analysis does note that there may be times when higher stages impact the vegetation communities present in the lake. An adaptive management plan should be used to identify areas where CEPP can improve lake health in the future.

Specific Comments about the Alternatives

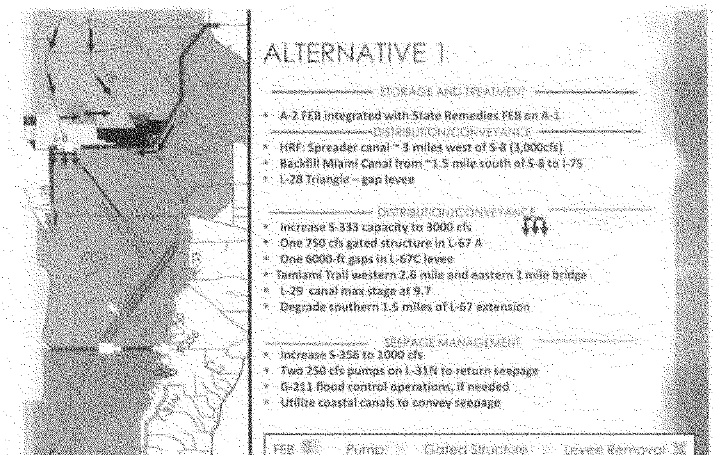

Figure 1. Alternative 1 of the Draft Final Array of alternatives for CEPP.

Alternative 1 was originally intended to be the minimal action plan or "bookend" and avoided any flow of water into WCA-3B. There is now a structure present on the L-67A and it is unclear if this is the retained DPM culvert or an additional culvert set. If we are planning to retain the

DPM structure, then this would be a cost savings for CEPP and it could possibly mean additional funding for monitoring of the DPM Project. The Service suggests that it should be listed as separate from the CEPP Project.

Additionally, it is not likely that one structure in the L-67A can provide enough flow into WCA-3B to alleviate concerns about the amount of time the WCA-3A regulation schedule would remain in Zone A. Although this alternative includes expansion of the S-333 structure capacity to 3,000 cubic feet per second (cfs), it is unclear at this time how this would be done and whether the hydraulic head in southern WCA-3A (under the lowered schedule implemented by the Everglades Restoration Transition Plan [ERTP]) would be sufficient to sustain 3,000-cfs flows.

The two 250-cfs pumps on the L-31N are not desirable as planned in this alternative. All other structures on the L-31 discharge into detention basins separate from the Everglades National Park (ENP) to reduce the likelihood of exotic fish transfer and to prevent impacts from poor quality water entering directly into the Park. Also, the location of the southern pump, which is currently sited directly north of and adjacent to the 8.5 Square Mile Area, would likely impact that projects ability to collect and remove seepage coming from Northeast Shark Slough (NESRS).

Finally, it is unclear how the benefit of degrading the lower 1.5-miles of the L-67 Extension will be evaluated. The Service does not recall data being generated by the iModel during the screening phase regarding partial degradation of the L-67 Extension. The Service recommends that this feature either be fully removed or left in place until future iterations of CEPP.

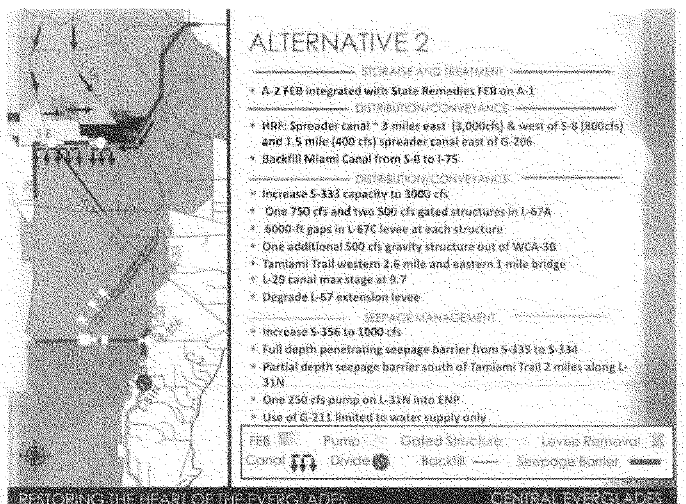

Figure 2. Alternative 2 of the Draft Final Array of alternatives for CEPP.

Alternative 2 is preferable to the Service at this point because it allows for a wider distribution of flows throughout the system while doing it in a passive manner. This alternative would allow rehydration of a majority of WCA-3B up to the newly defined stage at Site 71. Once this level is reached the structures on L-67A could be cycled off while discharge is increased at the S-333 with improved capacity. There is some uncertainty whether the one additional structure on the L-29, in conjunction with the existing S-355s, will match the inflows into WCA-3B. The RSM model output should be able to resolve this issue. An additional weir(s) may be necessary along the L-29 to ensure that new water added to WCA-3B can be discharged into the NESRS.

Degradation of the remaining portion of the L-67 Extension should benefit the spread of water at the downstream end of the S-12 structures. This would allow more water to move through the S-12 C and D and S-333 and help reduce the long hydroperiods currently observed in the western marl prairies.

Again, we believe direct discharge into ENP from L-31N is undesirable at this time, especially given that there is capacity in the South Dade Conveyance System and new Frog Pond detention areas associated with the C-111 Spreader Canal Project.

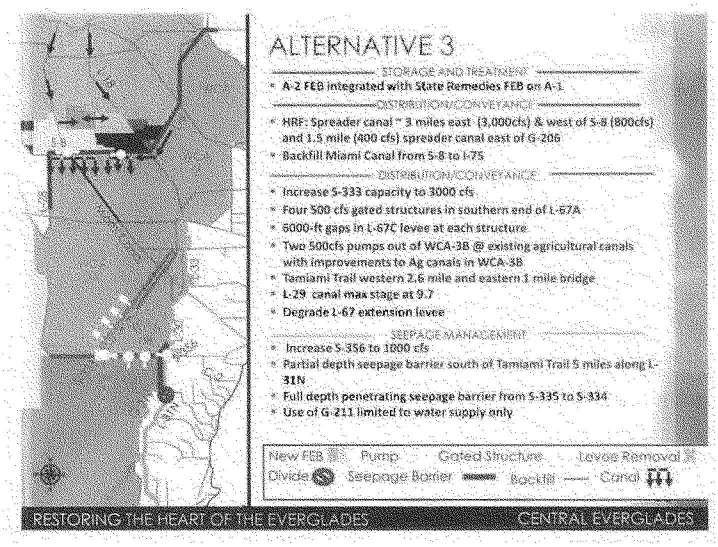

Figure 3. Alternative 3 of the Draft Final Array of alternatives for CEPP.

Should Alternative 2 not be able to move a sufficient amount of water from WCA-3A through WCA-3B passively (since this project is not providing additional storage of water in the North), then it may be necessary to utilize a temporary pump on the L-29 to facilitate the flow through

WCA-3B. Alternative 3 includes temporary pumps to move more water through WCA-3B, however, it seems to be slightly overbuilt for this increment of CEPP. The Service suggests removing one of the four structures on the L-67A and one of the temporary pumps on L-29. With the removal of those two features, this alternative would still move more water through WCA-3B than Alternative 2 but at less cost than currently conceptualized.

The Service would like to reiterate its desire to have the first increment of CEPP restore flow to as much of WCA-3B as possible and distribute flows east along a wide expanse of Tamiami Trail. We have recently been made aware by project managers that inclusion of pumps in this project is controversial. If a temporary pump on the L-29 means the difference between starting the restoration of WCA-3B at this time or delaying its restoration conceivably to a much later date, then a temporary pump seems desirable. A temporary pump on the L-29 would move clean water from WCA-3B into the NESRS of ENP.

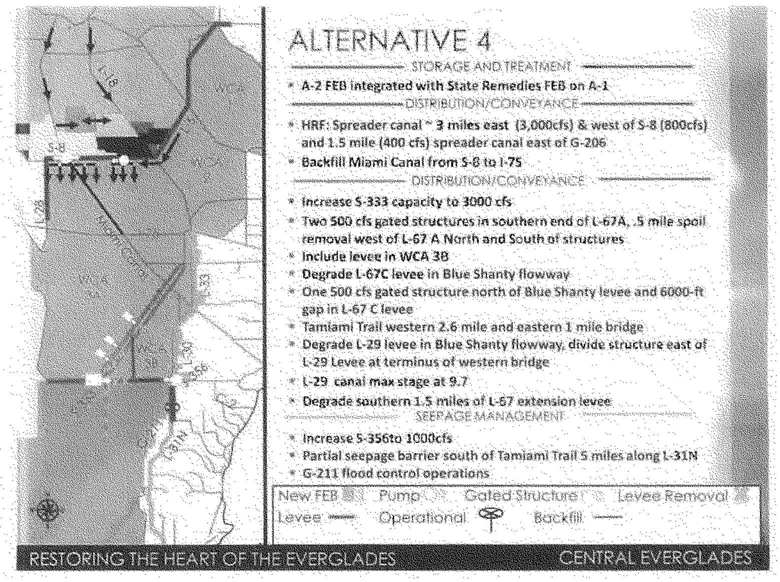

Figure 4. Alternative 4 of the Draft Final Array of alternatives for CEPP.

Alternative 4 is the "Blue Shanty Plan" and was originally designed to prevent high water from reaching the eastern portions of Tamiami Trail, in the event that DOI would not be able to modify the entire length of Tamiami Trail to accommodate higher water levels. This alternative originally included a temporary berm extending from L-67 A south to approximately 2 miles into ENP and a divide structure in the L-29 borrow canal. As the project progressed, we learned that DOI will, in fact, elevate the entire length of the Trail and that we should not consider it a constraint in CEPP. We also learned that the temporary berm would actually need to be a full-sized levee and that the National Park Service could not accept building a levee in a wilderness area.

The current conceptualization of this alternative retains the levee in WCA-3B and the divide structure in the L-29 in an effort to reduce the need for seepage management on the eastern side of WCA-3B. The Service does not feel that construction of a levee (roughly 20 acres of filled wetland) through WCA-3B and the resulting delay in shifting flows eastward through WCA-3B fits a first increment project like CEPP. If seepage management is needed in WCA-3B, in addition to the existing L-30/S-356 conveyance system and/or the Pensucco Wetlands, the Service feels that a seepage barrier along the already existing levee system would be the prudent choice.

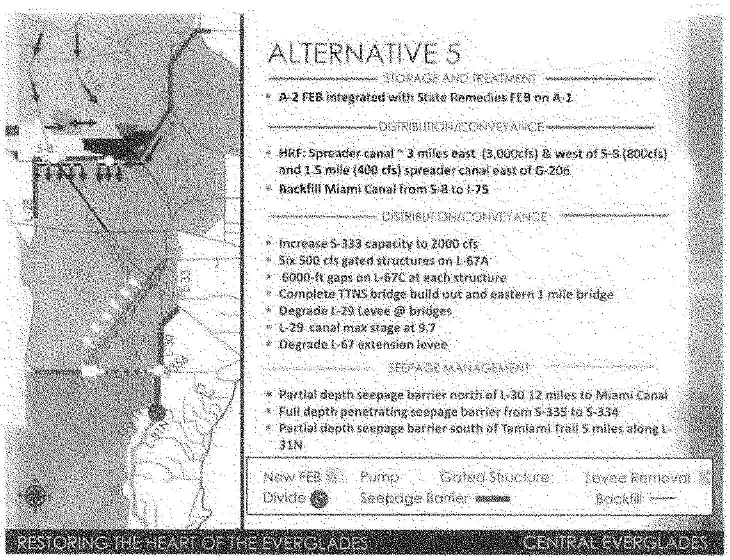

Figure 5. Alternative 5 of the Draft Final Array of alternatives for CEPP.

Although Alternative 5 contains some management measures that have the potential to move us closer to CERP-level restoration, it does not seem consistent with the scale of the other parts of the project. It is unlikely that enough flow could be provided in the dry season, without additional storage, to prevent WCA-3B from drying out in dry to average years if the entire L-29 is removed.

The Service believes this alternative should be removed at this time or modified to come more in line with the other alternatives. This would allow a potential hybrid plan to be included in the final array of alternatives.

Final Comments on CEPP Alternatives

The Service supports the Corps and District endeavors to model and analyze the proposed final array of alternatives. The Service is prepared to evaluate any and all data made available related to effects to threatened and endangered species, and all natural resources within the project area. We have a good idea of how these alternatives will perform from previous iModel results, and we believe Alternative 2 provides the most benefit to all areas of the system while still meeting the intent of an incremental project. We are concerned; however, that enough water will not be able to move through WCA-3B in this scenario which is why Alternative 3 with its temporary pump to facilitate the movement of water should be closely analyzed. We advocate, as we always have, a passive restoration system but understand the difficulty in flowing water across a degraded landscape that has lost much of its slough patterning and contains a high percentage of dense sawgrass. If, it is found through further modeling, a temporary pump could be utilized to effectively facilitate greater flow through WCA-3B into NESRS then the Service would support its temporary use. During the screening phase, plans that distributed water throughout WCA-3B, both with and without pumps, performed the best in the western marl prairies and WCA-3B while also providing substantial hydrologic lift in downstream areas of NESRS in ENP (Table 1). We look forward to receiving the first batch of RSM model output.

Table 1. The table below shows iModel screening output for the WCA-3B flow-through plans (Opt_3A1 – Opt_3B3) along with the target and base conditions. A1 and A2 scenarios do not include pumps while B2 and B3 do contain pumps which facilitate the movement of water from WCA-3B into NESRS (via L-29). Note that all plans make significant improvements above existing condition in NESRS (locations NE2 and P33). Plans with pumps improve hydroperiods in the western marl prairie (NP 205) over the existing conditions (ECB).

Hydroperiod							
Location	Target	ECB	FWO	Opt_3A1	Opt_3A2	Opt_3B2	Opt_3B3
				without pumps		with pumps	
NP205	58.14	73.53	74.04	79.37	78.95	67.54	66.00
Site71	99.53	93.36	91.16	97.01	97.10	99.02	96.73
NE2	99.53	87.75	87.28	99.67	99.86	99.77	100.00
P33	98.78	89.34	89.10	99.86	99.91	100.00	100.00
Average Water Depth							
NP205	-0.10	0.15	0.15	0.26	0.25	0.10	0.08
Site71	1.82	0.84	0.80	1.24	1.31	1.21	0.76
NE2	2.07	0.94	0.93	1.98	2.02	2.10	2.15
P33	2.05	0.96	0.96	1.57	1.62	1.65	1.65

Review of major points from previous PALs

- Reconnection of WCA-3B as a flow-through system connecting WCA-3A to ENP is the most critical part of restoration remaining to be planned. All options should be analyzed regarding how and to what extent this critical reconnection can be made.
- Relaxation of the G-3273 constraint, the integration of the S-356 pump station to control seepage in the L-30 and L-31N canals, and the expansion of S-333 structure to allow greater flow out of the ponded areas of WCA-3A into NESRS should be included in CEPP.
- Regulation schedules for WCAs 2 and 3B should be defined and the regulation schedule for WCA-3A should be refined.
- Further modification of the S-12s should not be considered as it was screened out in the recent ERTP for protection of the Cape Sable Seaside Sparrow (CSSS) (*Ammodramus maritimus mirabilis*). Once ERTP is authorized, the S-12C closure regime will be relaxed allowing for year-round operations.
- The general alternative formulation and evaluation process uses "upfront" modeling output whereby management measures are screened or combined into components which will then be screened out or combined to form the final array of alternatives. Relying on modeling products to choose alternative features for the final array of alternatives without regards to operations, adaptive management, and past experience could result in a plan with adverse impacts to the landscape and threatened and endangered species. The Service requests that we receive model output pertaining to threatened and endangered species throughout the planning process (including alternative screening, alternative formulation, operational plans, and adaptive management) so that we may help the team identify all possible means to reduce or eliminate impacts and ensure the TSP will help restore these imperiled species.
- It is critical for the PDT to begin discussing the "transition strategy" for how we will slowly introduce larger volumes of water into a system which has had its spatial extent reduced by 50 percent and its biological systems acclimated to reduced water flow.
- For the purposes of comparing modeled alternative runs it may be appropriate to use Natural System Model-based hydrologic targets; however, it should be understood that the first increment of CEPP will probably not meet these, and they may be inappropriate for use in some areas of the system.
- Use of the 2010 Multi-species Transition Strategy refined during ERTP-1 is highly recommended. A group of interagency scientists, in coordination with species experts, compiled the latest information regarding a number of species and defined a WCA-3A water management strategy. This science-based strategy was designed for Everglade snail kites (*Rostrhamus sociabilis plumbeus*), apple snails (*Pomacea paludosa*), wading birds, and vegetation found within WCA-3A and was based on the current hydrologic system. For CEPP, this strategy can be refined and other species and locations within the project area can be added.

- The Periodic Scientist Calls and seasonal scientist meetings should be utilized in CEPP. These meetings maintain a communication channel between regional water operators and interagency scientists responsible for managing the system for natural resources.
- The Service recommends that threatened and endangered species be considered regularly throughout the CEPP planning process, from screening, alternative formulation, water management plans, through adaptive management to ensure species protection while restoring the ecosystem.
- CSSS inhabit the relatively short hydroperiod marl marsh that flanks the Taylor and Shark River Sloughs in the ENP. Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 60 to 180 days is optimal for the plant species important for sparrow nesting and for maintenance of sparrow habitat. Recent observed average annual hydroperiods (since 2002 and implementation of Interim Operations Plan [IOP]) in subpopulation A (CSSS-A) as measured at NP-205 near the sparrow's core breeding habitat in western Shark Slough, have been in the range of 240 days or more. While the habitat occupied by sparrows can tolerate occasional average annual hydroperiods of 240 or more days this condition should not occur in concurrent years. Hydroperiods of 60 to 180 days should be experienced at the highest frequencies (*e.g.*, 7 out of 10 years) with occasional years ranging from 210 to 240 days. The opposite is true in the eastern subpopulations where hydroperiods are shorter resulting in higher threats of catastrophic fires and woody plant encroachment.
- Targets for CEPP alternative performance, with regards to sparrow nesting, in the vicinity of the six sparrow subpopulations (A-F) will remain the same as during IOP and ERTP-1. For all CSSS subpopulations the target is at least 60 consecutive days and preferably 80 or more consecutive days in most years during the nesting season from March 1 through July 15 with water levels at or below ground surface. For CSSS-A this equates to 60 days at or below 6.0 feet National Geodetic Vertical Datum (NGVD) at NP-205. In understanding this target, it is important to note that, due to topographic variation within the sparrow's habitat, available habitat at a higher elevation than the NP-205 reference point will remain dry for longer than habitat at the reference point elevation. Therefore this requirement, with current protective operations of S-12A/B, S-343, and S-344, should provide the 80 dry days required for completion of two successive broods over a larger percentage of habitat above 6.0 feet NGVD. At a stage elevation of 6.0 feet NGVD at NP-205, roughly 40 percent of the habitat is available for nesting by CSSS.
- The Service recommends that the PDT not rely solely on modeling for CEPP. Best available science, best professional judgment, ecosystem observations from monitoring, and adaptive management should be the primary tools used to design and select the TSP as discussed in the PDT kick-off meeting.
- The Service recommends making the model output of any screened-out scenarios available to the PDT members for their agency analyses to avoid any pre-decisional determinations. Current Everglades' performance measures and ecological targets, including those developed in the ERTP-1, should also be included as screening tools and in alternative model runs.

- The Service also wants to point out that using NSM-4.6.2 targets for the entire Everglades may not be desirable. The CEPP planning and modeling cannot ignore micro-topography as it is extremely important to the species and their habitats.
- The Service recommends that the CEPP PDT discuss and consider the current and predicted climate regimes that influence the rainfall patterns of the Florida Peninsula.
- Climate change should also be a part of the active dialog in planning for Everglades restoration in determining the viability of recommended restoration targets and solutions with emphasis around the perimeter of the Greater Everglades. Along with the Corps' climate change scenarios, the Service recommends the use of "Addressing the Challenge of Climate Change in the Greater Everglades Landscape" research initiative that was recently completed by a group of researchers at the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (MIT) in coordination with the Service and U.S. Geological Survey. Sea level rise, especially, should be considered and planned for as it will likely affect structural operations, water management plans, ecology, and landscapes. We feel it is important to include the MIT scenarios in discussions and planning to insure we investigate the best methods to restore our resources.

In summary, the Service continues to support the strategy and vision for accomplishing this challenging but critical restoration project. We commend the Corps' sustained efforts to complete CEPP within the expedited schedule. We pledge our continuing support in planning of restoration projects to maximize opportunities and minimize potential adverse effects to the natural system. For assistance or if you have questions regarding the contents of this PAL, please contact Lori Miller or Kevin Palmer at 772-562-3909.

Sincerely yours,

For Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic copy only
Corps, Jacksonville, Florida (Eric Summa, Kimberly Vitek)
Corps, West Palm Beach, Florida (Kim Taplin)
DEP, Tallahassee, Florida (Ernie Marks)
District, West Palm Beach, Florida (Lisa Cannon, Matt Morrison)
DOI, Miami, Florida (Shannon Estenoz)
ENP, Homestead, Florida (Bob Johnson, Carol Mitchell)
FWC, Tallahassee, Florida (Conservation Planning Services)
FWC, West Palm Beach, Florida (Chuck Collins, Barron Moody)
Service, Atlanta, Georgia (Dave Horning)
Service, Jacksonville, Florida (Miles Meyer)

A.2 Coordination Act Reports

The Final Fish and Wildlife Coordination Act (FWCAR) was received from U.S. Fish and Wildlife Service (FWS) on December 17, 2013.

United States Department of the Interior

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

December 17, 2013

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
Project: Central Everglades Planning Project

Dear Colonel Dodd:

Enclosed for your review is the Final Fish and Wildlife Coordination Act Report (FWCAR) on the Central Everglades Planning Project (CEPP). The Final FWCAR is based on the proposed action as described and analyzed in the U.S. Army Corps of Engineers' (Corps) Draft Integrated Project Implementation Report and Environmental Impact Statement and on model evaluations conducted by the U.S. Fish and Wildlife Service (Service) and other entities. This Final FWCAR provides the Service's evaluation of the Tentatively Selected Plan (TSP; Alternative 4R2) which was not complete at the time the draft FWCAR was submitted. This document reiterates guidance and recommendations for the benefit of fish and wildlife resources in the CEPP study area. This report is provided by the Service in accordance with the FWCA of 1958, as amended (48 Stat. 401; 16 U.S.C. 661 *et seq.*) and the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

The attached report includes an evaluation of Alternative 4R and 4R2 model runs which were released after the Draft FWCAR was prepared. The Corps has selected Alternative 4R2 as the TSP, and described it as an optimization of the previously selected Alternative 4. The attached analysis of effects for Alt 4R2 show that it functions similarly to previous alternatives while making some improvements to water supply and damaging freshwater discharge to northern estuaries. Alternative 4R2 will also create an additional 10,000 to 15,000 acre/feet of flow to the Greater Everglades and slightly shift the distribution of habitat units in certain parts of the system.

The Service continues to support this project and the Corps' selected TSP, which demonstrates a significant step forward in Everglade's restoration and conservation. Although significant strides will be made with the implementation of this project, there remains much to be done. In conjunction with the subsequent phases of the CEPP and other Comprehensive Everglades

Restoration Plan (CERP) projects, the currently proposed project will provide the additional water and improved distribution necessary to restore northern Water Conservation Area-3A, Water Conservation Area-3B, eastern Everglades National Park and Florida Bay. We request the Corps continue careful consideration of how to effectively sequence and implement the components of the CEPP to expedite and maximize the benefits to natural resources.

If you, or your staff, have any questions regarding the findings and recommendations contained in this draft report, please contact Kevin Palmer at 772-469-4280. The cooperation of your staff and the staff of the South Florida Water Management District in furthering Everglades Restoration is greatly appreciated.

Sincerely yours,

for Larry Williams
Field Supervisor
South Florida Ecological Services Office

Enclosure

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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Miami-Dade County Miami, Florida (Dr. Susan Markley)
NOAA Fisheries, Miami, Florida (Dr. Joan Browder)
Service, Atlanta, Georgia (David Horning)
Service, Jacksonville, Florida (Miles Meyer)

Final

Final Fish and Wildlife Coordination Act Report

Central Everglades Planning Project

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

December 2013

EXECUTIVE SUMMARY

The Final Fish and Wildlife Coordination Act Report (FWCAR) for the Central Everglades Planning Project (CEPP) should be regarded as a supplement to the Draft FWCAR which was submitted to the U.S. Army Corps of Engineers (Corps) in May 2013, and herein incorporated by reference in its entirety. Many of the analyses, conclusions and recommendations regarding the original Final Array of alternatives (Alternatives [Alt] 1 through 4) can be found in the Draft FWCAR and are not entirely repeated within this document. For more detailed information regarding the planning process and comparison of previous alternatives, please see the Corps' Project Implementation Report (PIR) (2013) and U.S. Fish and Wildlife Service's (Service) Draft FWCAR (2013).

In May 2013, the Service supported the Corps' Tentatively Selected Plan (TSP), Alt 4, in its Draft FWCAR. During preparation of the Draft FWCAR, however, the Corps had work underway to optimize the TSP. This FWCAR analyzes the modified CEPP Alt 4R and the new TSP Alt 4R2. The Service supports the Corps' selection of Alt 4R2 as the TSP for CEPP.

While the optimized Alts, 4R and 4R2, make slight adjustments to CEPP performance in certain areas of the system, the main focus remains to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south. This will allow for restoration of natural habitat conditions and water flow in the central Everglades and re-connect the central Everglades ecosystem with Everglades National Park (ENP) and Florida Bay. A brief description of the most recent alternatives can be found in this report along with a general analysis of alternative effects to geographic regions within the study area.

In varying degrees, the alternatives provided for improvements to the current distribution of water into Water Conservation Area (WCA) 3A and throughout the Greater Everglades into Northeast Shark River Slough (SRS). Improved distribution of water deliveries through SRS is anticipated to increase foraging opportunities for wading birds and snail kites as well as improve conditions for alligators and other wetland species inhabiting the partially-restored landscapes of northern WCA-3A, WCA-3B, and Northeast SRS. We also expect improved conditions in southern WCA-3A, by reducing the frequency and duration of high water events which erode the ridge and slough landscape and result in tree island flooding. Vegetation shifts are expected in marshes and on tree islands throughout northern WCA-3A, WCA-3B, and SRS.

Benefits to ENP and Florida Bay are likely by re-establishing sheetflow and hydropattern resulting in restored ridge and slough habitat beneficial to all natural resources within ENP. The Service also finds that the project would provide significant benefits south of Lake Okeechobee with an acceptable balance of risks to the ecology of Lake Okeechobee; however, until additional storage proposed for areas around Lake Okeechobee is available, the threat of damaging high and low lake stages will continue. For the estuaries, both Alts 4R and 4R2 increase the number of months in the preferred salinity range when compared to the Future Without Conditions (FWO). This difference could prove to be beneficial to seagrass and oyster abundance if suitable substrate was available for colonization and spat recruitment. In Florida Bay, CEPP will lower salinities resulting in measureable improvements in habitat for juvenile American crocodiles (*Crocodylus acutus*), juvenile spotted sea trout, pink shrimp, and seagrasses.

Despite the potential benefits described above and to reiterate from our Draft FWCAR (2013), the Service remains concerned about potential effects to Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*) subpopulations A and E and designated critical habitat for this species located on the eastern side of SRS. We are also concerned about the project's lack of improvement in habitat conditions for the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) in WCA-3. Furthermore, there were other issues identified during previous restoration actions that were to be addressed by this project. One example is the significant ponding of water in eastern and southern WCA-3A; however, there may be an opportunity to address this with operational flexibility. Another example is the inability to significantly reduce damaging flows to the northern estuaries. We believe that more storage combined with less consumption represents a balanced approach to restoring the downstream environment. The use of reservoirs is one component in this approach. Also, by implementing the TSP, WCA-3B will not be fully reconnected to re-establish the historic flow path and begin the process of ridge and slough regeneration in this area. This will result in continuing current operations which put too much flow into the western reaches of SRS. Lastly, while the CEPP model results for the TSP predict benefits to Florida Bay, we remain concerned that these same model results may indicate reduced flows to central and southern Biscayne Bay compared to the FWO project conditions. These reductions could impact fish and wildlife resources in Biscayne National Park and impact the effectiveness of the Comprehensive Everglades Restoration Plan's (CERP) Biscayne Bay Coastal Wetlands Project.

Incremental in nature, implementation of the Corps' PIR (2013) is the first part of a multi-step restoration effort intended on fulfilling the recommendations made by the National Academy of Science's National Research Council which stated that Incremental Adaptive Restoration is necessary to achieve the timely and meaningful benefits of CERP. It is expected that subsequent planning processes will utilize and implement additional CERP components previously envisioned to achieve the level of restoration envisioned for CERP.

While the Service believes that the CEPP has the operational flexibility necessary to maximize favorable ecological conditions, this operational flexibility needs to be translated into clear triggers and well-defined management actions through the CEPP Adaptive Management Plan. The AM plan should have continuous and secure funding throughout the life of the project until the targets are realized. The Service is committed to continue working with the Corps and South Florida Water Management District (District) to identify the operational flexibility necessary to improve conditions and enhance restoration in these areas. Additionally, the Corps should include aspects from previous CERP projects, such as Periodic Scientist Calls, in a well-designed adaptive assessment process to aid in identifying and alleviating these concerns. We look forward to assisting the Corps and District in optimizing and refining these restoration efforts.

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LIST OF ACRONYMS AND ABBREVIATIONS USED IN THE TEXT

ac-ft	Acre-feet
Act	Endangered Species Act
AFB	Alternatives Formulation Briefing
Alt	Alternative
AM	Adaptive Management
C-111SC	C-111 Spreader Canal
C&SF	Central and Southern Florida
cm	Centimeters
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CRE	Caloosahatchee River and Estuary
CSSS	Cape Sable seaside sparrow
Decomp	Decompartmentalization of Water Conservation Area 3
District	South Florida Water Management District
EAA	Everglades Agricultural Area
ECB	Existing Conditions Baseline
ENP	Everglades National Park
EIS	Environmental Impact Statement
ERTP	Everglades Restoration Transition Plan
ELVeS	Everglades Landscape Vegetation Succession Model
FEB	Flow Equalization Basin
FWCAR	Fish and Wildlife Coordination Act Report
FWC	Florida Fish and Wildlife Conservation Commission
FWO	Future Without Project
HSI	Habitat Suitability Indices
HU	Habitat Unit
IRL	Indian River Lagoon
km	kilometer
LEC	Lower East Coast
LECSA	Lower East Coast Service Area
LORS	Lake Okeechobee Regulation Schedule
LOSA	Lake Okeechobee Service Area
MBTA	Migratory Bird Treaty Act
MMN	Marine Monitoring Network
NESRS	Northeast Shark River Slough
NGVD	National Geodetic Vertical Datum
NSM	Natural System Model
NWR	National Wildlife Refuge
PDT	Project Delivery Team
PM	Performance Measure
PIR	Project Implementation Report
PWS	Public Water Supply

RECOVER	Restoration Coordination and Verification
RSM	Regional Simulation Model
RSMGL	Regional Simulation Model Glades Lower
SCS	Southern Coastal Systems
Service	U.S. Fish and Wildlife Service
SFWMM	South Florida Water Management Model
STA	Stormwater Treatment Area
SLE	St. Lucie River and Estuary
SRS	Shark River Slough
SAV	Submerged Aquatic Vegetation
TSP	Tentatively Selected Plan
USGS	U.S. Geological Survey
WADEM	Wader Distribution Evaluation Modeling
WCA	Water Conservation Area
WRDA 2000	Water Resources Development Act of 2000

I. PURPOSE SCOPE AND AUTHORITY

A. Introduction

The Final Fish and Wildlife Coordination Act Report (FWCAR) for the Central Everglades Planning Project (CEPP) should be regarded as a supplement to the Draft FWCAR which was submitted to the U.S. Army Corps of Engineers (Corps) in May 2013, and herein incorporated by reference in its entirety. Many of the analyses, conclusions and recommendations regarding the original Final Array of alternatives (Alternatives [Alt] 1 through 4) can be found in the Draft document and are not entirely repeated within this document. The Draft report supported the Corps' Tentatively Selected Plan (TSP), Alt 4, but at that time work was underway to optimize the TSP. This FWCAR analyzes the modified CEPP Alt 4R and the new TSP Alt 4R2 as they perform relative to the base conditions. The U.S. Fish and Wildlife Service (Service) supports the Corps selection of Alt 4R2 as the TSP for CEPP.

The evaluation of Alts 1 through 4 identified the need to revise the operations of Alt 4 to ensure the project savings clause constraints are met, to minimize localized adverse ecological effects, and to identify additional opportunities to provide for other water related needs. Alternative 4 was initially refined with operational changes to avoid potential impacts to water supply levels of service in the Lake Okeechobee Service Area (LOSA) and Lower East Coast (LEC), resulting in Alt 4R. Alt 4R was then refined further to determine if water supply cutbacks to the LOSA could be further reduced and to determine the quantity of additional Lower East Coast Service Area (LECSA) 2 and LECSA 3 public water supply (PWS) able to be provided while maintaining the natural system performance realized for Alt 4R. Alternatives 4R and 4R2 were compared to and evaluated against the FWO and Existing Conditions Baseline (ECB) to describe changes to existing conditions with implementation of each CEPP alternative.

While the optimized Alts, 4R and 4R2, make slight adjustments to CEPP performance in certain areas of the system, the main focus remains to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south. This will allow for restoration of natural habitat conditions and water flow in the central Everglades and re-connect the central Everglades ecosystem with Everglades National Park (ENP) and Florida Bay. The Corps, who is leading the planning effort in partnership with the South Florida Water Management District (District), has recommended that the Everglades Agricultural Area Storage (EAA) and Storage and Treatment, Decompartmentalization of Water Conservation Area 3 (Decomp), and Everglades Seepage Management projects form the core of CEPP. These are highly interdependent features of the plan that must be formulated and optimized in a comprehensive and integrated manner.

A brief description of the modifications to Alt 4 (Alts 4R and 4R2) can be found in this report along with a general analysis of alternative effects to geographic regions within the study area. For more detailed information regarding the planning process and comparison of previous alternatives please see the Corps Project Implementation Report (PIR) (2013) and Service's Draft FWCAR (2013). Areas of this document that have been considerably changed from the Draft version include the Executive Summary, Description of the TSP, Regional Evaluations of the Project, and Summary of Position.

B. Purpose and Scope of Project

The purpose of the 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 the CERP, reducing the risks and uncertainties associated with project planning and implementation. The term "increment" is used to underscore that this study will formulate an initial portion of individual CERP components. It is envisioned that later studies will further expand upon this "increment" by developing subsequent CERP components to achieve the level of restoration envisioned for the CERP. This study approach is consistent with the recommendations from the National Research Council to utilize Incremental Adaptive Restoration to both achieve timely, meaningful benefits of the CERP and to lessen the continuing decline of the Everglades ecosystem.

Prior planning efforts and the development of scientific goals and targets for CERP have led to a determination that some components are interdependent features that necessitate formulation from a systems approach. Recently authorized CERP projects are "perimeter" projects that generally do not greatly depend upon or influence other CERP projects. However, the components in the central part of the Everglades (interior CERP projects) are hydraulically connected from Lake Okeechobee to Florida Bay, and are reliant on one another for both inflows and outflows. These interdependencies require system plan formulation and analysis in order to optimize structural and operational components, rather than formulating separable components that may not be compatible when looking at the cumulative impacts.

The scope of CEPP included several components that were originally parts of the Yellow Book Plan (denoted with asterisk in list below). Other pieces that were within the scope of CEPP but not retained in CEPP's TSP are also listed:

- EAA Storage Reservoirs*
- Flow to Northwest and Central WCA-3A*
- WCA- 3 Decompartmentalization and Sheetflow Enhancement*
- Dade-Broward Levee/Pennsuco Wetlands
- Bird Drive Recharge Area
- L-31N Improvements for Seepage Management and S-356 Structures*
- Everglades Rain-Driven Operations

1. Study Area Location

The CEPP study area (Figure 1) encompasses a large portion of the south Florida Peninsula. For purposes of this document, the project area has been sub-divided into five regions: Northern Estuaries, Lake Okeechobee, a portion of the EAA, Greater Everglades, and Southern Coastal Systems (SCS) (especially Florida Bay). A brief description of each region is described below with more detail provided in the regional chapters of this report.

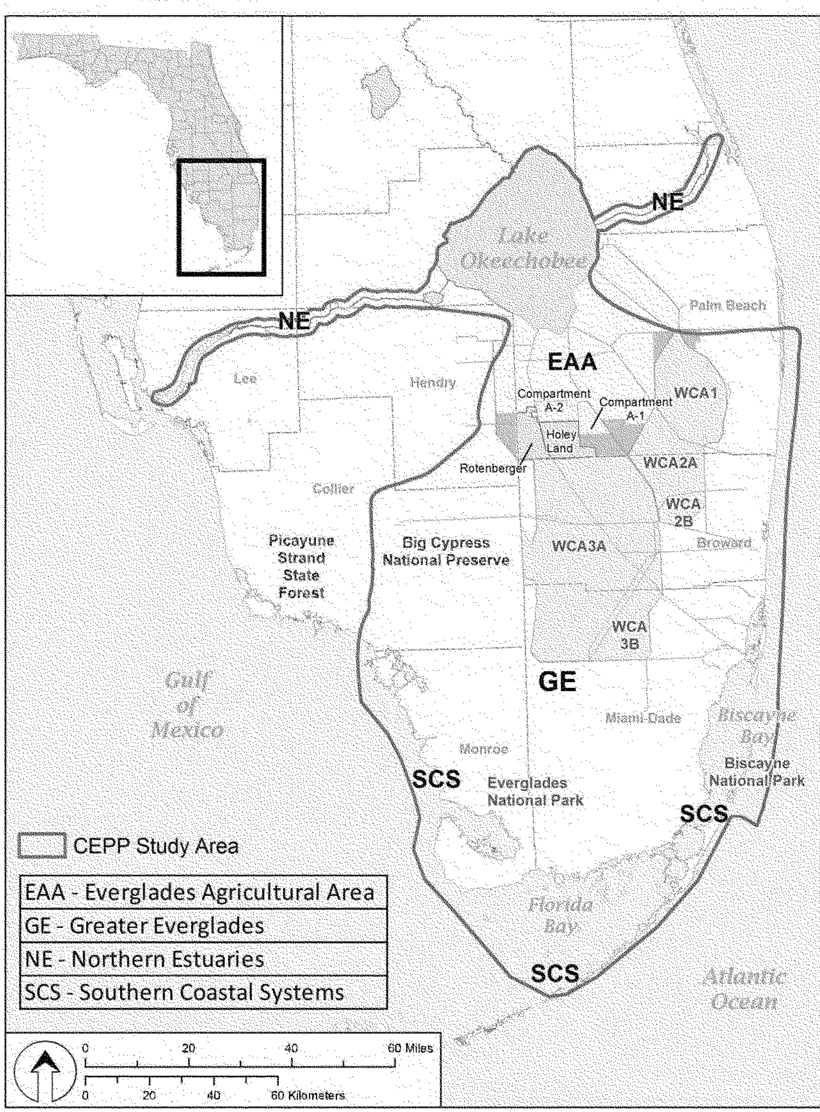

Figure 1. Map showing the CEPP study area.

a. Northern Estuaries

The Northern Estuaries are composed of two different discharge systems from Lake Okeechobee. The St. Lucie Canal feeds into the St. Lucie Estuary, part of a larger system known as the Indian River Lagoon (IRL). The lagoon is designated an Estuary of National Significance under U.S. Environmental Protection Agency's National Estuary Program. The Caloosahatchee Canal and River feeds into the Caloosahatchee Estuary to the west.

b. Lake Okeechobee

Lake Okeechobee is a large, roughly circular lake with a surface area of approximately 730 square-miles. It is a broad, shallow lake that lies 30 miles west from the Atlantic coast and 60 miles east of the Gulf of Mexico in the central peninsula of Florida. It serves as the principal water supply reservoir for southern Florida, and is also used for navigation, flood control, and recreation. The lake is impounded by a system of levees, and has six outlets: The St. Lucie Canal eastward to the Atlantic Ocean and the Caloosahatchee Canal and River westward to the Gulf of Mexico, and four agricultural canals – the West Palm Beach, Hillsboro, North New River, and Miami.

c. Everglades Agricultural Area

The EAA is approximately 700,000 acres in size and is located 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. The CEPP will include a southern component of the EAA.

d. Greater Everglades

The Greater Everglades encompasses the WCAs and the northern half of ENP. The WCAs are situated south and east of the EAA and comprise an area of approximately 1,350 square-miles; about 40 miles wide and 100 miles long from Lake Okeechobee to ENP. These provide for floodwater retention, PWS, and also serve as the headwaters of ENP. They are divided into three major sections: WCA-1 (Loxahatchee National Wildlife Refuge [NWR]), WCA-2, and, WCA-3 (the largest of the three). The ENP is located to the south of the WCAs, and is the third largest national park in the continental United States, established in 1947. The ENP covers approximately 2,353 square-miles and has total elevation changes of only 6 feet from its northern boundary of Tamiami Trail south to Florida Bay. The landscape is comprised of sawgrass (*Cladium* spp.) sloughs, tropical hardwood hammocks, offshore coral reefs, mangrove forest, lakes, pond, and bays.

e. Southern Coastal Systems

This region is comprised of Biscayne Bay, Florida Bay, the southwest Florida coast up to and including the Ten Thousand Islands Area. Biscayne Bay is a shallow coastal lagoon located along the southeastern coast of Florida. The bay is bordered to the west by the mainland of Florida and to the east by a series of barrier islands and the northern Florida Keys. Florida Bay is a mosaic of banks, basins and small islands located at the southern end of the Florida Peninsula. Basins within the bay are shallow (10 foot maximum), and are separated by a network of shallow, flat-topped banks. Over 85 percent of Florida Bay's 849 square-mile area lies within ENP. For purposes of this report, the southwest coastal environment includes Whitewater Bay and the estuarine areas associated with outflows from Shark River Slough (SRS). Virtually all of the area is within ENP.

2. Project Objectives

The major goal of the project, as stated by project managers, is to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south, allowing for restoration of natural habitat conditions and water flow in the central Everglades. This will re-connect the central Everglades ecosystem with ENP and Florida Bay. This portion of the CEPP will include those components that provide for storage, treatment and conveyance south of Lake Okeechobee, removal of canals and levees within the central Everglades and seepage management features to protect the urban and agricultural areas to the east from the increased flow of water through the central portion of the system. An integrated study effort on these components is needed to set the direction for the next decade of implementation of the CEPP. The goal of the study effort would be to develop an integrated, comprehensive technical plan for delivering the right quantity, quality, timing and distribution of water needed to restore and reconnect the central Everglades ecosystem. To achieve the goals stated above, the Corps and District have drafted preliminary project objectives as follows:

- Restore seasonal hydroperiods and freshwater distribution that support a natural mosaic of wetland and upland habitat in the Everglades System.
- Improve sheet flow patterns and surface water depths and durations in order to reduce soil subsidence, frequency of damaging fires, and decline of tree islands.
- 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 predicted by project modeling that will promote plant and animal diversity and habitat function.
- Increase oyster habitat and sea grass populations in the Northern Estuaries by reducing salinity fluctuations from freshwater regulatory pulse discharges.

C. Authorities

The WRDA of 2000 provided authority for the CERP in Section 601(b)(1)(A).
The authorization states:

(b) Comprehensive Everglades Restoration Plan. –

(1) Approval. –

(A) IN GENERAL. — Except as modified by this section, the Plan is approved as a framework for modifications and operational changes to the Central and Southern Florida Project that are needed to restore, preserve, and protect the South Florida ecosystem while providing for other water-related needs of the region, including water supply and flood protection. The Plan shall be implemented to ensure the protection of water quality in, the reduction of the loss of fresh water from, and the

improvement of the environment of the South Florida ecosystem and to achieve and maintain the benefits to the natural system and human environment described in the Plan, and required pursuant to this section, for as long as the project is authorized.

Specific authorization for the CEPP will be sought under Section 601(d) as a future CERP project:

(d) AUTHORIZATION OF FUTURE PROJECTS.—
(1) IN GENERAL.—Except for a project authorized by subsection (b) or (c), any project included in the Plan shall require a specific authorization by Congress.
(2) SUBMISSION OF REPORT.—Before seeking congressional authorization for a project under paragraph (1), the Secretary shall submit to Congress —
(A) a description of the project; and
(B) a project implementation report for the project prepared in accordance with subsections (f) and (h).

Sections 601(f) and (h) provide a provision to submit a PIR for the CEPP:

(f) EVALUATION OF PROJECTS.—
(1) IN GENERAL.—Before implementation of a project authorized by subsection (c) or (d) or any of clauses (i) through (x) of subsection (b)(2)(C), the Secretary, in cooperation with the non-Federal sponsor, shall complete, after notice and opportunity for public comment and in accordance with subsection (h), a project implementation report for the project.
(2) PROJECT JUSTIFICATION.—
(A) IN GENERAL.—Notwithstanding section 209 of the Flood Control Act of 1970 (42 U.S.C. 1962–2) or any other provision of law, in carrying out any activity authorized under this section or any other provision of law to restore, preserve, or protect the South Florida ecosystem, the Secretary may determine that—
(i) the activity is justified by the environmental benefits derived by the South Florida ecosystem; and
(ii) no further economic justification for the activity is required, if the Secretary determines that the activity is cost-effective.

(B) APPLICABILITY.— Subparagraph (A) shall not apply to any separable element intended to produce benefits that are predominantly unrelated to the restoration, preservation, and protection of the natural system.

(h) ASSURANCE OF PROJECT BENEFITS.—
(In summary, this section contains provisions for the protection of the South Florida Ecosystem and other water-related needs of the region, including water supply and flood protection.)

Sections 601(e) provides guidance on cost sharing for the CEPP:

(e) COST SHARING.—
(1) FEDERAL SHARE.—The Federal share of the cost of carrying out a project authorized by subsection (b), (c), or (d) shall be 50 percent.
in accordance with subsections (f) and (h).

II. SERVICE INVOLVEMENT IN CENTRAL EVERGLADES PLANNING PROJECT

For details regarding Service involvement with previous relevant projects leading up to CEPP and our involvement during CEPP, including early planning assistance recommendations, please refer to the Draft FWCAR (Service 2013). Since the draft was submitted, the Service has remained committed to meeting the Corps' requirements for deliverables including this Final FWCAR and a Preliminary Biological Opinion. The Service has attended multiple meetings, reviewed and analyzed model output for the optimized runs, drafted reports and coordinated critical Cape Sable seaside sparrow (CSSS) projects to ensure a smooth implementation of CEPP in the future.

III. DESCRIPTION OF THE TENTATIVELY SELECTED PLAN

A. Modeling

CEPP Operational Changes to Alternative 4

At the conclusion of the alternative evaluation and selection process, Alt 4 was chosen by the CEPP's project delivery team (PDT) as the TSP. Model refinements were then begun on Alt 4 primarily using variations of the coarse operations contained in the regional hydrologic model. During this process, stakeholders requested that the refined model runs be compared to Alts 1 through 4 to insure that the team has adequately chosen the best performing alternative. The Corps and District modelers maintained that the new refinements beginning with Alt 4R were not directly comparable to Alts 1 through 4 due to:

- Modifications to address project constraints such as WCA-2B, WCA-3B, and water supply for the LOSA and the LECSA.
- Modifications to address low flows to the St. Lucie Estuary.
- Modifications to minimize action of reductions in the flows to Biscayne Bay.

The final set of alternatives (Alt 4R, Alt 4R1, and Alt 4R2) used the same modeling assumptions as Alts 1 through 4. However, operational changes were made in the final model runs. (Wilcox 2013). The following table indicates the release dates of the final model runs.

Table 1. Release dates of the final optimization runs of Alt 4.

Model Run	Release Date
Alt 4R	February 28, 2013
Alt 4R1	June 6, 2013
Alt 4R2	June 26, 2013

Key Modeling Assumptions and Inclusions:

Existing Condition Baselines (ECB and 2012EC):

The original ECB is based on conditions and operations in years 2010 and 2011 and includes the Interim Operation Plan. 2012EC is based on conditions and operations on December 13, 2012, and includes the Everglades Restoration Transition Plan (ERTP) (Wilcox 2013A). This baseline was developed primarily for the water supply and flood protection subteam to analyze the savings clause. The savings clause Water Resources Development Act of 2000 (WRDA 2000) requires that existing levels of flood protection be maintained. The only changes in the 2012EC were modeling refinements for localized conditions (*i.e.*, S-9, S-9A, L-28 weir, Site-1). The major change is the lowering of WCA-3A Zone A of the regulation schedule during ERTP for dam safety concerns. These concerns were to be addressed by a flood risk analysis. This flood analysis no longer has Corps authorization or funding so it will not be completed. The following are key modeling assumptions and inclusions for ECB and 2012EC:

- Conditions and demands at the time the TSP is identified.
- Existing operations of the Central and Southern Florida (C&SF) Project at the time TSP is identified.
- Non-CERP projects with approved operating manuals at the time the TSP is identified.
- Authorized CERP projects with approved operating manuals at the time the TSP is identified.
- Refinements to the model representation of the S9/S9A, L28 Weir and Site 1.

Future Without Project:

The FWO did not change throughout all of the modeling iterations.

Initial Operating Regime:

The IOR was developed primarily for the water supply and flood protection subteam to analyze the project assurances. Project specific assurances (WRDA 2000) required water for the natural systems and for other water related needs be identified. In CEPP, the IOR is the same as the TSP Alt 4R and includes:

- 2012 conditions and demands or estimated permitted demands at the time that the TSP is identified, whichever is greater.
- Existing operations of C&SF Project at the time the TSP is identified.
- Non-CERP activities with approved operating manuals at the time the TSP is identified.
- Authorized CERP projects with approved operating manuals at the time the TSP is identified.
- The TSP is included.

Initial Operating Regime Baseline (IORBL):

The IORBL is the same as the IOR without the TSP (Wilcox 2013B) and includes and is based on:

- The FWO as of December 13, 2012.
- Updated A-1 Flow Equalization Basin (FEB) operations from the project Environmental Impact Statement (EIS) work.
- Includes "western" 2.6-mile Tamiami Trail Bridge.

- Refinements to model representation of S9/S9A, L28 weir, Site-1, etc.
- Other operations at the time of the selected TSP.
- Captures water reservations and water anticipated from future projects.
- Estimated permitted demands.
- Includes projects such as the C-43, C-44, IRL, Broward County Site-1, Biscayne Bay, C-111 Spreader Canal (C-11SC), restoration strategies for EAA, 1-mile Bridge, and 2.6-mile Bridge along the Tamiami Trail.

Alternative 4R:

How Alt 4R model run differs from the FWO (Wilcox 2013C):

Lake Okeechobee:

- Optimized release guidance in order to improve selected performance within the Lake Okeechobee, Northern Estuaries, and LOSA while meeting environmental targets in the Everglades.
- Lake Okeechobee sends flood releases south through the Miami Canal and North New River Canal to the FEB when the Lake Okeechobee stage is above the bottom of Zone D and the FEB depth is below 2 feet.
- Lake Okeechobee sends flood releases south to help meet water quality based flow targets at stormwater treatment area (STA) 3/4, STA-2N, and STA-2S when Lake Okeechobee stage is above the bottom of the baseflow zone.

St. Lucie Canal Basin:

- C-44 reservoir releases water back to Lake Okeechobee when stages are below the bottom of the baseflow zone.

Storm Water Treatment Areas:

- FEB includes both A-1 and A-2.
- No supplemental water supply is provided to the FEB.
- STA-3/4 will NOT receive 60,000 acre-feet (ac-ft) annually from Lake Okeechobee regulations.
- STA-3/4 will discharge into lower Miami and lower NNR canals.

How ECB differs from FWO:

Northern Lake Okeechobee Watershed Inflows:

- Kissimmee River inflows are based on interim schedules for Kissimmee Chain of Lakes using the IKISS model.
- Restored reaches and pools of the Kissimmee River as of 2010.
- Fisheating Creek, Istokpoga, Taylor Creek, and Nubbin Slough basin inflows are calculated from historical runoff estimates.

Lake Okeechobee and the Northern Estuaries:

- A regional hydrologic surrogate for the 2010 Adaptive Protocol operations is utilized. This attempts to mimic desired timing of releases without estimating salinity criteria for the estuaries.

Everglades Agricultural Area:

- EAA runoff and irrigation demand is compared to South Florida Water Management Model (SFWMM) (ECB) simulated runoff and demand from 1965 to 2005 for reasonability.
- Compartment C land in the Miami Canal basin between STA-5 and STA-6 is not considered to be in production (shrub land use); therefore, no irrigation demands are required in this area.
- Compartment B (excluding cell 4) land in the NNR / Hillsboro is not considered to be in production (shrub land use); therefore no irrigation demands are required in this area.

Stormwater Treatment Areas:

- STA-2: Includes first four cells: 9,910 acres.
- STA-5: Includes first 3 cells at 7,619 acres.
- STA-6: 2,486 acres.

How FWO differs from ECB:

Lake Okeechobee:

- Releases via S-77 can be diverted into C-43 Reservoir.
- No Lake Okeechobee environmental releases.

Northern Lake Okeechobee Watershed Inflows:

- Headwaters Revitalization schedule for Kissimmee Chain of Lakes uses the UKISS model.
- Kissimmee River Restoration is complete.

Caloosahatchee River Basin:

- Maximum reservoir height of 41.7 feet National Geodetic Vertical Datum (NGVD) with a 9,379 acre footprint in western C-43 basin with a 175,800 ac-ft. effective storage.
- Proposed reservoir meets estuary demands while C-43 basin supplemental demands for surface water irrigation are met by Lake Okeechobee.

St. Lucie Canal Basin:

- Excess C-44 basin runoff is allowed to backflow into Lake Okeechobee if lake stage is 0.25 ft. below the Zone D pulse release line before being pumped into the C-44 reservoir.
- Indian River Lagoon South (IRL-S) Project features that include Ten-mile Creek Reservoir and STA, C-44 Reservoir, and C-23/C-24 Reservoir and STA.
- All proposed reservoirs meet estuary demands.

Everglades Agricultural Area:

- Regional Simulation Model (RSMBN) ECB runoff and irrigation demand is compared to SFWMM (ECB) simulated runoff and demand from 1965 to 2005 for reasonability.

Stormwater Treatment Areas:

- STA-2N, STA-2S, STA-5N, STA-5S, and STA-6 are expanded.
- Inflows for STA-3/4, STA-2N, and STA-2S are based on the Dynamic Model for Stormwater Treatment Areas and meet local basin runoff, Lake Okeechobee regulatory discharge, and available A1 FEB storage.

Flow Equalization Basin (A-1):

- FEB inflows are from excess EAA basin runoff.
- FEB outflows are used to meet established inflow targets at STA-3/4, STA-2N, and STA-2S if EAA basin runoff and Lake Okeechobee regulatory discharges are not sufficient.

Alternative 4R1:

Alternative 4R1 model run was developed for the Savings Clause Analysis and includes comparisons within the table below (Wilcox 2013D). If no significant and adverse reductions result, then requirements of savings clause have been met. Significant is determined on a case-by-case basis according to the modelers.

Table 2. Iterations of model runs for Alt 4R1.

Modeling Steps	Base Model Run	With Project Model Run
1	2012EC	IOR Alt 4R
2	Pre-CERP Baseline (previous SFWMM 36-year period of record (POR) run and RSM-2000 ECB)	IOR Alt 4R
3	IOR w/o project IORBL	IOR Alt 4R

The purpose of the above mentioned iterations was to:

- Revise Lake Okeechobee operations in Alt 4R to meet similar water supply cutback performance of ECB2012 (now referred to as 2012EC) and IORBL. Improved performance is important for more severe drought events like 1981, 1982, 1989, and 1990.
- Keep natural system benefits (Habitat Units [HU]) the same as Alt 4R while utilizing a portion of the additional water in the regional system to meet other water related needs, specifically PWS located in the LEC 2 and 3 areas.
- Utilize the optimized Alt 4R, now called Alt 4R1 to complete savings clause and project assurances analyses.

Alternative 4R2:

The last round of refinements was completed in model run Alt 4R2, which is considered the final TSP (Wilcox 2013E). Again, key modeling assumptions did not change, but there were some changes to operations (Wilcox 2013) that included:

- An updated Lake Okeechobee Regulation Schedule (LORS)08 CEPP release from Lake Okeechobee to the estuaries.

- Allow C44 Reservoir water to be sent to Lake Okeechobee when the lake stage is below the baseflow zone (C44 reservoir discharges to C44 canal and then backflows through S308).
- No changes in operations of the STA/FEB compared to Alt 4R.
- After L-6 diversions and the S-8 Rain Driven Operations (RDO) are completed, 40 percent of the L-6 diverted water previously targeted for the S-8 is returned to the S-7 pump station.
- WCA-2A floor is defined in the modeling as being crossed when either of the following two criteria are met:
  - Stages at 2A-U1 marsh gage falls below 10.5 feet.
  - Stages in L38 canal fall below 10.0 feet.
- WCA-3A floor is defined as being crossed when either of the following two criteria are met:
  - Stages at 3-69W marsh gage falls below 7.5 feet.
  - Stages in CA3 canal fall below 7.0 feet.
- Environmental target deliveries through the new L-67 S-345 structures are determined through the iModel produced Rainfall Driven Operations (RDO). Target flows are:
  - S345D = 40 percent
  - S345F = 35 percent
  - S345G = 25 percent
- Tamiami Trail releases (S-333 @2500 cubic feet per second [cfs] capacity and S-12s at existing ERTP capacities). CEPP replaces the rainfall plan with the RDO. CEPP attempts to deliver 100 percent of both the environmental and regulatory calculation through S-333 subject to capacity and hydraulic constraints. After final calculations have been completed, a final check is made to quantify any flood control water to be delivered through the S-12s. If hydraulic capacity exists at the S-345s, then this discharge occurs into WCA-3B instead of the S-12s. This adds a flood control component to the S-345s in addition to the existing RDO environmental target.
- L-29 canal can receive inflow up to 9.7 feet, from S-333 and S-356.
- G-3273 constraint = 9.5 feet using the L29 divide structure criteria.
- Same discharges and design capacity for S-334.
  - L-30 Canal – CEPP delivers water supply from the regional system from WCA-3A through the S-151 / S-337 to maintain L-30 at:
  - 01 Jan = 6.45 feet
  - 01 Jun = 5.40 feet
  - 01 Nov = 6.45 feet
  - 31 Dec = 6.45 feet
- Water supply reserve level applies when WCA-3A is below the floor and no in-kind Lake Okeechobee releases are occurring (when regional water availability does not meet water supply requirements).
  - 01 Jan = 6.25 feet
  - 01 Jun = 5.20 feet
  - 01 Nov = 6.25 feet
  - 31 Dec = 6.25 feet
- Operate to send water from L-29W to L-29E to equilibrate canals when L-29E falls below 7 feet.

B. Description of Final Optimization Alternatives

1. Alternative Formulation Process

Two main alternatives were created during the operational refinement of Alt 4 which became Alts 4R and 4R2. These two alternatives do not differ structurally from one another and only slightly from Alt 4 in that the eastern portion of the spreader canal along the L-5 Levee was deemed unnecessary through modeling and was therefore removed from the Alts 4R and 4R2 evaluations. The main differences in Alt 4R and Alt 4R2 are minor modifications to the coarse operational regime employed in the Regional Simulation Model (RSM). Staff on the District's modeling team implemented the modifications and provided a limited set of output for the various subteams to evaluate. Alternative 4 was initially refined with operational changes to avoid potential impacts to water supply levels of service in the LOSA and LEC, resulting in Alt 4R (for detail see section above; Corps 2013). Alternative 4R was then refined further to determine if water supply cutbacks to the LOSA could be further reduced and to determine the quantity of additional LECSA 2 and LECSA 3 PWS made available while maintaining the natural system performance realized for Alt 4R (Corps 2013). It was unclear at the time what the targets were for supply cutbacks to the LOSA or what an acceptable level of reduction of environmental benefits would be but after reviewing the data the Corps decided that Alt 4R2 was an acceptable TSP.

2. The Tentatively Selected Plan (Alternative 4R2)

Alternative 4R2 differs little from Alt 4 structurally (Corps 2013). The major operational refinements included an updated LORS08, C-44 Reservoir flow to Lake Okeechobee, L-29 canal stages up to 9.7 feet and G-3273 constraint raised to 9.5 feet. The general result of the operational refinements in Alt 4R2 included moderate hydrologic change in Lake Okeechobee, characterized by a stage increase of 0.25 to 0.50 feet for the upper 70 percent of the stage duration curve and a 60 percent increase in the number of days, stage is above 16 feet National Geodetic Vertical Datum (NGVD) (an increase from 696 to 1162 days). A moderate improvement to discharges to the St. Lucie Estuary with a mean monthly reduction in flows above 2,000 cfs and 3,000 cfs reduced by 29 months and 7 months respectively. The alternative also provided an additional 10,000 – 15,000 ac-ft of water to the Greater Everglades on average annually. Alternative 4R2 provides significant benefits in the form of increased flow to northern and central WCA-3A, WCA-3B, and northeast SRS in ENP. Conditions in southern WCA-3A and northwest SRS remain a concern. Biscayne Bay and Florida Bay are slightly improved by the project.

3. The Service's Preferred Alternative

The Service has been steadfast throughout CEPP planning that it prefers an alternative that makes the most of any new water by spreading it throughout the project area. This would provide the most consistent and even transition into restoration preserving the trust resources and their habitat currently found throughout the Everglades system. While the Service fully supports the Corps in implementing the alternative they deem most appropriate, a more balanced and less invasive approach like Alt 2 is preferred by the Service. Alternative 2 costs slightly more (roughly $30 million) than Alt 4R2 and provides less HUs; however, the hydrologic lift downstream is nearly identical and cost savings measures were not applied to this alternative. The Service understands that flowing water though the currently degraded WCA-3B is challenging and may not be possible in this increment of CEPP, but the Service recommends that at least the hydrologic performance in WCA-3B should approach that of Alt 2. The Service also suggests, as the Corps' stated during the January 23, 2013, PDT meeting, that the Blue Shanty Levee be constructed last and only if necessary. It may be the case that the project can operate satisfactorily and without negative impacts to WCA-3B without the levee and its associated negative impact.

4. Literature Cited

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IV. REGIONAL EVALUATIONS OF THE PROJECT

In this section we present the highlights of the evaluation. For more detailed information, see Annex E of the CEPP PIR and EIS entitled, *RECOVER System-wide Evaluation of the Central Everglades Planning Project.*

A. Northern Estuaries

1. Performance Measure Results and Evaluation

a. Caloosahatchee River and Estuary

The evaluation of the Caloosahatchee River and Estuary (CRE) is based on the number of mean monthly flows that fell into specified flow classes during the 41-year (1965 to 2005) period of record. The Performance Measures (PM) target flow is a mean monthly inflow at the S-79 (Figure 2) structure between 450 and 2,800 cubic feet per second (cfs) during all months. Flows at the S-79 that are less than 450 cfs are considered harmful to tape grass (*Vallisneria americana*) in the upper estuary, flows greater than 2,800 cfs cause mortality of the marine shoal grass (*Halodule wrightii*) and oysters (*Crassostrea virginica*) in the lower estuary, and flows greater than 4,500 cfs cause seagrasses to decline downstream in San Carlos Bay (Table 3).

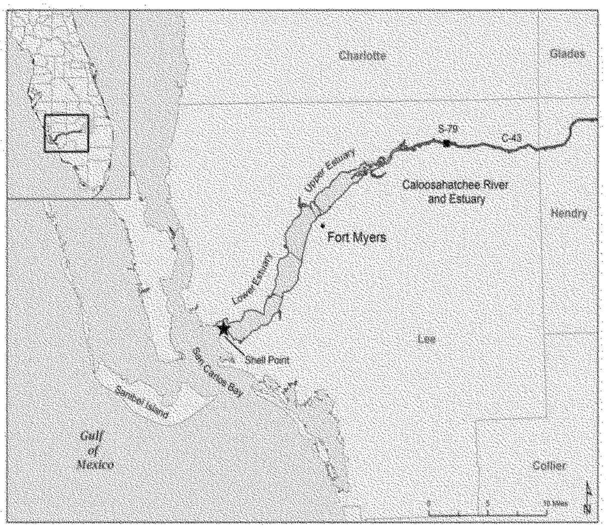

Figure 2. Caloosahatchee River and Estuary.

For this analysis, high-flow events were combined into one flow category (greater than 2,800 cfs). A reduction in the number of damaging high flow events represents improvement. A reduction in the number of times that flow is below 450 cfs also represents an improvement.

Table 3. Mean monthly flow classes for the CRE and the anticipated ecological effects.

Mean Monthly Inflow at S-79	Ecological Response	Ranking Criteria
< 450 cfs	Damage to upper estuary tape grass	Fewer is better
450-2800 cfs	Tolerable range	More is Better
2800-4500 cfs	Damage to estuary	Fewer is Better
> 4500 cfs	Damage to estuary and bay	Fewer is Better

The predicted number of times that the salinity envelope criteria were not met in the CRE is shown in Figure 3. Analysis of the data showed there was no substantial difference between the FWO and Alts 4R or 4R2 when predicting high and low flow events. The data did reveal a significant difference when comparing the ECB to the FWO and Alts. This difference may be explained by comparing the number of times the low-flow criteria (less than 450 cfs) are not met. Because the C-43 West Basin Storage Reservoir CERP project provides base flows to the CRE during the dry season, its inclusion in the FWO and CEPP alternative's account for the observed reduction and subsequent system improvements. Despite the lack of a substantial difference, it should be noted that when compared to the FWO, both Alt 4R and Alt 4R2 have 11 fewer high-flow months which would increase the number of months in the preferred salinity range. This difference could prove to be beneficial to seagrass and oyster abundance if suitable substrate was available for colonization and spat recruitment. If the system were degraded to a condition where existing shell and shell/sand habitat was buried, oyster recovery times would be protracted.

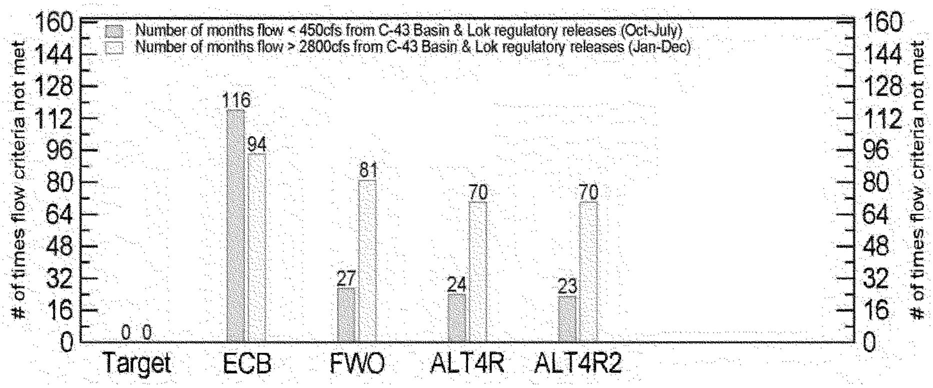

Figure 3. Number of times the salinity envelope criteria are not met in the CRE over the 41-year period of record.

b. St. Lucie River and Estuary

The evaluation of the St. Lucie River and Estuary (SLE) focuses on the total combined freshwater inflow. This includes flows at the S-80 structure, which integrates the discharges from Lake Okeechobee at the S-308 structure plus the C-44 basin, as well as an estimate of inflows from other basins in the watershed. An objective of CEPP is to reduce damaging high volume discharges from Lake Okeechobee to maintain a salinity range favorable to fish, oysters and Submerged Aquatic Vegetation (SAV). The targeted area for oyster population restoration in this estuary is between the Roosevelt/US-1 (Figure 4) and A1A bridges.

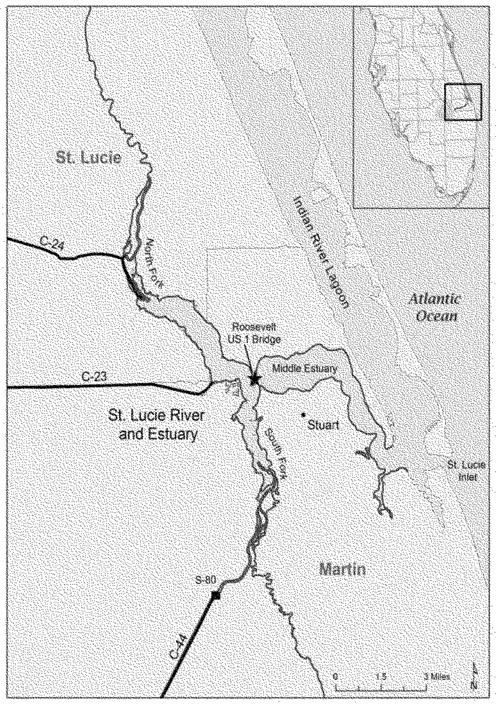

Figure 4. St. Lucie River and Estuary.

The CERP system-wide PM for Northern Estuaries salinity envelopes proposes a full restoration target of a mean monthly inflow into the SLE from all sources including groundwater and all surface water tributaries below 350 cfs for 31 months in a 36-year period, no more than 28 high flow events greater than 2,000 cfs based on a 14-day moving average and no regulatory discharge events of flows greater than 2,000 cfs from Lake Okeechobee based on a 14-day moving average (RECOVER 2007).

Based on the salinity tolerances of oysters, flows less than 350 cfs result in higher salinities at which oysters are susceptible to increased predation and disease. Flows in the 350–2,000 cfs range produce tolerable salinities while flows greater than 2,000 cfs result in low, intolerable salinities within the estuary. Seagrasses in the IRL-S are damaged when flows exceed 3,000 cfs (Table 4). For this analysis, high flow events were combined into one category (greater than 2,000 cfs).

Table 4. Combined flow* classes for the SLE and the anticipated ecological effects.

Flow Categories	Ecological Response	Ranking Criteria
< 350 cfs	Salinity too high for optimal oyster health	Fewer is Better
350-2,000 cfs	Tolerable range	More is Better
2,000-3,000 cfs	Damage to estuary	Fewer is Better
> 3,000 cfs	Damage to SLE and IRL	Fewer is Better

* S-80, S-97, and S-49 structures

The predicted number of times the salinity envelope criteria are not met for the ECB, FWO and CEPP alternatives is shown in Figure 5. Analysis of these flows showed a substantial difference between the CEPP alternative's and both ECB and FWO. Alternatives 4R2 and 4R had a lower number of combined high flow events (greater than 2000 cfs) than either FWO or ECB (86, 100, 151 and 177 respectively). Alternative 4R2 also had a decrease in the number of times the low flow criteria (less than 350 cfs) were not met which increased the number of months the estuary was in the preferred salinity range. This difference would prove to be beneficial to seagrass and oyster abundance if suitable substrate was available for colonization and spat recruitment. Therefore, the removal of muck and addition of artificial substrate associated with the IRL-S CERP project are essential components for estuarine restoration.

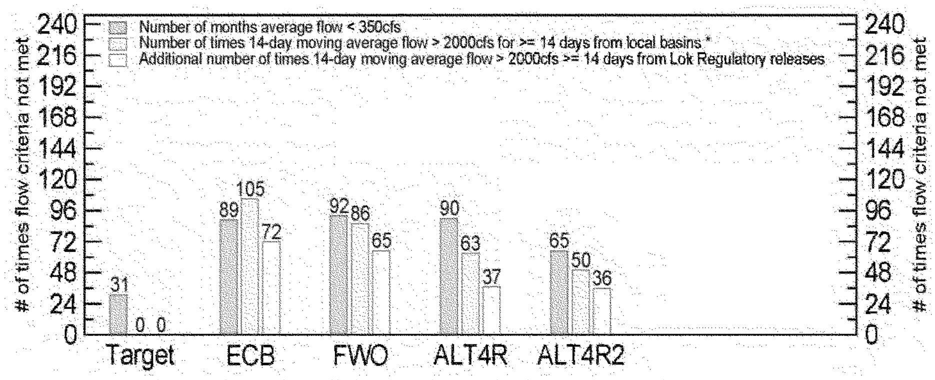

Figure 5. Number of times the salinity envelope criteria are not met in the SLE over the 41-year period of record.

2. Other Ecological Tools Results

Additional evaluations of Alt 4R2 were performed based on salinity performance and selected estuarine resources including oyster and seagrass. The oyster simulation models for both estuaries were simplified versions of a framework derived to evaluate potential effects of increased area of oyster habitat on SLE water quality (Buzzelli et al. 2012a). This model uses an idealized oyster-salinity relationship, variable temperature, and a constant suspended solid concentration to predict oyster density. Similarly, the shoal and manatee grass simulations for both estuaries were simplified models derived to quantify effects of variable freshwater discharge and salinity on seagrass shoot density at Boy Scout Island located in IRL-S (Buzzelli et al. 2012b). Water column chlorophyll a and turbidity were assumed constant although depth and the amount of colored dissolved organic matter and, therefore, submarine light varied dynamically throughout the 41-year simulations. A description of these tools and results can be found in the RECOVER's Systemwide Evaluation of the CEPP Northern Estuaries section (Corps 2013).

3. Potential Adverse and Beneficial Effects of the Project

One objective of CEPP is to reduce the number and duration of damaging high volume discharges from Lake Okeechobee in an effort to improve the quality of oyster and SAV habitat in the northern estuaries. In the CRE, the number of low flow events (less than 450 cfs) and high flow events (greater than 2,800 cfs) predicted by the modeling indicated that the TSP did not perform different than the FWO although it was better than the ECB.

In the SLE, the modeling indicated that the TSP would reduce the number of combined high-flow events from 151 in the FWO to 86 (approximately 43 percent). There is also a reduction in the number of times the low-flow criteria were not met from 92 in the FWO to 65 (approximately 29 percent) with the implementation of the TSP. Both of these improvements increase the amount of time that the SLE will be in the appropriate salinity range for oyster and SAV production, the key estuarine indicator species. It is important to note that the predicted TSP benefits are dependent on the construction of the authorized IRL-S CERP project. The difference between Alts 4R and 4R2 pertain to changes in operations of the C-44 Reservoir and STA and its connection to the C-23 which are components of IRL-S. The sequence of CEPP component construction and implementation is critically linked to the sequence of other CERP and non-CERP projects. Refining this interdependent project component sequencing is the key to achieving predicted restoration with the aide of adaptive management.

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B. Lake Okeechobee

In this section we present the highlights of the evaluation of the effects CEPP on Lake Okeechobee. For more detailed information, see Annex E of the CEPP PIR and EIS entitled, *RECOVER System-wide Evaluation of the Central Everglades Planning Project.*

1. Performance Measures Results

All PMs were scored between 0 and 100 with the minimum value of 0 representing a fully degraded ecosystem and a maximum value of 100 representing the restoration target. The lake stage envelope PM evaluates both the magnitude and duration that alternative plans exceed the optimal stage envelope (12.0 to 15.5 feet NGVD). For the period of simulation, the standardized scores ranged from 82.50 for FWO to 71.76 for Alt 4R2. Based on this measure, Alt 4R and Alt 4R2 performed worse than the FWO.

To better understand the standardized scores, we evaluated years where the greatest differences between hydrographs occurred (Figure 6). For the simulated year 2003, the Alt 4R2 lake stage was 6.0 to 19.5 inches higher than it was for the FWO for 306 days. Although this PM may indicate a difference in lake stage, it did not always translate to a difference in hydrograph score. For example, in simulated January and December 2003, although the modeling indicated the lake was deeper under Alt 4R2 than the FWO or the baseline, the alternatives for both months were within optimal conditions. Contrast that to the simulated June, July, and August 2003, where neither alternative performed optimally, but the FWO was 9.9 to 18.9 inches lower than Alt 4R2 and therefore, received a better overall score.

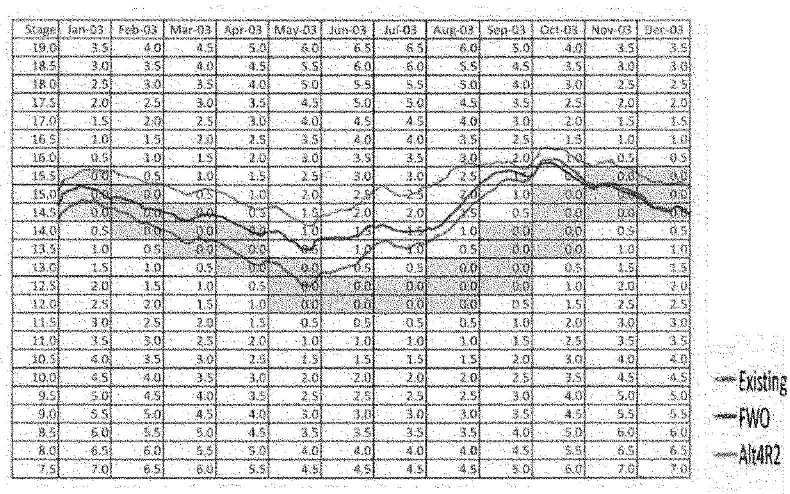

Figure 6. Simulated Lake Okeechobee stages for 2003 for baseline, FWO, and Alt 4R2. Optimal conditions are represented by the blue band between 12.0 and 15.5 feet NGVD.

2. Below Lake Stage Envelope

The below lake stage envelope PM evaluates how many times the alternative plans result in a stage envelope below the optimal level. The standardized score was derived from a combination of the magnitude and duration of exceedances. A perfect score would be 100. The results ranged from 47.95 (Alt 4R2) to 34.29 (FWO) indicating that Alt 4R2 performed better than the FWO and Alt 4R (44.50). We expected that Alt 4R2 would perform better than the FWO for this PM because one of the goals of the CEPP was to store more water in the lake for later release to the Greater Everglades.

3. Above Extreme High Lake Stage

The above extreme high lake stage PM evaluates the amount of time lake stage is in excess of 17.0 feet NGVD. The scores were similar (99.11 for FWO and 97.78 for both Alt 4R and Alt 4R2) indicating little ecological difference between alternatives.

4. Below Extreme Low Lake Stage

The below extreme low lake stage PM evaluates the amount of time the lake stage is below 10.0 feet NGVD. The scores were 88.62 (Alt 4R2), 86.50 (Alt 4R), and 86.02 (FWO). Because of uncertainty in the model simulations, it is difficult to define if these are significantly different outcomes statistically or environmentally.

5. Stage Duration Curve

Figure LO2 shows the stage duration curves for the FWO, Alt 4R, Alt 4R2, and ECB. The ideal curve would be very flat between lake stages 12.0 to 15.5 feet and steep outside this range. The curve showed a similar pattern for all alternatives, and ECB when the lake was below 12.6 feet. This might be expected given the proposed operation of the CEPP to stop additional lake water releases to the FEBs (under Alt 4R or Alt 4R2) if lake levels drop to 12.6 feet (in effect from January 1 to August 31). Lake water releases for water supply could continue.

For the remainder of the curve, Alt 4R2 holds the lake higher (deeper) than FWO or Alt 4R. This was also expected because modelers added up to approximately 15,000 ac-ft of water from the future C-44 Reservoir to the lake and generally held the lake higher to offset the additional water demand of the CEPP, which calls for sending an annual average 215,000 ac-ft south to the Everglades. For the critical time where the preferred lake stage is between 12.5 and 15.5 feet, the FWO performed better than Alt 4R2 by holding the lake in that range for slightly more time. At damaging high stages (15.5 to 17.0 feet), Alt 4R2 performs slightly worse numerically than the FWO by holding lake stage higher for a longer amount of time.

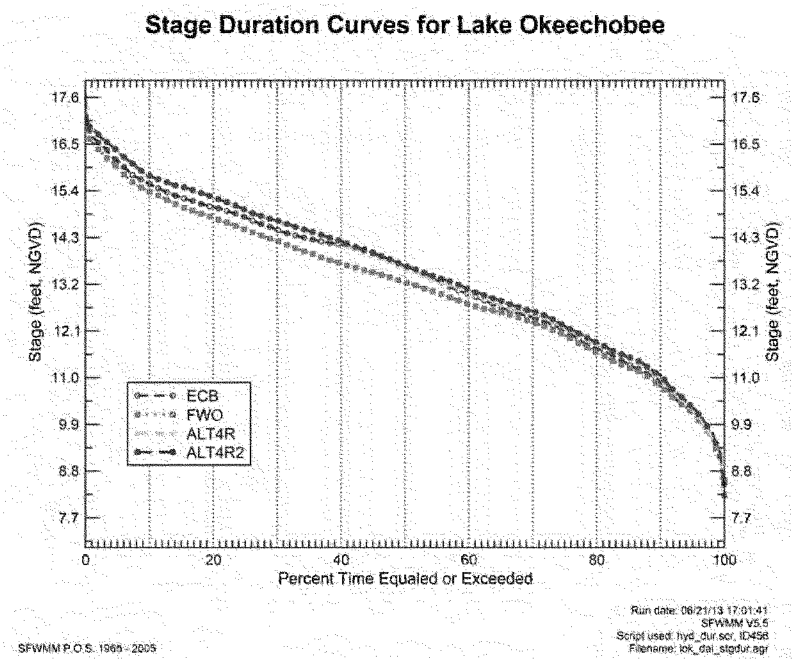

Figure 7. Lake Okeechobee stage duration curve.

6. Flood Protection Criteria

The flood protection criteria evaluate the number of days the lake stage is above 16.5 feet NGVD from August 1 to September 15 as well as the maximum water levels in the 41-year period of simulation. While both alternatives exceeded the 16.5 feet stage at various times of the year, only Alt 4R2 exceeded it (for 9 days in September 1995; maximum stage = 16.56 feet) during the appropriate time of year. During this period, the FWO maximum simulated stage was 16.14 feet. We do not believe this to be a substantial difference for this short duration.

The maximum water levels during the entire period of simulation for the ECB and both alternatives (achieved on April 1, 1970) were as follows: 17.54 feet (ECB), 17.66 feet (Alt 4R2), and 17.50 feet (FWO). For these criteria, the simulated FWO performed better than Alt 4R2 numerically, although it is not apparent that this 0.16 foot difference is meaningful.

7. Minimum Water Level and Duration Measure

The minimum water level and duration measure compares the number of times that the simulated water level was below 11.0 feet NGVD for more than 80 consecutive days in the 41-year simulation. Note that this is different from the revised MFL (minimum flows and levels) PM as it is purely hydrologic and does not take into account the legal definition of how MFL exceedances and violations are counted. The ECB, FWO, and Alt 4R2 exceeded this measure six times. For the simulated 1974, 1977, and 1981 events, the numbers of days between the ECB and two alternatives were similar. However, in 1989, the ECB and Alt 4R2 simulations were comparable (151 and 139 days, respectively), but outperformed the FWO (which was below 11.0 feet for 191 days). In 1990, Alt 4R2 (160 days) performed better than both the ECB (188 days) and the FWO (189 days). In 2001, the ECB (229 days) and Alt 4R2 (231 days) outperformed the FWO (271 days). We expected that the Alt 4R2 would perform better under this metric because the lake operations were changed under the Alt 4R2 simulation to hold lake stages higher when possible to make water more available to the CEPP. As recent data have indicated (actual conditions 2005 to 2012), a lower lake stage is not as harmful to the Lake's ecology as high water stages (RECOVER 2009, 2012). Therefore, this PM could be refined to enable an actual determination of minimum water level violations, which would include an x times in y years component. As it stands now, the ECB, FWO, and Alt 4R2 had the same number of exceedance events, but the Alt 4R2 had fewer days than FWO below the threshold within three of the six events (*i.e.*, Alt 4R2 performed slightly better than FWO).

8. Daily Time Series Analysis

Greater Than 15 Feet Events

We identified seven events where the simulated Alt 4R2 hydrograph performed worse (*i.e.*, potentially more ecologically damaging because the stage was greater for a substantial amount of time) than the simulated FWO. It is difficult to say whether substantial ecological damage would occur if these simulations reflected "real world" conditions because we do not have evaluation tools that are precise enough to parse out the differences. We can infer from on-going vegetation studies in Lake Okeechobee that the following events have, at least, the potential to negatively affect submerged aquatic vegetation; however, because it may take 6 months to 3 or 4 years for vegetation shifts to result from differing conditions, and because of other compounding factors (turbidity, nutrients, and storms) we cannot offer better conclusions. The seven events are as follows.

From July 21, 1968 to December 30, 1968 (163 days), Alt 4R2 was above the 15.0 feet threshold (maximum = 15.94 feet), but the FWO exceeded 15.0 feet (maximum = 15.01 feet) for only 4 days. During this period, there were 72 days when Alt 4R2 was 6.0 inches to 10.0 inches higher than the FWO and 58 days of difference greater than 10.0 inches (Figure 8). This represents a slight improvement in the performance of Alt 4R2 over the simulated performance of Alt 4R.

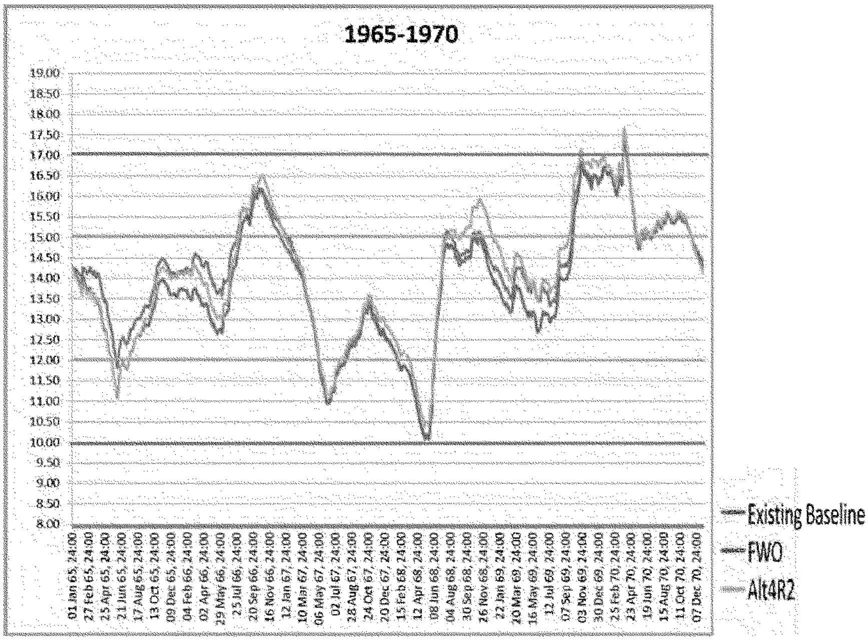

Figure 8. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, Alt 4R2, and FWO from 1965 to 1970.

The Alt 4R2 simulation was also greater than 15.0 feet for 224 days (August 24, 1978 to April 4, 1979; 16.39 feet maximum stage), while the FWO simulation exceeded this stage for only 99 days during this period (maximum = 15.66 feet). Furthermore, Alt 4R2 exhibited a 6.0-inch to 9.1-inch difference for 131 days over the FWO. Alternative 4R2 performed worse than Alt 4R for this event.

The Alt 4R2 simulation was greater than 15.0 feet for 125 days (September 29, 1983 to January 28, 1984; maximum = 15.53 feet), while the FWO simulation did not exceed 15.0 feet (range = 14.33 to 14.87 feet). Additionally, the Alt 4R2 simulation was 6.0 inches to 9.2 inches higher than the FWO. For this event, Alt 4R2 was slightly worse than Alt 4R.

From August 27, 1991 to December 18, 1991 (114 days), the Alt 4R2 simulation was again greater than 15.0 feet (maximum = 15.70 feet). Over this same period, the FWO simulation was greater than 15.0 feet for 50 days (maximum = 15.20 feet). Alternative 4R2 was 6.0 inches to 8.4 inches higher than the FWO for 46 days (Figure 9). For this event, Alt 4R2 was slightly worse than Alt 4R.

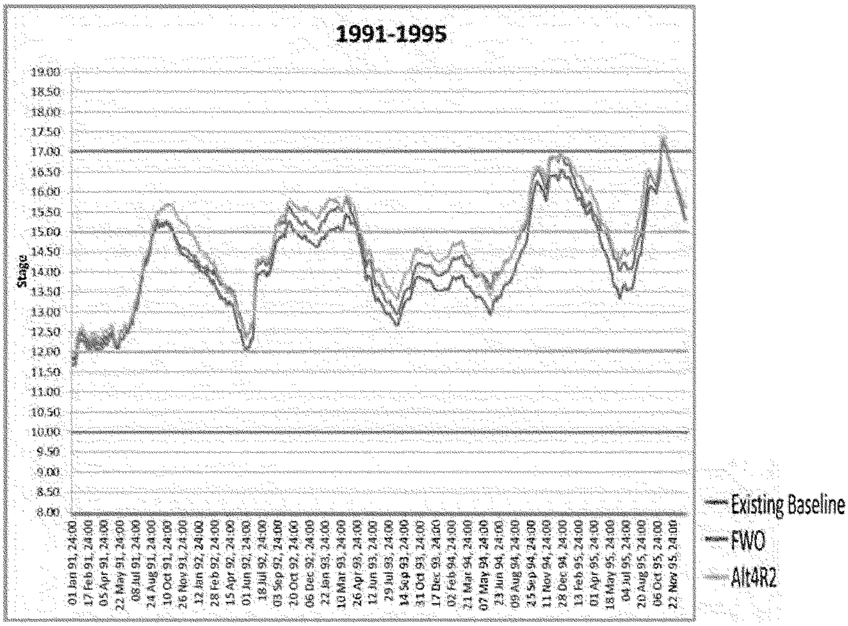

Figure 9. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, Alt 4R2, and FWO from 1991 to 1995.

Alternative 4R2 exceeded 15.0 feet from August 28, 1992 to May 9, 1993 (255 days; maximum 15.92 feet), while the FWO exceeded 15.0 feet for only 85 days (maximum = 15.39 feet). Additionally, Alt 4R2 was 6.0 inches to 10.0 inches higher than the FWO for 218 days during that period (Figure 10). For this event, Alt 4R2 was slightly worse than Alt 4R.

From December 14, 2002 to April 15, 2003 (123 days), the Alt 4R2 simulation was again greater than 15.0 feet (maximum 15.92 feet). Over this same period, the FWO simulation was greater than 15.0 feet for only 10 days (maximum = 15.05 feet). Alternative 4R2 was 6.0 inches to 10.0 inches higher than the FWO for 30 days and 10.0 inches to 17.5 inches higher for 91 days. For this event, Alt 4R2 was substantially worse than Alt 4R due to an additional 44 days over 15.0 feet and deeper water (Alt 4R was up to 11.6 inches deeper than FWO; Alt 4R2 was up to 17.5 inches deeper than FWO).

From June 22, 2003 to January 13, 2004 (206 days), the Alt 4R2 simulation was greater than 15.0 feet and achieved a maximum elevation of 16.48 feet. Over this same period, the FWO simulation was greater than 15.0 feet for 101 days (maximum = 16.22 feet). Alternative 4R2 was 6.0 inches to 10.0 inches higher than the FWO for 86 days and 10.0 inches to 18.7 inches higher than the FWO for an additional 71 days. Similar to the previous event, Alt 4R2 was substantially worse than Alt 4R.

Greater Than 17 Feet Events

We also identified times when the 17.0 feet threshold was exceeded by both Alt 4R2 and the FWO (although for less time for the FWO). For example, from March 27, 1970 to April 12, 1970, the Alt 4R2 simulation exceeded the 17.0 feet threshold for 17 days (maximum stage = 17.66 feet). The FWO exceeded 17.0 feet during this same period for 15 days (maximum stage = 17.50 feet). A similar event happened from October 18, 1995 to November 7, 1995 (21 days; Figure LO4). Conversely, from October 29, 2005 to November 17, 2005 (20 days), Alt 4R2 exceeded 17.0 feet (maximum = 17.29 feet), while the FWO only reached a maximum elevation of 16.69 feet. None of these events, even though they exceeded 17.0 feet, indicated a measurable ecological difference between Alt 4R2 and FWO simulations. In essence, both alternatives performed poorly and no additional substantial ecological damage would likely have occurred under simulated Alt 4R2 conditions (when compared to FWO conditions) during these periods. For these high lake stage events, the performance of Alt 4R2 was similar to Alt 4R.

Ecologically Beneficial Event

While the previous discussion identified events where Alt 4R2 may have performed worse than the FWO, there was at least one event where Alt 4R2 may have performed better. On May 25, 1987, the simulated FWO dropped below 12.0 feet (the low side of the preferred stage envelope), and stayed below 12.0 feet until October 22, 1987 (150 days; minimum stage = 10.97 feet). The simulated Alt 4R2 dropped below 12 feet for 48 days (minimum stage = 11.74 feet) (Figure 10). Under these conditions, more of the littoral zone would have been flooded under Alt 4R2. For example, at 12.0 feet, approximately 26,000 acres of littoral zone are flooded but at 11.5 and 11.0 feet approximately 17,000 and 6,000 acres, respectively, are flooded. Periodic drying of the littoral zone may be beneficial to lake ecology through oxidation of undesirable organic soils (*i.e.*, muck), but prolonged desiccation can negatively affect apple snail survival and cause unwanted shifts from aquatic plant to upland plant species. The duration of this simulated event could have negatively affected native apple snails, but more so under the FWO condition. According to Darby (2006), adult native apple snails show the following desiccation tolerances: a 3-month dry-out will kill 21 percent of the population; a 4-month dry-out will kill 50 percent of the population; and a 4.5-month dry-out will kill 63 percent of the population. Juvenile snails have even less tolerance to desiccation -- for example, a 3-month dry-out will kill 40 percent a population of six-week old apple snails (10-15 millimeters in size). The simulated FWO was between 11.0 and 11.5 feet for 4 months. For this event, Alt 4R2 performed better than Alt 4R (Alt 4R was drier longer; *i.e.*, had 91 days below 12 feet NGVD).

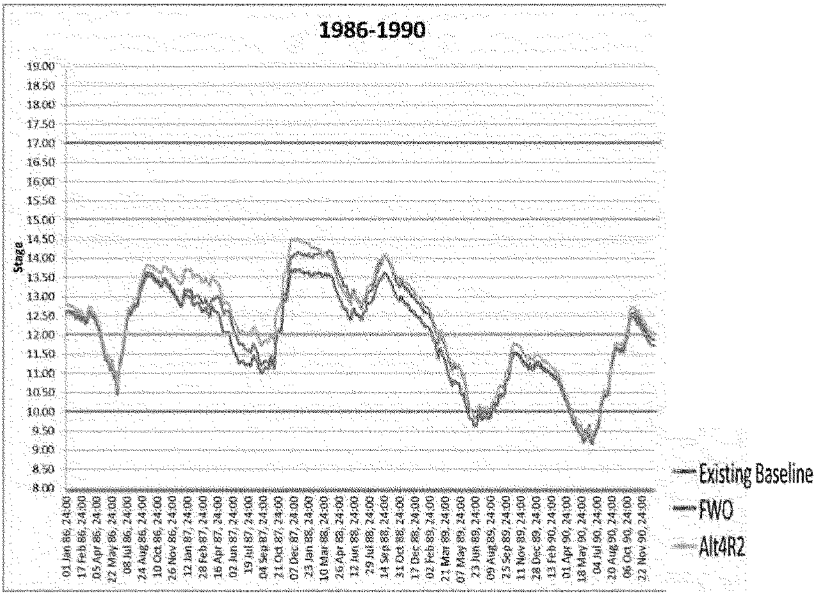

Figure 10. Daily Time Series Stage Hydrographs for Lake Okeechobee as simulated for the ECB, Alt 4R2, and FWO from 1986 to 1990.

9. Potential Adverse and Beneficial Effects of the Project

a. Effects on the Lake Okeechobee Littoral Zone

As modeled, the CEPP is likely to have few long-term effects on the littoral zone of Lake Okeechobee. Most of the time there was no difference between Alt 4R2 and FWO. For approximately 5 percent of the time (and usually during the rainy season), Alt 4R2 was 6.0 to 18.7 inches higher than the FWO. This occurred at 15.0 feet NGVD and so water essentially "stacked" under Alt 4R2. This would eliminate most foraging habitat for short-legged wading birds and potentially adversely affect emergent vegetation through uprooting. This, in turn, could adversely affect the macroinvertebrates and fish that rely on those habitats. Conversely, during the 1987 event, approximately 10,000 more acres of littoral zone remained hydrated under the simulated Alt 4R2, than for FWO. This may indicate a benefit to apple snails during droughts, but it only occurred once in the 41-year period of simulation. There were other times when both the FWO and Alt 4R2 approached 10.0 feet NGVD, yet there were no differences in performance between alternatives. It is likely that preceding precipitation patterns and lake operating rules could affect the frequency of dry season benefits of CEPP to the lake.

Any project that does not keep the annual hydrograph between 12.0 and 15.0 feet can be only marginally successful at restoring the lake's littoral zone close to the more favorable vegetation patterns in the Pesnell and Brown (1977) littoral zone survey. However, this cannot be achieved with the current infrastructure surrounding the lake; much more dynamic storage will need to be connected to the lake. It may also increase the risk of having to send more freshwater into the estuaries to provide flood control in preparation of a large storm. High water levels are also destructive to snail habitat. Once the water depth in a particular area exceeds approximately 40 centimeters (cm), the area is considered to be too deep to allow snails to breed. Higher lake stages also allow wind storms to tear out emergent vegetation, particularly along the outer edge of the littoral zone. Because the snails must breathe air, they need stems to climb to survive; they also need portions of the stems to remain above water level for their eggs to hatch.

b. Lake Okeechobee Minimum Flows and Levels

Both the simulated FWO and Alt 4R2 violated the MFL three times. The MFL represents the point at which further withdrawals would cause significant harm to the water resources or ecology of the area. It is the District's intent to correct or prevent the violation of these MFLs through management of the water resources and implementation of a recovery strategy.

c. Lake Okeechobee Regulation Schedule

The current project dependencies for CEPP include the implementation of a new Lake Okeechobee Regulation Schedule prior to the completion of the A-2 FEB. While we know today the lake levels that are beneficial or detrimental for the ecology of the lake, it would be premature to predict if those levels would still be appropriate in the 15 to 20 years when CEPP is scheduled to be implemented under a new lake regulation schedule. Therefore, we recommend a robust monitoring and adaptive management protocols.

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C. Everglades Agricultural Area

1. Regional Area Location and Existing Condition

The EAA extends south from Lake Okeechobee to the northern levee of WCA-3A, from its eastern boundary at the L-8 canal to WCA-1 and WCA-2 and along the western boundary to the L-1, L-2 and L-3 levees.

Under the CEPP project concept, water flowing south from Lake Okeechobee can be separated into three flow-paths: the Western flow-path that extends beyond the EAA to the west, the Central flow-path, which is the bulk of the EAA, and the Eastern flow-path. The FEB project site is in the southern portion of the Central EAA flowpath.

a. Ecological Description

The A-1 FEB footprint contains 16,152 acres of land, of which 14,705 acres are waters of the United States and 1,447 acres are uplands. The waters of the United States consists of 10,158 acres of mixed scrub shrub wetlands, 234 acres of exotic scrub shrub wetlands, 3,877 acres of herbaceous freshwater marsh wetlands, 109 acres of lateral farm ditches, and 327 acres of channelized waterway. The uplands consist of existing levees and areas that have been previously filled to store rock material and muck soils (Corps 2013).

The A-2 FEB footprint contains 13,900 acres of land of which 13,778 acres were devoted to the cultivation of sugarcane, 45 acres of canals, 7 acres of upland scrub, and 13 acres of wetland (Florida Land Use and Cover Classification System 2009).

b. Fish and Wildlife Resource Concerns

The draft Fish and Wildlife Coordination Report (Service 2013) evaluated potential effects of CEPP Alts 1, 2, 3, and 4 on a variety of species that occur, or may potentially occur, within the EAA and the A-1 and A-2 FEB footprints. The report also included the following threatened and endangered species: Florida panther, West Indian manatee, Everglade snail kite, wood stork, bald eagle, eastern indigo snake, Audubon's crested caracara and Okeechobee gourd.

Based on subsequent analysis, the Corps determined that Alt 4 was the most cost effective alternative and has further optimized the performance by developing two new Alts (4R and 4R2) since the draft Coordination Act Report was written. The optimized components of Alts 4R and 4R2 occur south of the red line (*i.e.*, south of the EAA) and therefore are not expected to result in significant changes to the anticipated effects within the EAA and A-1 and A-2 FEB footprints compared to the previous alternatives.

Direct Impacts

Direct impacts are defined as impacts that occur within the footprints of the proposed project site during or as a direct result of construction and operation activities. The following discusses potential direct impacts to federally-listed threatened and endangered species, species of special concern (SSC), and designated critical habitat. The impact analysis also includes listed species that have the potential to occur within the A-1 and A-2 FEB project footprints. Construction of these projects would lead to unavoidable adverse wetland and surface water impacts due to placement of fill and excavation activities. Wetland conditions would occur within the FEBs after construction is complete and the facilities become operational. The FEBs would be operated at an average depth of 1.5 feet and a maximum depth of 4 feet. Emergent and submerged aquatic wetland vegetation is expected to be maintained or grown within the FEBs. Existing wetlands not converted to agriculture and within the FEB footprint will be inundated with water up to 4 feet.

Agricultural Lands

Although natural wetland habitat has been mostly replaced by agriculture in the FEB project areas, the creation of ditches, canals, rice paddies, and the flooding of fallow agricultural fields during the rainy season provides some habitat for terrestrial and aquatic wildlife. These habitats provide attractive foraging habitat for birds, particularly during the rainy season with the highest diversity and total number of individuals found in rice fields, followed closely by flooded fallow fields. Therefore, temporarily flooded areas may serve as important habitat for bird species within the EAA.

Wetlands

Many fish and wildlife species may be affected by the replacement of wetland habitat in the A-1 and A-2 FEB projects during construction. Species that rely on shallow water areas will be displaced, while deeper water aquatic species and those species that rely on them for survival may benefit positively. The construction of the FEBs would result in the replacement of all existing on site wetlands.

Increase in Aquatic Habitat

Although the construction of the FEBs will result in a reduction of wetlands in addition to a loss of terrestrial agricultural habitat, there will be an increase in available open-water aquatic habitat in the project footprints. Fish and macroinvertebrate species common to the surrounding canals are likely to enter the FEBs via inflows, and populations may survive unless and/or until the majority of an FEB dries out completely. Emergent, submerged or floating aquatic vegetation may provide vegetative habitat. Fish and other aquatic wildlife within the FEBs may provide foraging opportunities for avian species such as the osprey (*Pandion haliaetus*), double-crested cormorant (*Phalacrocorax auritus*), least tern (*Sterna antillarum*), and bald eagle. Wading birds, including the endangered wood stork, may forage within the FEBs along the bottom surface when stages are low. The FEBs may provide important foraging opportunities for nesting wading birds during extreme regional dry events as waters recede. Ducks and other waterfowl may also inhabit and/or use the FEBs although depending upon the density of vegetation, primarily in the form of emergent vegetation such as cattail, may lessen potential benefit. Amphibians and aquatic reptiles are likely to inhabit and/or forage within the FEBs, and within the footprint, the aquatic area may provide foraging opportunities for mammals such as the river otter (*Lutra canadensis*), raccoon (*Procyon lotor*), and rodent species.

Deep Water Refugia

Deep water refugia are areas of lower elevation within the FEBs that provide habitat for macroinvertebrates, fish, and amphibians during dry events. Deep water refugia will consist of the existing agricultural canals and ditches, as well as borrow pits excavated within the project footprints to provide fill for the FEB embankments. In addition, the refugia may provide foraging areas for wading birds during extreme regional dry events. Of particular significance may be the presence of refugia for foraging habitat during the nesting seasons of the federally endangered wood stork and State-listed wading birds. However, the refugia could also act as sinks for contaminants that may be ingested by fish and wildlife during regional dry events.

Wildlife-related Recreation

Recreation features proposed for any CEPP project should be compatible with the authorized project purposes, should be affordable within project limits, and easily operated and maintained. The Corps and the District should keep regional recreation development in mind throughout the planning process in conjunction with their other project goals and objectives. The intent is to incorporate regional recreation development to the extent practical, justified, and in accordance with primary objectives of Ecosystem Restoration policies throughout the CEPP region.

Opportunities for recreation within the FEB project areas should be evaluated and include biking, hiking, equestrian activities, nature study, wildlife viewing, bank fishing, canoeing, and boating (Corps and District 2006). Boat ramps, benches, parking areas, trail shelters, and informational kiosks have been proposed. Providing recreational opportunities is one of the original C&SF purposes. The Corps indicates that one of the FEB project objectives will be to not adversely impact the ability of the public to enjoy existing natural areas such as Holey Land and Rotenberger Wildlife Management Areas (Corps 2005). The CERP Master Recreation Plan may further identify and evaluate potential new recreation, public use, and educational opportunities within the FEBs (District 2004).

A more detailed discussion of the project area, species effects, and operations of the FEBs can be found in the draft Fish and Wildlife Coordination Report and the Corps PIR/EIS.

D. Greater Everglades

1. Evaluation of the Project

a. Performance Measure Results

RECOVER Performance Measures and Habitat Units

The PM scores were generated for the Greater Everglades region using the RMS Glades LECSA (RSMGL) which provides daily, detailed estimates of hydrology across the 41-year period of record (January 1965 to December 2005). The PM scores are displayed as a function of restoration potential or achievement of the target with the minimum value of zero representing a fully degraded ecosystem and a maximum value of 100 representing the restoration target. The habitat suitability indices (HSI) associated with each PM are then summed and applied to the total spatial extent of each zone (in acres) to produce HUs. The Greater Everglades were divided into nine zones based on differences in existing conditions. Zones evaluated include northeast WCA-3A (3A-NE), northwest WCA-3A (3A-NW), WCA-3A Miami Canal (3A-MC), central WCA-3A (3A-C), southern WCA-3A (3A-S), WCA-3B (3B), northern ENP (ENP-N), southern ENP (ENP-S), and southeast ENP (ENP-SE; Figure 11).

Habitat unit results for Alts 4R and 4R2, which represent modifications to the TSP, ECB and FWO are displayed in Table 5. These alternatives were not evaluated in the Draft FWCAR (Service 2013) because they were not yet complete at the time that report was drafted. The Corps instructed PDT participants to evaluate these modifications with regards to the FWO and ECB runs but instructed that they were not to be evaluated against the original final array of alternatives 1 through 4 because of changes to model parameters. Habitat unit results for the FWO were subtracted from each alternative to produce a HU lift (Table 5). The results in Tables 5 and 6 indicate that Alt 4R and Alt 4R2 perform similarly to Alt 4 which provided the greatest lift for the Greater Everglades and Florida Bay relative to the FWO condition. Out of the final array of alternatives, Alt 3 provided the second best lift followed by Alts 1 and 2 (Corps 2013, Service 2013). Within the Greater Everglades and Florida Bay, the FWO generally provides less HUs than the ECB, resulting in a positive lift for the ECB.

It should be noted that all of the alternatives provide substantial lift above the FWO and ECB base conditions within the Greater Everglades. Additionally, there are many other factors to be considered in choosing the TSP. The Corps has instituted a process by which other factors can be utilized in choosing the TSP. This is especially important given the similar hydrologic performance between the alternatives. For more detailed information on the raw hydrologic model output for each PM and zone and for detail on how the Corps factors in other considerations besides modeling, please refer to the Draft PIR (Corps 2013).

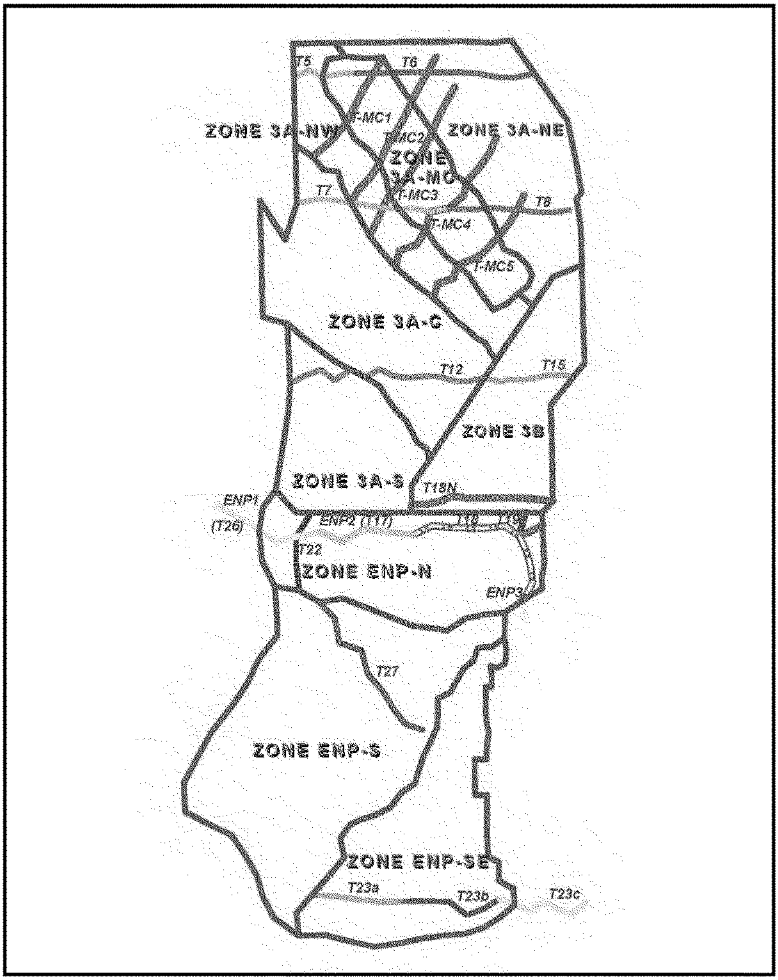

Figure 11 Graphic showing the performance measure zones and flow transect lines.

Table 5. Habitat unit results for zones located within the Greater Everglades Region.

Zone	ECB	FWO	Alt 4R	Alt 4R2	Target
3A-NE	44,451	29,634	92,606	91,372	123,475
3A-MC	32,847	27,373	54,746	54,746	78,208
3A-NW	30,970	30,266	54,198	54,198	70,387
3A-C	108,414	105,669	109,786	111,159	137,233
3A-S	69,247	68,423	68,423	68,423	82,437
3B	55,697	48,842	58,268	59,125	85,688
ENP-N	57,557	55,054	98,847	98,847	125,123
ENP-S	124,068	126,454	169,400	169,400	238,592
ENP-SE	79,711	81,062	85,116	83,764	135,104
All Zones	**602,962**	**572,777**	**791,390**	**791,034**	**1,076,247**

Table 6. Difference in habitat units comparing CEPP alternatives to ECB.

Zone	ECB	Alt 4	Alt 4R	Alt 4R2
3A-NE	14,817	66,677	62,972	61,738
3A-MC	5,474	29,719	27,373	27,373
3A-NW	704	23,228	23,932	23,932
3A-C	2,745	4,117	4,117	5,490
3A-S	824	0	0	0
3B	6,855	5,998	9,426	10,283
ENP-N	2,503	47,547	43,793	43,793
ENP-S	-2,386	62,034	42,946	42,946
ENP-SE	-1,351	2,702	4,054	2,702
All Zones	**30,185**	**242,022**	**218,613**	**218,257**

b. Everglades Restoration Transition Plan Performance Measures

Cape Sable seaside sparrow

The two CSSS PMs were not "new" to CEPP and have been used by the Service to evaluate the effects of hydrologic restoration projects on the sparrow since the mid 1990's. These metrics include a nesting component which measures the number of days during the nesting season (March 1-July 15) that water levels are below ground surface. CSSS construct their nests close to the ground and will only initiate breeding when water levels have dropped to at or below ground surface. The second metric is a habitat component and targets the annual discontinuous hydroperiod at between 90-210 days. This range provides the optimal conditions for the clumped graminoid grasses that the sparrow prefers to nest in (*e.g., Muhlenbergia, Schoenus, Shizacrium* and sparse *Cladium*).

Tables 7 and 8 coarsely summarize the results of the two CSSS PMs. More detailed analyses using additional data will be conducted during preparation of the Corps' Biological Assessment and the Service's Preliminary Biological Opinion. The CSSS nesting condition results are summarized by the number of years that the target was met over the 40 year period of record produced by the RSMGL. Various gauge locations and indicator regions within the model mesh were used to assess spatial aspects of alternative hydrology can be seen in Figure 12.

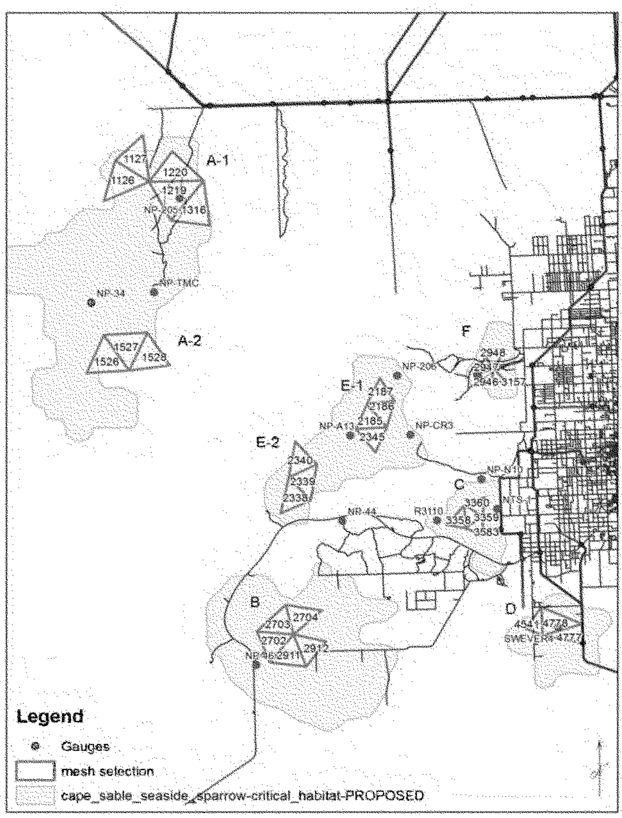

Figure 12. Regional Simulation Model cells and gauges used for CSSS indicator regions in CEPP modeling.

Of note is the reduction in years when the target is met in CSSS-A-2 and in the second most productive subpopulation, CSSS-E. This was somewhat expected as the project was designed to shift dry season water flow from western SRS to eastern SRS; however, as stated earlier, CSSS-E is a productive breeding area for the sparrow and consecutive years of reduced nesting potential should be avoided at all costs. On the beneficial side, CSSS-A-1 shows a slight improvement in the number of years the target is met.

The greatest concern is the increase in annual hydroperiod of CSSS-E as seen in Table 8 and the reduction of years the target is met. Successive years with hydroperiods greater than 210 days will cause the sparrow's preferred nesting habitat to shift to a wetter marsh type that will preclude successful nesting. This impact will need to be mitigated through intensive monitoring and real-time operational adaptive management.

Table 7. Cape Sable Seaside Sparrow nesting. Number of years in period of record that target is met. Target is more than 60 continuous dry days during the nesting season March 1 – July 15.

Subpopulation		ECB	FWO	Alt 4R	Alt 4R2
		# of years	# of years	# of years	# of years
A	Indicator Region A1	18	20	22	22
	Indicator Region A2	33	33	26	25
	Gauge P34	31	29	29	29
	Gauge TMC	34	32	29	29
B	Gauge CY3	40	40	40	40
C	Gauge R3110	39	39	39	39
	Gauge E112	38	38	38	38
D	Gauge EVER4	20	22	20	20
E	Gauge NE of NPA13	37	36	33	33
F	Gauge NE of RG2	32	33	33	33

Table 8. Cape Sable Seaside Sparrow Habitat. Number of years in period of record that target is met. Target is 90-210 days annual discontinuous hydroperiod.

Subpopulation		ECB	FWO	Alt 4R	Alt 4R2
		# of years	# of years	# of years	# of years
A	Indicator Region A-1	4	6	10	10
	Indicator Region A-2	10	9	8	8
B	Indicator Region B	25	25	24	24
C	Indicator Region C	17	19	16	15
D	Indicator Region D	11	16	12	13
E	Indicator Region E-1	25	24	17	18
	Indicator Region E-2	13	12	10	10
F	Indicator Region F	19	18	15	14

Everglade Snail Kite

The Everglade snail kite PM, defined in the MSTS through collaboration with researchers responsible for monitoring the kite population, provides optimal hydrologic ranges for two important time periods within the year. The first is the pre-breeding season which is most effectively measured on January 1. Water levels between 9.76 and 10.26 feet NGVD on January 1, coupled with the recommended recession rate (0.05 feet per week), are recommended to provide favorable conditions in southwest WCA-3A for optimal snail kite nest success during the peak breeding season (March-June). As discussed earlier, higher water levels up through this time period are associated with decreased snail kite nest success; thus, reduced water levels (from the wet season high) should benefit nesting kites. Attaining the recommended water levels on or around January 1 (followed by the recommended recession rate) should allow individual snail kites to choose nesting locations more appropriately based on water depths that can be expected to be present throughout nest building, incubation, and nestling stages.

The second metric provides an optimal hydrologic range at the end of the dry season from May 1–June 1. Minimum water levels between 8.8 and 9.3 feet NGVD are recommended to provide favorable conditions in southwest WCA-3A for increased snail kite nest success and juvenile survival. For more detailed information on how these metrics were defined please refer to the Service's MSTS white paper (Service 2010). Although the snail kite metrics were applied to locations throughout WCA-3A and 3B, most of the snail kite nesting in recent years has been concentrated in central to southwestern WCA-3A. Therefore, gauges 3A-4, 3A-28 and 3A-SW may be the most important to focus on. However, improving conditions in areas that have been absent kite nesting may allow them to utilize these areas for the first time or return to old nesting grounds.

The Corps did not evaluate Alts 4R and 4R2 with the snail kite-specific PMs described above, as they had for the previous final array of alternatives. They determined that only using these metrics in southern WCA-3A where they were designed to be used in ERTP is too restrictive for use in CEPP. Instead they opted to use an apple snail based hydrologic metric and apple snail model as a surrogate for their snail kite analysis. While the Service agrees that using the ERTP metrics in southern WCA-3A does not adequately cover the geographic scope of CEPP, we do not feel that it is appropriate to solely use the apple snail metrics to evaluate the performance of CEPP regarding snail kites. The Service will provide a more robust and thorough snail kite analysis in future ESA consultations when more information is learned about when certain aspects of the project will be constructed.

As indicated in our draft report (Service 2013), all of the alternatives keep conditions the same or slightly better with the exception of the gage in 3A-SW which shows slight reductions in the number of years the target is achieved. Alternatives 4R and 4R2 are no different in this regard. This result is somewhat disappointing as one of the goals of CEPP was to improve conditions in southern WCA-3A for wildlife and other resources in the vicinity. Of note are the base condition scores which are very low. This indicates that conditions were poor to start with at this location and the alternatives do not improve upon it. Additional analyses should be conducted on this output to ensure its accuracy. Areas of improvement over the base conditions are northern WCA-3A which has been historically too dry for snail kites. The alternatives make these areas significantly better which could become suitable kite foraging habitat if other conditions are met (note snail kite critical habitat is not defined in northern 3A; however, it has been designated in WCA-1 and WCA-2A and 2B).

Florida Apple Snail

Optimal hydrologic ranges for successful apple snail reproduction are also provided during two time periods within the year, similarly to the snail kite (Table 9). Water depths between 9.65 and 10.31 feet NGVD (40-60 cm) on January 1, coupled with a slow, gradual recession rate (approximately 0.05 feet per week), are recommended to provide favorable conditions (*i.e.*, water depths ≤ 40 cm, as discussed under dry season recommendations below) for apple snail egg production beginning in March, and prevent delayed or reduced apple snail egg production. Additionally, apple snail egg production is maximized when dry season minimum water levels are < 9.65 feet but > 8.67 feet NGVD (water depths < 40 cm but > 10 cm). Maximizing egg cluster production contributes to increased snail density the following year.

As expected for this project, all of the alternatives, including Alts4R and 4R2, make the May 1-June 1 conditions better for apple snails in most areas because the project is designed to deliver water during the dry season. As with the snail kite PM the apple snail metric performs worse than the base conditions at the 3A-SW gauge location. This gauge is located just north of the terminus of the L-28 Tieback in the mouth of Mullet Slough. This area usually gets a lot of flow funneling out of Big Cypress National Preserve into WCA-3A and may explain why the targets are not met in most years.

Table 9. Numbers of years in the period of record (41 years) that target water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet between May 1 and June 1 for the apple snails in WCA-3A. Numbers in parenthesis in the Total line represent the percentage of total years possible 328.

	May 1 - June 1			December 31c		
		ALTERNATIVE			ALTERNATIVE	
	FWO	4R	4R2	FWO	4R	4R2
3A-NE	2	21	20	0	0	0
3A-NW	4	17	19	0	17	16
3A-3	7	21	20	11	10	10
3A-4	18	23	23	22	24	22
3A-28	19	17	15	5	4	4
3A-SW	37	31	31	2	0	0
3B-71	5	28	28	5	6	6
3BS1W1	13	17	17	18	24	21
Total	**105** (32%)	**175** (53)	**173** (53)	**63** (19%)	**85** (26)	**79** (24)

Dry Season Recession Rate

A recession rate of 0.05 feet per week is recommended from January 1 to June 1 (or the onset of the wet season) to maximize kite nest success. This equates to a stage difference of approximately 1.0 feet between January and the dry season low. This recession rate guideline is most important to follow during the peak snail kite breeding season (March-June). Recession rates < 0.05 feet per week, or > 0.05 feet but < 0.10 feet per week may also be considered acceptable under certain environmental conditions (*e.g.*, unseasonably heavy rainfall). These recession guidelines may also be applied in the fall (October-December), although faster recession rates during this time may be considered acceptable under exceptionally high water conditions (> 11.0-11.5 feet NGVD) to reach desirable pre-breeding (January 1) water levels.

The Corps did not provide information on this metric in its updated PIR, however, it is assumed here that Alts 4R and 4R2 perform similarly to the other alternatives reported in our previous document (Service 2013). All of the alternatives perform similarly to the base conditions for the optimal range of 0.05 – 0.07 feet per week; however, the number of weeks is low indicating that the target is not currently met very often. The benefit comes from the alternatives ability to shift recession rates from outside all acceptable ranges into the mid-range rates (> -0.05 but < 0.06 and >0.07 but <0.17). This seems to be a benefit over the base conditions. The Corps has committed to continuance of the Periodic Scientist Calls where recession rates are evaluated periodically throughout the year and adjustment made where necessary.

Wet Season Rate of Rise (Ascension Rate)

A maximum ascension rate (rate of rise) of ≤ 0.25 feet per week is recommended from June 1 to October 1 to avoid drowning of apple snail egg clusters. The importance of this guideline depends on what happens in the dry season (*i.e.*, whether snails need additional time for egg production due to poor hydrological conditions earlier in year). Darby et al. (2005) and Darby et al. (2009) observed a shift in peak egg cluster production (to later in the year) associated with higher water depths in 2003 and at relatively deeper southern sites in the relatively wet year of 2005.

The Corps did not provide information regarding this metric for Alts 4R and 4R2 in their updated PIR Appendix C.2.2. It is assumed here that the operational refinements of Alt 4 (4R and 4R2) perform similarly to alternatives previously analyzed, which would be similar to or slightly better than base conditions.

Wood Stork Foraging Conditions

Several methods were used to evaluate wood storks and other wading birds with regards to the CEPP Project. Originally, Beerens and Cook (2010; Appendix B) reviewed wood stork survey data and hydrological data and found that, at the minimum 3-AVG stage during 2000-2005 (8.02 feet on May 21, 2001), wood storks were still feeding in southeastern WCA-3A. Flock size appeared to increase correspondingly with a decrease in stage during the breeding seasons in these years. Their analysis also indicated that wood storks used a mean depth of 0.48 feet

(14.63 cm), with the optimal range including the 95 percent confidence intervals equal to 0.46-0.50 feet (13.93-15.33 cm).

This information was used to create a PM for the MSTS during ERTP which was analyzed in our original draft report (Service 2013). Model output was categorized by percentage of time wood stork foraging depth target of 5 – 25 cm within the core foraging area (18.6 mile radius) of any active wood stork colony. Conclusions from the previous draft were that for areas in northern WCA-3A all of the alternatives perform similarly and slightly worse than the base conditions. One might expect this as the project was designed to move water into this area during the dry season. The result for 3ASW is confusing as it is not located in the southwestern portion of WCA-3A rather it is located at the north end of the L-28 tieback in Mullet Slough. How the project is changing hydrology in this area should be more closely investigated. Additionally, a more suitable gauge in southwestern WCA-3A should be included in the analysis (*e.g.*, 3AS3W1 or W2). Southern WCA-3A remains largely unchanged by the alternatives and has low base condition scores. This is due to the fact that southern WCA-3A is impounded behind the Tamiami Trail and usually stays too wet for foraging wading birds during the dry season. Performance in WCA-3B is maintained by Alt 4 while other alternatives tend to make it slightly worse.

Since the last report was drafted, Beerens and Noonburg (2013) completed work on their model WADEM (Wader Distribution Evaluation Modeling), and have provided a report summarizing Alts 4R and 4R2 as compared to the FWO for CEPP. The WADEM essentially uses Systematic Reconnaissance Flight data collected between 2002 and 2009 and pairs it with EDEN hydrologic parameters such as recession rates, days since drydown, reversals and hydroperiods for each cell within the model domain. The main relationships that the authors discovered are that a geographical location is used more frequently by wading birds when it has a higher number of days since last drydown, which produces more forage, and shallow foraging depths which concentrates prey making it easier to obtain.

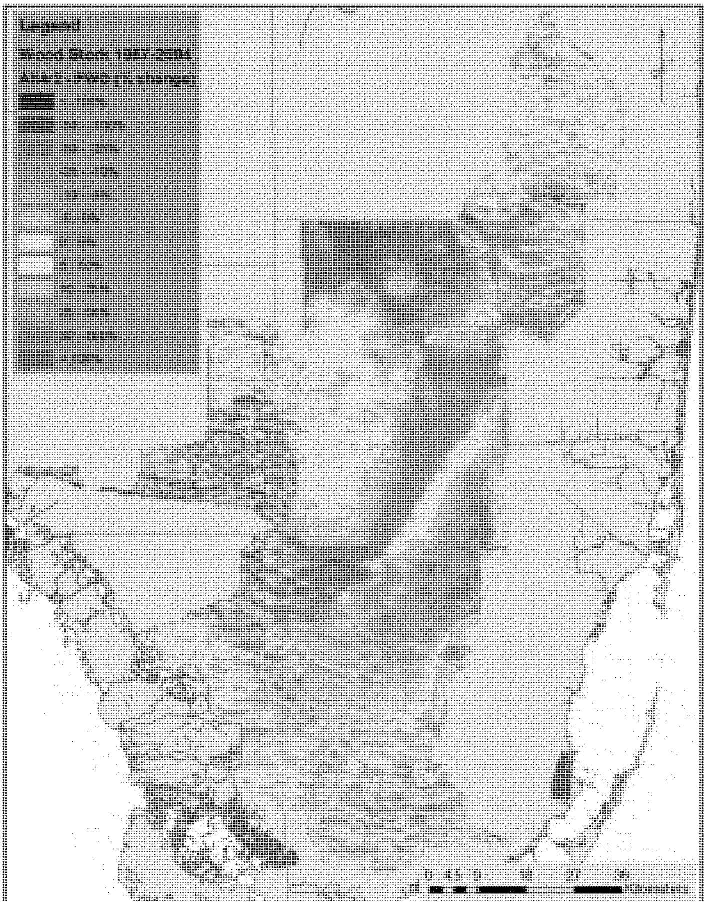

Figure 13. Mean percent change in wading bird cell use (Jan–May, 1967-2004) for Alt 4R2 relative to FWO.

Figure 13 shows a difference map with varying coloration demonstrating percent change between the tentatively selected plan Alt 4R and the FWO condition. An increase in wading bird usage can be seen in northern WCA-3A, WCA-3B and northeast SRS which is anticipated based on project features. These areas have been consistently drier than other parts of the system and will benefit greatly by increased dry season flow provided by CEPP. What is not as clear is what effect, if any, this increased dry season flow will have on wet season high water stage and timing of dry downs.

Additional wood stork analysis was provided by ENP as modeled and analyzed by their Wood Stork Foraging Probability Index (ENP 2013). The Wood Stork Foraging Probability Index

(Lo Galbo et al. 2012) is a spatially explicit modeling tool that simulates wood stork foraging habitat suitability throughout the Greater Everglades based on the foraging and water depth relationships of Herring and Gawlik (2011). The model also includes a penalization for water depth recessions to estimate the impact of water reversals on wood stork foraging.

Summary output for ALTs 4R and 4R2 as compared to the FWO can be seen in Figure 14. As with the previous analyses, wood stork foraging conditions improve the most in northern WCA-3A and in southern ENP.

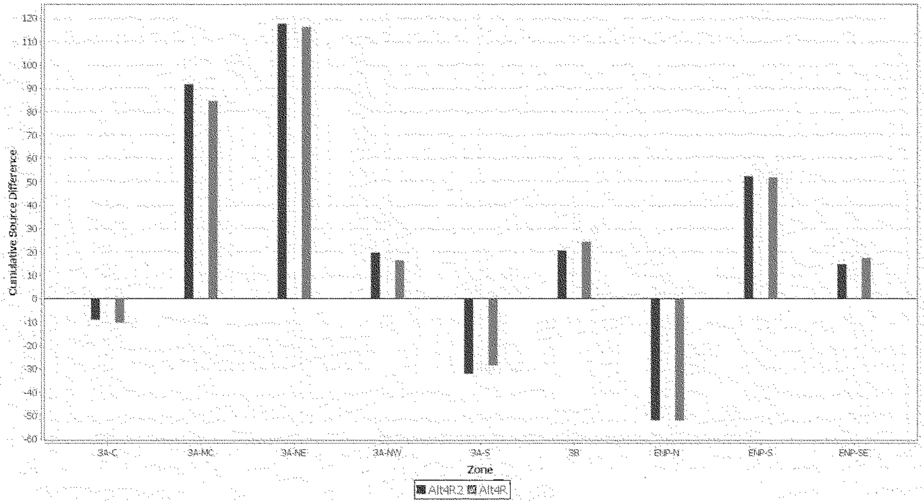

Figure 14. Cumulative wood stork foraging suitability (1965-2005) lift from CEPP FWO for CEPP TSP (Alt 4R2) and CEPP alternative (Alt 4R) within each CEPP zone. A maximum score of 1327 is possible if FWO has a suitability score of 0.0 every week and the alternative has a suitability score of 1.0 every week of the 41 year hydrologic model runs.

c. Other Ecological Tool Results

Everglades Landscape Vegetation Succession Model

The Everglades Landscape Vegetation Succession model (ELVes) is a spatially explicit simulation of vegetation community dynamics over time in response to changes in environmental conditions. The model uses empirically based probability functions to define the realized niche space of vegetation communities. Temporal lags in response to changing environmental conditions are accounted for in the model. The Everglades Landscape Vegetation Succession Model (ELVeS) Version 1.1 simulates Everglades freshwater marsh and prairie community response to hydrologic and soil properties. The ELVeS has been developed to provide scientists, planners, and decision makers a simulation tool for CERP landscape-scale analysis, planning, and decision making.

In examining the dominant vegetation communities selected by ELVeS at the end of the 41-year period of hydrologic record, little difference is discernible among the alternatives and FWO or ECB. Open water is eliminated in all the alternatives (Alt 4R, Alt 4R1, and Alt 4R2) in southern WCA-2B and increased wetting in Alt 4R1 is being expressed along the western edge of northern WCA-3A with pockets of spikerush (*Eleocharis* spp.). Northern WCA-3A in the ECB and FWO is drier than it is expected to be in the alternatives and is characterized by willow and shrubs. In the alternatives, water deliveries to northern WCA-3A result in ELVeS probabilities for sawgrass becoming quite high and following the pathways of water flow. One notable transition occurs in northern WCA-3A (CEPP Zone 3A-NE) where increased water deliveries from CEPP result in a decreased spatial extent of wet scrubland community and subsequent increased spatial extent of sawgrass community. Another significant shift occurs within the Blue Shanty Flow-way in WCA-3B (southwestern portion of CEPP Zone 3B) and northeast SRS (CEPP Zone ENP-N) with Alt 4R2. Sawgrass communities are replaced by cattail, floating emergent marsh, and open marsh as a result of the substantial increased flow deliveries that occur to the Blue Shanty Flow-way with CEPP implementation.

Marl Prairie Indicator

The Marl Prairie Indicator is a temporally and spatially explicit modeling tool that ENP uses to simulate hydrologic suitability of marl prairies based on CSSS survey presence data threshold ranges (Pearlstine et al. 2013). The marl prairie indicator evaluates marl prairie habitat suitability with four metrics: (1) average wet season water depths (June – October); (2) dry season water depths (November – May); (3) discontinuous annual hydroperiod (May – April of the next year); and (4) maximum continuous dry days during the nesting season (March 1 – July 15).

Similarly to the more detailed analysis of sparrow conditions currently being completed by the Service, the Marl Prairie Indicator predicts substantial negative effects to the western portions of CSSS-E, extreme western edge of CSSS-B, and CSSS-D (Figure 15). Modest gains in habitat suitability can be seen in the very northern edges of CSSS-A and CSSS-C. A more detailed analysis of CEPP effects on the sparrow will be in the Service's ESA consultation document which will be provided in the future during detailed planning and design of CEPP components expected to impact sparrows.

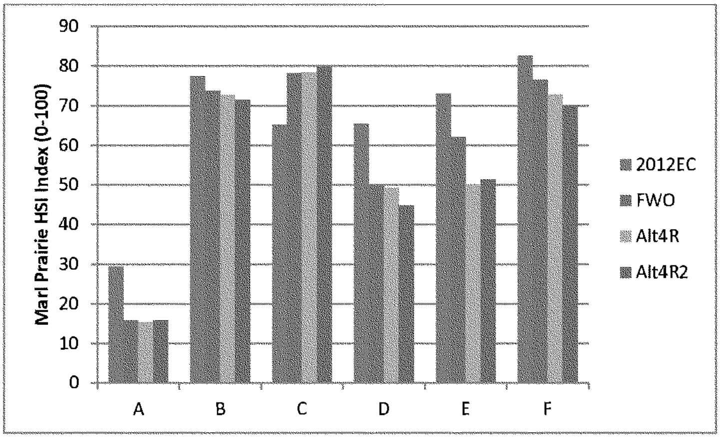

Figure 15. This bar graph shows the relative performance of Alts 4R and 4R2 compared to the FWO and EBC in each of the 6 sparrow subpopulations.

The Service remains concerned that the impact of CEPP as modeled, if it were to be implemented tomorrow, to the relatively strong but vulnerable CSSS-E would result in an intolerable decrease in the overall sparrow population. Fortunately, it will be many years before the implementation of CEPP components that will affect the CSSS and the Service and Corps are working together to implement projects and study initiatives to reassess baseline conditions and help bolster sparrow populations so that they may better weather the transition into full CEPP and CERP.

American Alligator Production

The American alligator is a keystone species within the Everglades marsh systems, acting as predator and prey and structuring plant communities (Brandt and Mazzotti 2000). Alligators are dependent on spatial and temporal patterns of water fluctuations that affect courtship and mating, nesting, and habitat use. Water management practices and other anthropogenic changes to the Everglades region have affected alligators, which historically were abundant in peripheral marshes of the Everglades (Craighead 1968) and are now most abundant in central sloughs (Kushlan 1990). The alligator ecological planning tool models habitat suitability annually for five components of alligator production: (1) land cover suitability; (2) breeding potential (female growth and survival from April 16 of the previous year - April 15 of the current year); (3) courtship and mating (April 16-May 31); and (4) nest building (June 15-July 15), and egg incubation (nest flooding from July 01-September 15).

All of the alternative plans, including Alt 4R and Alt 4R2, improve alligator habitat in northern WCA-3A and the Miami Canal zone by as much as 20 percent because of new water deliveries to northern WCA-3A. Gains are smaller in central WCA-3A, WCA-3B and ENP north and south zones with modest variation regarding which alternative best improves scores. Changes to WCA-3A south and ENP southeast are negligible. When scores are aggregated by water conservation area, the trends are similar, but lifts are compressed by aggregation over a larger area. In addition, WCA-2 has a five percent loss of habitat suitability resulting from water being redirected from WCA-2 to WCA-3A.

Apple Snail Population

This model was developed by Phil Darby (University of West Florida), Don DeAngelis U.S. Geological Survey (USGS), and Stephanie Romañach (USGS) and is being used in CEPP as an Ecological Planning Tool. The purpose of the model is to describe the dynamics of the apple snail population as a function of hydrology and air temperature. The estimated number and size distribution of the snails are simulated on a daily basis and can be calculated for any day of a year with user input. Standard output is produced as difference maps which show the simulated alternative minus the base condition.

Conditions will be provided for dry years for each alternative, which is the period when CEPP is likely to have the biggest impact, given that the system is largely rainfall driven in the wet season. Results will also be provided for adult snails (> 20 mm) during the spring of a dry year, before that years' reproductive period. Adult snails during a given year are a product of egg production, and thus environmental conditions, from the previous year.

Inputs

- Water depth from the District's RMS
- Air temperatures from DBHYDRO interpolated across hydro input domain

Outputs

- Apple snail population numbers per 500 x 500 meter cell on a daily time step (500 meters cell interpolation from the District's RSMGL hydrologic output)
- Snail egg numbers on a daily time step

As with the four previous alternatives, Alts 4R and 4R2 provide better conditions for apple snail populations compared to the FWO. All of the alternative plans should lead to increased apple snail populations in northern WCA-3A, WCA-3B and Northeast Shark River Slough (NESRS).

2. Potential Adverse and Beneficial Effects of the Project

Overall, the alternatives perform quite similarly; however, all show marked improvement over the existing and FWO conditions. This is expected as most of the project components were designed using existing information produced from prior project planning efforts. As was expected from a first increment while making significant gains in the Greater Everglades and other project areas the TSP does not fully complete restoration. The Corps and the District should, as soon as is feasible, continue planning the next phase of restoration. Following is a brief description, by geographical region within the Greater Everglades, of potential adverse and beneficial effects of the TSP.

a. Loxahatchee National Wildlife Refuge

Hydrologic impacts from the implementation of any of the final array alternatives are not expected in Loxahatchee NWR because no changes to the regulation schedule or current water management infrastructure are contemplated.

b. Water Conservation Areas 2A/2B

Although the team tried to identify ways to improve the hydrologic conditions in WCA-2, it was never an objective of CEPP to change the regulation schedule for this area. Future phases of Everglades restoration should study the problems in WCA-2 and implement changes.

CEPP does include a component, called L-6 diversions, which would move water discharged from STA-2, normally discharged into WCA-2A, west into northern WCA-3A. The hydrologic effect of this component generally made conditions during dry times worse in WCA-2A. The TSP will require adaptive management of operations to avoid performance issues in this area.

The Service provided draft WCA-2A regulation schedule changes early in the planning process to help guide the modeling team in their efforts to define operations. These proposed draft changes can be seen in Figure 16 and were contemplated in conjunction with the FWC. Future work on WCA-2 regulation schedules should include various wildlife agencies and start with modifying the regulation schedule to be more environmentally based.

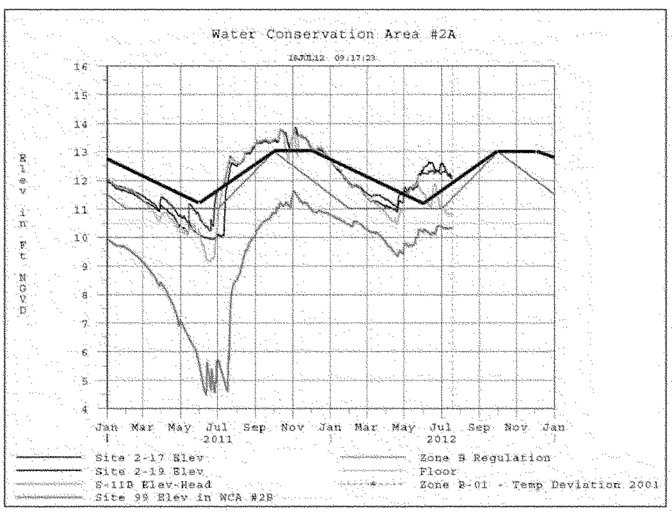

Figure 16. Proposed draft regulation schedule changes for WCA-2A shown as black line on existing regulation schedule hydrograph.

The CEPP is not making changes to either operations or infrastructure to WCA-2B thus no changes are expected in this area. However, conditions in WCA-2B are generally poor with sustained high water levels and little inter-annual variability. This area should be included in future discussions regarding the restoration of WCA-2.

c. Water Conservation Area 3A

All alternatives showed improved ecological performance for fish, wading birds, and apple snails in northern and central WCA-3A and SRS. Improved hydroperiods and sheetflow in WCA-3A, WCA-3B, and ENP result in less soil oxidation, which promotes peat accretion necessary to rebuild the complex mosaic of habitats across the landscape.

The project does not appear to alleviate the long-standing concern of ponded water at the Miami Canal/L67 A junction and in southern WCA-3A. Adaptive management should be used when possible to continue movement of water east into WCA-3B, NESRS and the South Dade Conveyance System when upstream and downstream areas will not be impacted. Additionally, the guidelines outlined in the MSTS and other aspects of the ERTP should continue to be followed throughout CEPP.

d. Water Conservation Area 3B

WCA-3B will see a substantial increase in beneficial flow through which should begin the re-establishment of ridge and slough patterning in this area. There is a concern that too much water may pool in the southeastern corner of WCA-3B during the wettest years. To alleviate these concerns the Corps should include this area in its monitoring and adaptive management plan and be prepared to make real-time operational changes to alleviate these concerns. An additional outflow structure may be necessary in the southeastern corner of WCA-3B just north of the existing Tamiami Trail 1-mile bridge. This structure, in conjunction with the use of the proposed L-29 divide structure which lowers stages in eastern Tamiami Trail will create the necessary hydrologic head to move water out of WCA-3B into NESRS.

e. Shark River Slough

Since the construction of the L-67 A and C levees and installation of the S-12 structures on the western side of Tamiami Trail, too much water has entered western SRS negatively impacting marl prairies in this location. Consequentially, too little water has been delivered to northeastern SRS causing the eastern marl prairies and Rocky Glades to become too dry. This has resulted in this area seeing increased woody vegetation encroachment and has made it susceptible to catastrophic wild fires. The TSP of CEPP will make significant positive gains in routing flows to the east, improving sheet flow and hydroperiod in NESRS which will benefit snail kites, wading birds, tree islands and other wildlife resources in this area.

f. Marl Prairies

The Service's greatest concern with the TSP at this time is the rapid change in hydrology predicted in areas of marl prairie on the eastern flank of SRS. The second most productive subpopulation CSSS-E is located in this area, roughly 10 miles south of the L-67 Extension, and contained an estimated 736 sparrows in 2012. Modeling has shown that we may expect a roughly 35 percent decline in the number of years in which hydroperiod falls within the 90 to 210 day window. Consecutive years of hydroperiods above 210 days will significantly alter currently suitable sparrow nesting habitat to a more marsh-like *Cladium*-domintated habitat which is unacceptable for sparrow nesting. Although other areas in and around currently suitable sparrow habitat may be enhanced by the project, rapid reduction of currently productive habitat will have a greater negative effect on overall sparrow population numbers than relatively slow gain in habitat in other areas.

The key to overcoming this impact is a slower transition into full hydrologic restoration. A stringent monitoring plan including helicopter surveys, intensive ground surveys and vegetation surveys in conjunction with adaptive management and real-time operational control will help alleviate the risk to sparrows resulting from this project. The Service is committed to working closely with the Corps and its local sponsor during formal consultation in the coming months to ensure that full CEPP benefits can be achieved throughout the system while restoring and maintaining trust resources like the sparrow.

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E. Southern Coastal System

1. Model Results

a. Florida Bay

Figure 17 shows flows across Transect 27 in SRS. Alternatives 4R and 4R2 show substantially greater flow across the transect toward the coast compared to FWO and ECB. This flow can directly benefit the southwest coastal wetlands and estuaries (*e.g.*, Whitewater Bay and riverine estuaries). It can less directly benefit Florida Bay via surface water and shallow groundwater flow and by plumes of low salinity water across the bay's western boundary (around Cape Sable). Note that Florida Bay salinity for CEPP is estimated from wetland stage and not flow.

Simulations show greater mean annual flow, mean dry season flow, and wet season flow for Alt 4R and Alt 4R2 compared to FWO and ECB. Alts 4R and 4R2 provide nearly identical flows across Transect 27; however, Alt 4R2 provides slightly more flow during the dry season than Alt 4R. Annual flow increases above FWO are 164,000 ac-ft per year for Alt 4R and

166,000 ac-ft per year for Alt 4R2. Compared to FWO, Alt 4R2 provides 34 per cent more flow across the transect during the wet season and 21 per cent more flow during the dry season. Both CEPP alternatives provide significantly more flow compared to ECB.

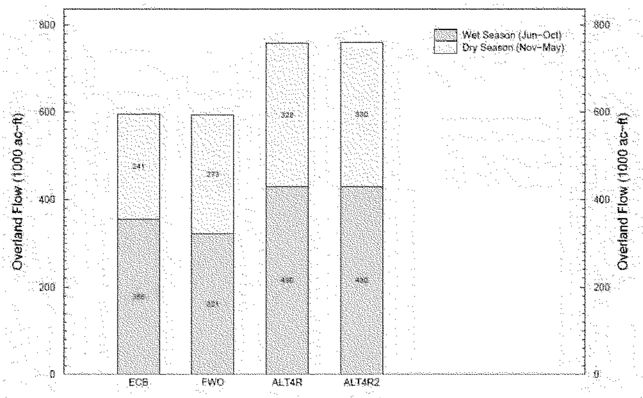

Figure 17. Average annual overland flow across Transect 27 (southwestward flow in central Shark River Slough).

Average annual overland flow across Transect 23B (one of the three flow transects across western Taylor Slough) also shows increases for Alt 4R and Alt 4R2 compared to FWO and ECB (Figure 18). For this location Alt 4R provides slightly more flows than Alt 4R2. Annual flow increases above FWO are 10,000 ac-ft per year for Alt 4R and 8,000 ac-ft per year for Alt 4R2. Combining the flows across the three Transect 23 sites yields a similar result as the Transect 23B site. Alternative 4R provides 27,000 ac-ft per year (10 percent) more flow than FWO; whereas, Alt 4R2 provides 23,000 ac-ft per year (9 percent) more flow than FWO. Both CEPP alternatives provide more flow to Taylor Slough compared to ECB.

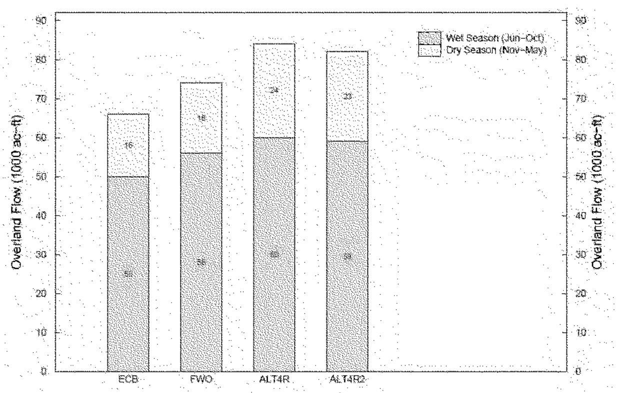

Figure 18. Average annual overland flow across Transect 23B (southwestward flow in central Shark River Slough).

c. Biscayne Bay

Flow at coastal structures

Evaluation of the coastal structure flow is displayed in Table 10. The purpose of this evaluation is to ensure that CEPP does not affect Biscayne Bay in any manner that would worsen it from existing conditions. Unfortunately, improving conditions in Biscayne Bay was not a CEPP objective, but CEPP should induce no harm to the bay. Also, the comparison of FWO and the alternatives against ECB is necessary to understand the effects of the different model assumptions made in the ECB and future conditions.

Results indicate that total flows to Biscayne Bay past all coastal structures combined under FWO, Alt 4R, and Alt 4R2 are greater than ECB. Alt 4R2 provides 3 percent more flow than ECB; whereas, Alt 4R provides 7 percent more water than ECB. Alternative 4R2 provide 2 percent less total flow to the bay compared to FWO.

Table 10. Mean annual flows for all Biscayne Bay coastal structures. Differences between annual means of FWO, Alt 4R, and Alt 4R2 compared to ECB (expressed in percent). Color codes depict North Bay (yellow), Central Bay (blue), South-central Bay (orange), and South Bay (green).

	ECB	**FWO**		**Alt 4R**		**Alt 4R2**	
Structure	Mean Flow	Mean	% Diff ECB	Mean Flow	% Diff ECB	Mean Flow	% Diff ECB
S29	282.8	372.3	32%	374.5	32%	310.8	10%
S28	90.9	93.2	3%	93	2%	90.8	0
S27	115.2	114.5	-1%	115.1	0	115.1	0
S26	124.6	116.4	-7%	124.5	0	124.9	0
S25B	109.3	102.4	-6%	103.3	-5%	105.6	-3%
S25	9.7	9.6	-2%	9.6	-1%	9.7	0
G93	28.4	26.7	-6%	26.8	-6%	27.8	-2%
S22	121.2	113.9	-6%	115.3	-5%	117.7	-3%
S123	17.5	17.3	-1%	17.5	0	17.7	1%
S21	101.3	101.9	1%	106.3	5%	115.3	14%
S21A	58.2	60.6	4%	60.8	5%	62.8	8%
S20G	0.4	0.3	-1%	0.3	0	0.4	0
S20F	145.7	154.7	6%	152.7	5%	154.9	6%
S20	6.6	6.6	0	6.6	0	6.6	0
S197	22.8	9.2	-60%	11.2	-51%	11.3	-50%
Total	**1234.5**	**1299.2**	**5%**	**1317.7**	**7%**	**1271.2**	**3%**

As requested by the CEPP project managers, the Biscayne Bay coastal structure evaluation was performed for four separate bay regions—North, Central, South-central, and South Bay areas (Manatee Bay/Barnes Sound). Modeled flow output indicates an increase in annual flow to North Bay under both Alt 4R and Alt 4R2 compared to ECB (see yellow cells in Table 10). Alternative 4R2 flow at the S29 indicates a 10 percent increase in annual flow compared to ECB. Further analyses indicate the increase occurs during both wet and dry seasons. Alternative 4R2 shows significantly less flow at the S29 compared to FWO. Flow at the S28 and S27 structures indicate no change in annual flow compared to ECB. However, further analysis indicates an approximate 1 to 2 percent reduction in flow past the S28 and S27 during the dry season (not shown). Alternative 4R2 exhibits very similar flow to FWO at the S28 and S27 structures.

In the Central Bay region, simulations indicate a relatively small decrease (1 to 3 percent) in annual flows at three of the five coastal structures under Alt 4R2 compared to ECB (see blue cells in Table 10). However, all five coastal structures in this bay region show a decrease in dry season flows of 3 to 20 percent under Alt 4R2 compared to ECB. Flow at the S26 exhibits the largest decrease (almost 20 percent) in dry season flows under Alt 4R2 relative to ECB (Figure 19). Further, two structures (S25B and G93) indicate a decrease in flow during both seasons compared to ECB. Figure 20 shows that flow under Alt 4R2 is reduced 10 percent during the dry season and almost 2 percent during the wet season at the S25B structure compared to ECB. All five coastal structures in this bay region show an increase in total annual flow and seasonal flow under Alt 4R2 compared to FWO. The only exception is the S26 structure, which shows slightly greater decreases in flow during the dry season under Alt 4R2 compared to FWO. Alternative 4R performed worse than Alt 4R2 at all coastal structures in the Central Bay region (Table 10).

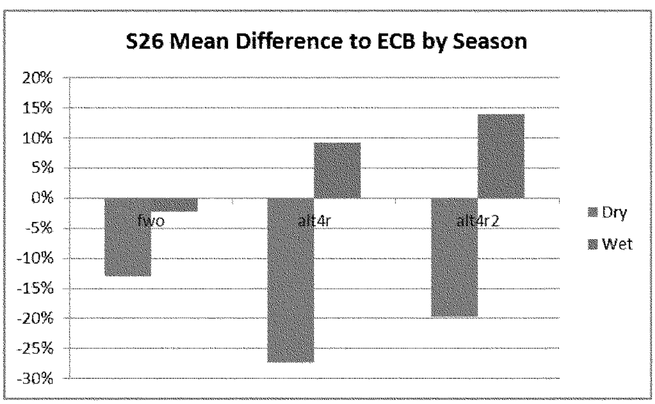

Figure 19. Histogram showing the mean difference (percent) in flow at the S26 structure (Miami Canal) for FWO, Alt 4R, and Alt 4R2 compared to ECB.

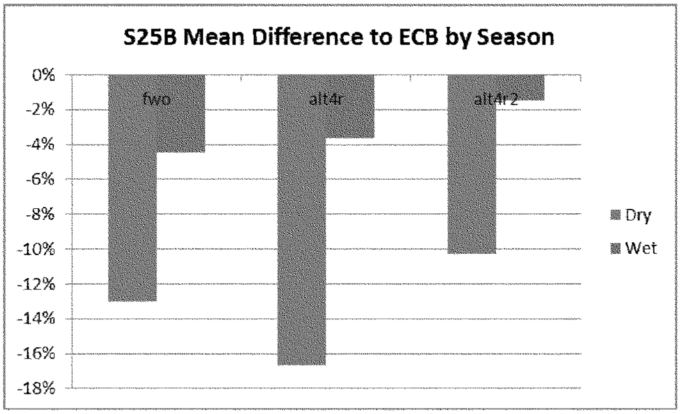

Figure 20 Histogram showing the mean difference (percent) in flow at the S25B structure for FWO, Alt 4R, and Alt 4R2 compared to ECB.

In South-central Bay, simulations indicate an increase in annual mean flows at four of the five structures under Alt 4R2 compared to ECB. The fifth structure (S123) shows no change in annual mean flows between Alt 4R2 and ECB. The maximum increase is at the S21 (C-1 Canal) where Alt 42 flow is 14 percent greater than ECB. All structures show increases in flows during both seasons, except S123, which shows a very small reduction in flow during the dry season for Alt 4R2 compared to ECB (not shown). Alternative 4R also shows increases in annual mean flows compared to ECB for S21, S21A, and S20F compared to ECB with no change at the S123 and S20G structures. Alternative 4R2 also shows increases (2 to 13 percent) in annual mean flows above FWO for all South-central Bay coastal structures. Results from S-20G (Military Canal) are not applicable as the sole function of this canal is to provide stormwater drainage from Homestead Air Reserve Base and is not affected by the overall operation of the South Dade Conveyance System (*i.e.*, CEPP would have no effect on this canal).

For South Bay (Manatee Bay and Barnes Sound), results show no change in flows at S-20, but significant decreases in annual flow for FWO, Alt 4R, and Alt 4R2 compared to ECB. Those reductions range from 50 percent (Alt 4R2) to 60 percent (FWO). Flows at this structure are relatively small compared to most other coastal structures, but this flow is important for establishing and maintaining brackish salinities in Manatee Bay and Barnes Sound. While the desired restoration scenario for Manatee Bay includes the reduction of large, pulsed discharges through the S-197 structure, it is important to emphasize that the volume of water lost to the reduction in flows in FWO and the alternatives is not captured by another feature and redistributed to the region. This results in a net loss of freshwater flows to this particular region. It is speculated that the CERP C-111SC Project is responsible for the simulated reduction in flows at the S197. Alternative 4R2 provides slightly more flows at the S197 compared to FWO.

<u>Flow at Divide Structures</u>

Flows at select divide structures were evaluated partly because these structures provide flow east across the Atlantic Ridge to Biscayne Bay and partly because of model uncertainty associated with output at the coastal structures. Coastal structures are along the edge of the model domain which increases uncertainty. Only flows at the S-338 (C-1 Canal), S-194 (C-102 Canal), and S-196 (C-103 Canal) were included in the analysis. Results show that Alt 4R2 provides 24 to 51 percent more flow to Biscayne Bay compared to ECB (Table 11). Alternative 4R2 provides 28 percent and 4 percent more flows than FWO at the S338 and S194 structures, respectively. However, Alt 4R2 provides slightly less flow (-1 percent) at the S196 compared to FWO. Alternative 4R provides slightly less flow at each of the three structures compared to ECB and significantly less flow than FWO at S194 and S196. It should be noted that the value of including analyses of divide structure flows is diminished because the latest CEPP runs includes withdrawals from wells east of those structures for water supply, which will affect groundwater levels east of the ridge, thereby affecting groundwater flow into the conveyance canals.

Table 11. Mean annual flows at the three divide structures that provide freshwater flows across the Atlantic Ridge to south-central Biscayne Bay for ECB, FWO, Alt 4R, and Alt 4R2 simulations.

	ECB		**FWO**		**Alt 4R**			**Alt 4R2**		
Structure	Mean Flow	% Diff from FWO	Mean	% Diff ECB	Mean Flow	% Diff ECB	% Diff FWO	Mean Flow	% Diff ECB	% Diff FWO
S338	58.9	3	57.1	-3	58.0	-2	2	72.9	24	28
S194	21.0	-19	25.8	23	20.8	-1	-19	26.8	28	4
S196	9.0	-34	13.7	52	8.8	-2	-36	13.6	51	-1

2. Performance Measure Results

a. Florida Bay

The first of the Florida Bay salinity PM results (regime overlap metric) is shown in Figure 21. Alternatives are compared to FWO and ECB, and wet season and dry season results are shown. The plots show lift in both seasons for all regions (except the east region during the dry season) for Alt 4R and Alt 4R2 compared to FWO and ECB. Lift during the wet season is higher than during the dry season for most regions. Alternative 4R2 performs slightly better than Alt 4R in most regions, but the differences are very small. Note that conditions in Florida Bay are always better (relatively closer to the Natural System Model [NSM] target) in the wet season than dry season – dry season conditions are typically very poor.

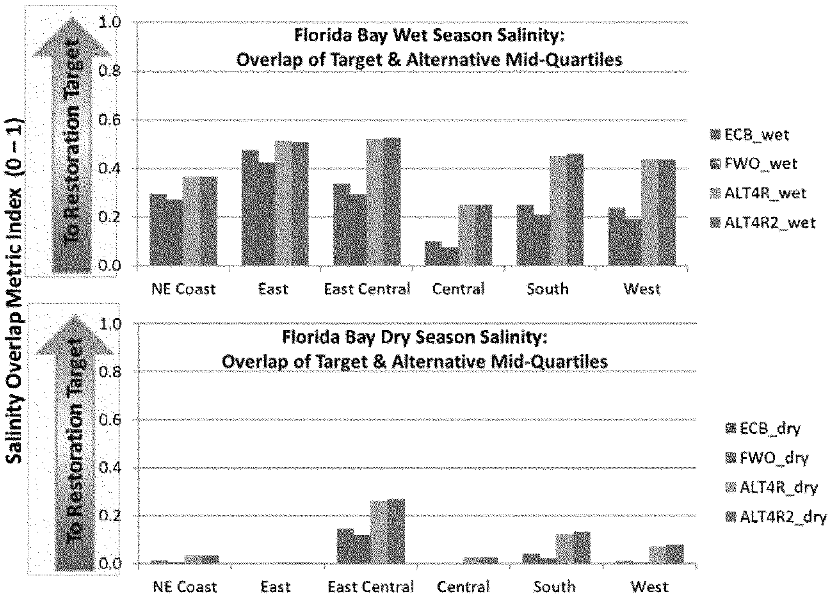

Figure 21. Histogram plot of salinity regime metric comparing CEPP alternatives, Alt 4R and Alt 4R2 to FWO (wet season shown in top plot and dry season in bottom plot). Dry season values from alternatives in the East zone are zero.

The high-salinity metric scores for Alt 4R and Alt 4R2 compared to FWO and ECB are shown in Figure 22. This metric indicates the frequency of unnatural and harmful high salinity conditions. It shows a similar lift pattern to that of the regime metric, with generally more lift occurring in the wet season except for the East-Central Region. In the South and West regions there is about a 65 percent increase in the metric index value during the wet season for both CEPP alternatives compared to FWO. During the dry season, both alternatives show about an 85 percent increase in the index score compared to FWO. Again, differences between Alt 4R and Alt 4R2 are slight compared to differences of alternatives relative to FWO. In several sub-regions, Alt 4R and Alt 4R2 appear to be equal. Also, the East Region shows almost no lift from Alt 4R or Alt 4R2 in either season over FWO. Note that both CEPP alternatives fall well short of the target during both wet and dry seasons.

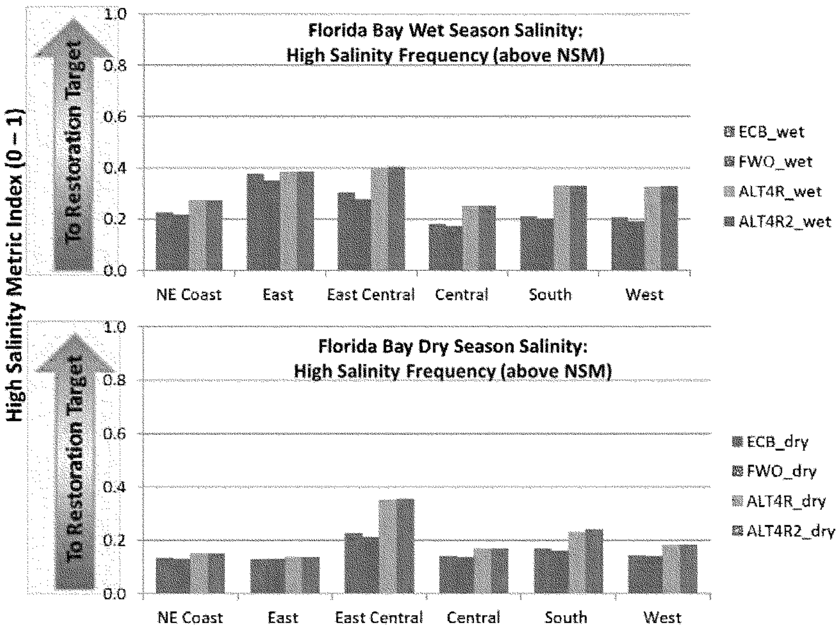

Figure 22. Histogram plot of high-salinity metric index comparing Alt 4R and Alt 4R2 to FWO and ECB (wet season shown in top plot and dry season in bottom plot).

The third of the three Florida Bay salinity PM metrics—the salinity offset—is shown in Figure 23. This metric is the difference between an alternative's (FWO, ECB, Alt 4R, or Alt 4R2) mean salinity and the NSM target's mean salinity. The values are absolute salinity units ("psu" is practical salinity units, which are nearly equivalent to parts per thousand). Lower values mean the alternative is closer to the NSM target (*i.e.*, more desirable). The results show that Alt 4R and Alt 4R2 perform almost equally and generally decrease mean salinities about 1.5 to 2 psu closer to the NSM target compared to FWO, except in the East Zone, which is more hydrologically isolated from the Everglades than other zones. In the East Zone the two CEPP alternatives decrease mean salinities by only about 0.5 psu compared to FWO. Note that this salinity offset metric was not included in habitat unit calculations of the CEPP benefits analysis because it is not a zero-to-one scale index that can be multiplied by acres.

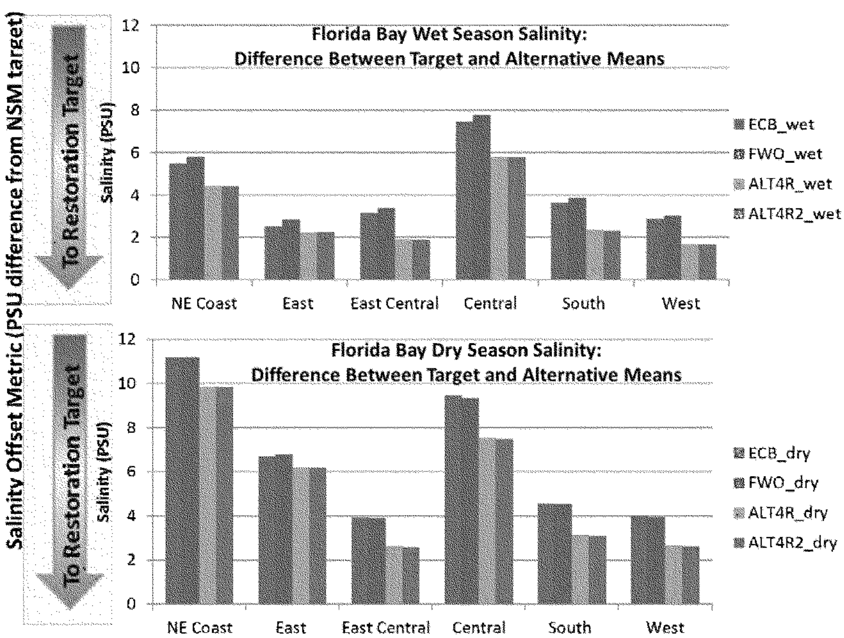

Figure 23. Histogram plot of salinity offset metric index comparing CEPP alternatives, Alt 4R and Alt 4R2 to FWO and ECB (wet season shown in top plot and dry season in bottom plot.

b. Biscayne Bay

Results of the RECOVER salinity PMs for Biscayne Bay are shown in Table 12. These PMs utilize daily, monthly, or seasonal flow envelope targets at select coastal structures as a proxy for desired salinity conditions in the bay. For each PM, the percentage of time, the daily flows are within the flow target envelope are compared. The primary focus of this evaluation is to compare the Alt 4R2 against ECB to ensure that the TSP does not impair existing conditions in the bay. In North Bay, there is a PM only for the S29 coastal structure. Results indicate Alt 4R2 daily flows fall within the target envelope 5 percent more of the time than ECB, but 6 percent less time than FWO.

In Central Biscayne Bay, salinity PMs have been developed only for the S26/S25/S25B and S22 structures. For the S-22 PM, Alt 4R2 indicates no change in performance compared to ECB. However, Alt 4R2 shows a 3 percent reduction in mean flows past this structure compared to ECB. For the S26/S25/S25B PM, Alt 4R2 shows a slight reduction in performance compared ECB, which is supported by a slight reduction in flows under Alt 4R2. The TSP shows improved performance compared to FWO for both PMs.

In South Bay, salinity PMs have been developed for all structures except the S20G. Results show slight improved performance at the S123 for Alt 4R2 compared to ECB. Results for the S21, S21A, and S20F show slightly reduced performance for Alt 4R2 compared to ECB. However, mean flows at each of these structures under Alt 4R2 is slightly greater than ECB. It is unclear why there is this discrepancy between mean flows and PM performance, but it may be due to differences in timing of flows and magnitude of releases.

In the Manatee Bay/Barnes Sound region, there is one PM available for use at the S197 structure. Results show a reduction in percent time the flows are within the PM of 1 percent for the TSP. Also, the flows at S197 are 50 percent less for Alt 4R2 compared to ECB. This reduction is supposedly attributed to the C-111SC Project, but it should be noted that these reductions may exacerbate harmful hypersaline events that occur in the receiving bodies of Manatee Bay and Barnes Sound.

Table 12. Mean flow and performance measure results for Biscayne Bay coastal structures.

	ECB	ECB	FWO	FWO	FWO	Alt 4R2	Alt 4R2	Alt 4R2
Structure	Mean Flow	% within PM	Mean	% Diff ECB	% within PM	Mean	% Diff ECB	% within PM
S29	282.2	68%	372.3	32%	79%	310.8	10%	73%
S26/S25/S25B	243.6	35%	228.4	-6%	32%	240.2	-1%	34%
S22	121.2	12%	113.9	-6%	11%	117.7	-3%	12%
S123	17.5	21%	17.3	-1%	21%	17.7	1%	22%
S21	101.3	67%	101.9	1%	66%	115.3	14%	65%
S21A	58.2	46%	60.6	4%	46%	62.8	8%	44%
S20F	145.7	43%	154.7	6%	43%	154.9	6%	42%
S197	22.8	3%	9.2	-60%	1%	11.3	-50%	2%

3. Habitat Units

Total HUs generated in Florida Bay by ECB, FWO, Alt 4R, and Alt 4R2 simulations are provided in Table 13.

These results indicate that the FWO provides less HUs than the ECB, even though the FWO condition includes the implementation of several CERP and non-CERP projects with the capability of improving the timing, quantity, and quality of flow to Florida Bay (*e.g.*, C-111 Spreader Canal Western Project). The overall negative ecological trends, continued loss of resources through landscape alterations and degradation of habitat, are expected to continue into the future without better restoration efforts. More natural hydroperiods produced by the implementation of these restoration projects would assist in slowing the continued degradation of existing habitat function within the WCAs, ENP and Florida Bay; however, until the completion of CERP, current problems plaguing the areas are expected to continue and worsen in some areas.

Table 13. Total habitat units for ECB, FWO, and Alts 4R and 4R2.

Florida Bay Zone	Habitat Units			
	Existing Condition Baseline	FWO Condition	Alt 4R	Alt 4R2
West	23,693	20,534	39,488	41,068
Central	9,025	8,205	13,948	14,769
South	16,614	14,659	27,364	28,341
East Central	21,984	20,225	33,416	34,295
North	2,154	2,028	2,534	2,661
East	9,440	8,685	9,818	9,818
Total Florida Bay	**82,910**	**74,336**	**126,568**	**130,952**

Habitat unit results for the FWO were subtracted from Alt 4R and Alt 4R2 to produce HU lift (Table 14). Results indicate that Alt 4R2 provides greater lift in Florida Bay relative to the FWO condition compared to Alt 4R. Surprisingly, the total HU increase in Florida Bay for Alt 4R2 compared to FWO is 76 percent and the Alt 4R2 lift in the West Zone is 100 percent. These are very high lift values.

Table 14. Habitat unit lift of Alt 4R and Alt 4R2 over FWO.

	Habitat Units	
Florida Bay Zone	Alt 4R	Alt 4R2
West	18,954	20,534
Central	5,743	6,564
South	12,705	13,682
East Central	13,191	14,070
North	506	633
East	1,133	1,133
Total Florida Bay	**52,232**	**56,616**

The relatively small improvement in salinity in the bay brings into question the seemingly large HU lift, especially in the west and south zones. This large proportional increase is perhaps a consequence of three factors. First, the base condition of Florida Bay salinity, estimated in both ECB and FWO model runs, is poor, especially in the north and central zones. With low scores, a small increase in a PM score can yield a large relative improvement. If the base condition was closer to the restoration target, it would take much more flow to yield the predicted improvement. This aspect of proportional gains is a consequence of the scaling of all PMs used in the benefits analysis; it is not unique to Florida Bay metrics. Second, the absolute amount of additional freshwater flows (increase above ECB and FWO flows) delivered to

Florida Bay with all CEPP alternatives is not small. Comparison of flows down SRS (Transect 27) shows Alt 4R and Alt 4R2 increase mean annual flows to Florida Bay over FWO flows by 164,000 ac-ft and 166,000 ac-ft, respectively. This corresponds to a 28 percent increase in flow compared to FWO. Additionally, Alt 4R and Alt 4R2 increase mean annual flows to Florida Bay over FWO flows by 10,000 ac-ft and 8,000 ac-ft, respectively, in Taylor Slough. Finally, the increase in the PM indices is multiplied by thousands of acres for each zone, which translates into large HU values.

Another point to make about the HUs analysis is essentially a repeat of the point made above regarding the salinity analysis; that is, the calculation of HUs does not include information on the statistical significance of differences between alternatives. It is likely that the difference between either Alt 4R and Alt 4R2 and FWO is significant, but it is unclear if the relatively subtle difference between Alt 4R and Alt 4R2 is statistically significant.

There is one obvious inconsistency regarding Alt 4R and Alt 4R2 performance. As noted above, Alt 4R provides slightly more water to Taylor Slough compared to Alt 4R2, yet salinity performance and HUs are greater for Alt 4R2 compared to Alt 4R in the Florida Bay zones that are fed by Taylor Slough (North, East-central, and Central). Also, it should be noted that all the original CEPP alternatives (Alt 1, Alt 2, Alt 3, and Alt 4) provided noticeably more benefits to Florida Bay than either Alt 4R or Alt 4R2.

4. Other Eco Tools Results

This section provide results from the four habitat suitability indices applicable to Florida Bay—juvenile crocodiles, juvenile spotted seatrout, pink shrimp, and submerged aquatic vegetation. Additional results from these four HSIs can be found in Annex E of the CEPP draft PIR and EIS.

a. Juvenile crocodiles

Results from applying the salinity data into the juvenile crocodile HSI is shown in Figure 24. The plot shows the difference between Alt 4R2 and FWO, ECB, and Alt 4R using an index of juvenile crocodile growth and survival at sites along the northern Florida Bay shoreline for all years of the model runs. Sites in the orange box historically have had the most crocodile nesting. Results indicate that there is no difference between Alt 4R and Alt 4R2 at any of the sites. Alternative 4R2 performs better than FWO at all sites except Joe Bay with the crocodile index increasing a maximum of about 0.1 at the Terrapin Bay site. Alternative 4R2 performs better than ECB at all sites except Garfield, where the HSI value is 0.11 less under Alt 4R2 conditions than ECB. Alternative 4R2 shows no improvement over FWO or ECB at the Joe Bay site. It is worth noting that determination of any statistical significance between alternatives is not possible.

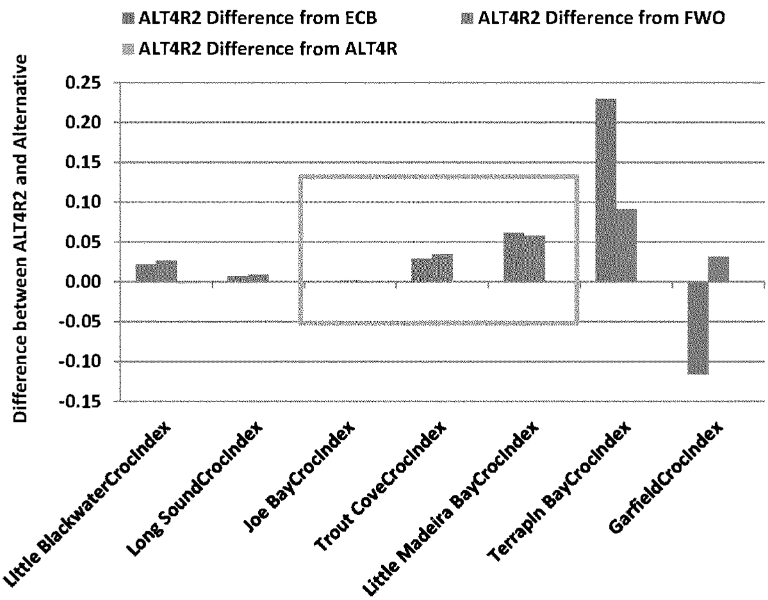

Figure 24. Histogram showing the comparison of the juvenile crocodile HSI results for seven locations of known crocodile nesting areas. Index values show lift provided by Alt 4R2 compared to ECB, FWO and Alt 4R. Sites in the orange box historically have had the most crocodile nesting.

Results of the juvenile crocodile HSI performance for an extremely dry year (1989) are shown in Figure 25. Again, there is no difference in performance between Alt 4R and Alt 4R2. Alternative 4R2 shows almost no lift over FWO at the Joe Bay, Trout Cove and Garfield Bay sites. Also, Alt 4R2 shows very small lift at the other sites, with lift ranging between 0.02 and 0.05 index units. Overall, Alt 4R and Alt 4R2 provides very little crocodile habitat improvement compared to ECB and FWO during the simulated dry year.

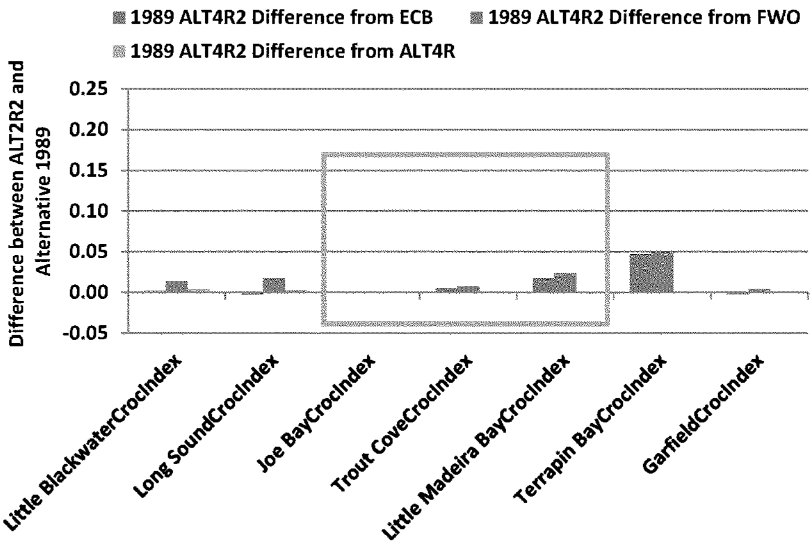

Figure 25 Histogram comparing the results of the juvenile crocodile HSI for seven locations of known crocodile nesting areas during 1989 (a very dry year). Index values show lift provided by Alt 4R compared to ECB, FWO and Alt 4R. Sites in the orange box historically have had the most crocodile nesting.

b. Juvenile spotted seatrout

The juvenile spotted seatrout HSI model was run on the monthly average salinities from May through November to coincide with spotted seatrout juvenile recruitment for all CEPP scenarios. The HSI model output from the salinity monitoring stations in Florida Bay was gridded to produce spatial distributions of HSI scores for each month. This allowed for the calculation of area of optimal juvenile spotted seatrout habitat in square kilometers. The mean area of optimal juvenile spotted seatrout for the entire period of record for NSM, ECB, FWO, Alt 4R, and Alt 4R2 is shown in Figure 26. The error bars reflect the standard error for the data set. The NSM serves as the target for this analysis since it had the largest mean area of optimal juvenile spotted seatrout habitat at 368 km^2. The FWO had the lowest optimal habitat followed by ECB. Alt 4R and Alt 4R2 show improvements over FWO and ECB. Alternative 4R2 provides 28 km^2 additional optimal habitat compared to FWO, which is about a 10 percent increase. Results from a Mann-Whitney U-test indicate that Alt 4R2 had statistically significantly higher areal extent of optimal habitat for juvenile spotted seatrout (α=0.1) compared to FWO. However, there was no significant differences between Alt 4R and Alt 4R2 (α=0.1). An alternative way to examine these data is to calculate the percent increase towards the target. This calculation reveals that Alt 4R2 provides a 33 percent increase toward the target compared to FWO ([Alt 4R2 – FWO] ÷ [NSM – FWO]).

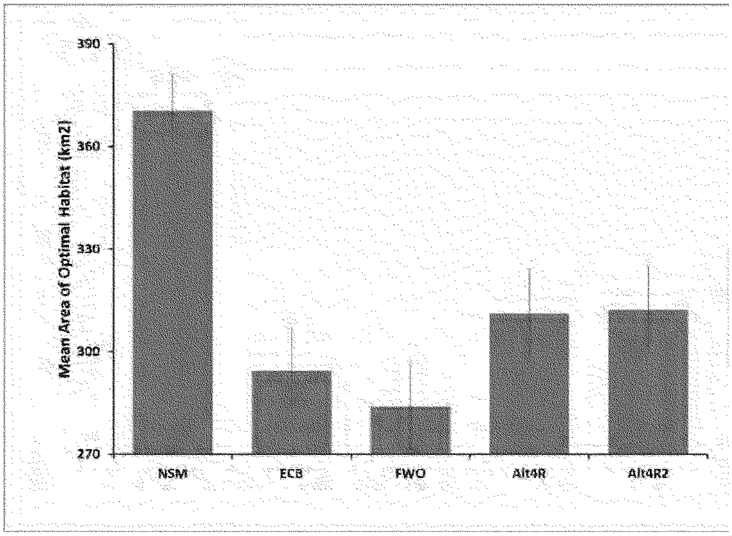

Figure 26. Histogram showing the mean optimal habitat area of the juvenile spotted seatrout HSI for NSM (target), ECB, FWO, Alt 4R, and Alt 4R2.

d. Pink shrimp

Results of the 41-year simulations of potential harvests from Whipray Basin in north central Florida Bay and Johnson Key Basin in western Florida Bay are shown in Figure 27. Results show the lift above FWO and ECB (as percent) in potential harvests for Alt 4R2 only. The equation for calculating lift as percent of FWO was as follows: 100 x (Alt_X – FWO) / FWO, where Alt_X is simulated potential harvest from a given alternative and FWO is simulated potential harvest from FWO salinity conditions. The equation for ECB substitutes ECB for FWO. Alternative 4R2 provides minimal lift in potential harvest over FWO and ECB (generally less than 0.7 percent). The lift from Alt 4R2 is greater in Whipray Basin than in Johnson Key Basin, but only by a very small amount. Also, Alt 4R2 offers greater improvement over FWO than over ECB in both basins.

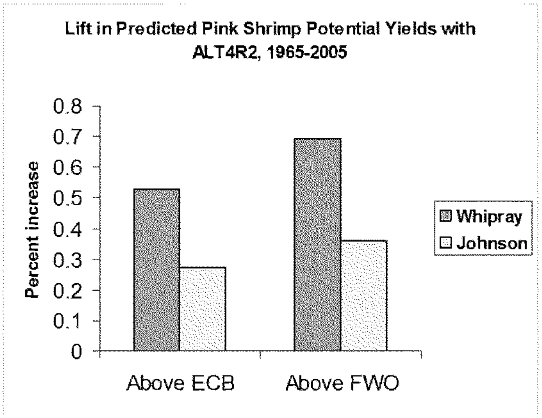

Figure 27. Histogram showing the results of the potential pink shrimp harvest in Whipray Basin for the 1965-2005 period of record based on model output. Bars show percent increase over ECB and FWO.

5. Potential Adverse and Beneficial Effects of the Project

a. General Fish and Wildlife Effects and Benefits

The effects on fish and wildlife resources in the SCS as a result of CEPP are anticipated to be mostly beneficial to Florida Bay and the southwest Florida coast through the restoration of estuarine, tidal wetland and freshwater wetland habitat types. The project should provide relatively small benefits to these nearshore estuarine areas by maintaining a lower salinity than current conditions or the FWO conditions resulting in a slightly healthier coastal estuarine community. Increased stage and flow in tidal and freshwater wetlands is anticipated to begin the restoration and enhancement of these wetland community types. Although the beneficial effects in Florida Bay and the southwest Florida coast are relatively small, they are moving in the right direction and will likely be increased as other CERP projects are constructed and implemented. However, negative impacts to fish and wildlife resources may be possible due to the quality of water that will be diverted to the wetlands and estuaries. Past activities in and around ENP have resulted in a legacy nutrient pool that remains sequestered in the soil and plant tissues. Increased water deliveries may result in the mobilization and redistribution of soil and plant tissue nutrients downstream, which could increase the frequency, spatial extent, duration and/or magnitude of algal blooms in Florida Bay and the lower southwest Florida coast.

The analysis described earlier indicates that flows to Biscayne Bay may be reduced in some areas, which could increase salinity in the bay. Such increases in salinity would have the opposite effect of what is predicted in Florida Bay and the southwest Florida coast. That is, a raised salinity regime would result in further degradation of nearshore estuarine and coastal wetland communities, which would negatively affect fish and wildlife resources.

Construction-related Effects

There are no CEPP construction features in the footprint of the SCS region; therefore, there are no construction-related effects to this area from CEPP.

Operational Effects

Upstream operations could have profound and significant effects to the SCS. CEPP modeling indicates that pump stations, some of which are part of the seepage management features, will be operated to provide additional freshwater flow to Florida Bay and the southwest Florida coast via SRS and Taylor Slough. Given appropriate water quality, these additional flows will certainly be beneficial to fish and wildlife resources in those areas. However, modeling results indicate that the pumps and seepage features reduce flows to Biscayne Bay in the central and southern regions, during both wet and dry seasons. The magnitude of these reductions could significantly impact fish and wildlife resources in these areas. The Service believes it will be critical to monitor flows at the Biscayne Bay coastal water management structures to ensure that operations associated with CEPP seepage management in the urban areas to the east of the CEPP study area will not negatively impact Biscayne Bay.

Although not in the SCS region, it should be reiterated that the operation of high-volume pumps to move water in the CEPP project area represents a potential threat to fish and other aquatic resources. Pumps can cause direct loss of fish, amphibians, invertebrates, and other aquatic life through impingement and entrainment. Also, operation of pumps associated with the project will divert water south to transitional wetlands in the SCS, which may alter this habitat over time. The significance of this impacted area on fish and wildlife, including listed species, is unclear, although it is anticipated to increase habitat value for fish and wildlife.

Water diversion operations also can cause the undesirable spread of non-native fish, such as the Asian swamp eel (*Monopterus albus*), butterfly peacock (*Cichla ocellaris*), and various cichlid species. However, many of these non-native species require relatively deep-water habitat, little of which is found in the wetlands of the project area. Due to the sensitivity of the habitat in the project study area, care should be taken in final project feature design and operation to protect against undesired spreading of non-native fish.

V. RECOMMENDATIONS/CONSERVATION MEASURES

A. Northern Estuaries

- It is imperative that all of the IRL-S components (not just C-44 reservoir/STA) and C-43 reservoir are operating when CEPP is implemented to ensure that dry season water is delivered to the CRE and SLE as obligated prior to routing the water south. The Service recommends that the Master Implementation Sequencing Plan and Integrated Delivery Schedule be updated to ensure that interdependent projects and/or project components are linked in an effort to provide restoration optimization and avoid unanticipated adverse effects.

- The Service believes that in future increments of CEPP, the Corps should explore opportunities to provide additional storage to protect the CRE, SLE, and IRL estuaries from damaging Lake Okeechobee regulatory releases. The Service recommends that the Corps start the planning process for the next increment of CEPP as soon as this Final PIR/EIS is completed. The next CEPP increment should include adequate storage of high volume lake regulatory releases that could be held and redirected south when needed.
- The Service recommends that a re-evaluation of base flow criteria for the CRE and SLE, especially in the dry season, be conducted during the development of the CEPP Operations Manual. This effort must include, but is not limited to, "lessons learned" from the Corps' Periodic Scientists conference calls for Lake Okeechobee and the Northern Estuaries as well as data from the RECOVER oyster mesocosm studies currently underway.
- The Service recommends that the Corps or the District pursue funding for oyster reef restoration in the CRE and SLE by placement of hard substrate to increase the likelihood of oyster reef expansion. The restoration target for the CRE is 400 acres of suitable oyster habitat with at least 100 acres of living oyster reefs. The restoration target for the SLE is to provide approximately 900 acres of suitable oyster habitat. Although the CEPP TSP may improve salinity conditions for oysters and associated flora and fauna, oyster expansion is directly tied to the availability of hard substrate for recruitment and colonization.

B. Lake Okeechobee

- The water regulation schedules that agencies use to decide when, where, and how much water to release from the lake is a critical component in maintaining a proper water balance throughout south Florida. The CEPP is an added feature in south Florida that will increase the amount of lake level management needed for both the existing regulation schedule and the yet to be proposed regulation schedule that is to be implemented prior to the A-2 FEB. Prudent water management under the LORS is served when agencies can coordinate with stake holders in a timely manner so that management decisions can be made quickly (within days) across the full range of water conditions affecting Lake Okeechobee and surrounding areas.
- We recommend that Lake Okeechobee stage not be kept higher than what would be expected under the existing LORS until the FEB has been in operation for at least 6 months to allow testing of the integrity and flow capacity of the water management infrastructure for the FEBs. This would help to preclude the FEB going off-line for an unknown structural reason and then having to potentially release additional "stored" water from the lake to the estuaries where it may be ecologically damaging.
- There was at least one event in the modeling which indicated a potentially significant beneficial effect of CEPP on the littoral zone of Lake Okeechobee (1987 event). We recommend that the Corps evaluate and discuss in the PIR why that year indicated a benefit when other low-stage events in the simulation did not respond similarly to Alt 4R2 (or Alt 4R). It is possible that project benefits to alleviating environmental impacts from droughts were not fully recognized. We also recommend that the Corps evaluate severe drought water years outside of the Period of Record (*e.g.*, 1954-56, 2007) to assess whether or not CEPP provides environmental benefits during those occurrences.

- The existing PM for evaluating project effects on snail kites is difficult to apply to Lake Okeechobee. The Service is committed to assist in developing reliable and sufficiently sensitive PMs to specifically analyze the effects of water levels on snail kite feeding and nesting and in the lake.

C. Everglades Agricultural Area

- The initial operating plan should specifically address when water would be discharged from Lake Okeechobee and the EAA to the FEBs. The final operating plan should also specifically address when water would be discharged from the FEBs to the STAs.
- The operating manual(s) should be consistent with project assurances.
- The Service supports the inclusion of existing agricultural canals in the FEB to serve as deep water refugia for aquatic organisms during extreme dry periods or when it is emptied for operations or maintenance.
- The Service recommends optimization of FEB design, construction, and operations in a manner that considers potential impacts to fish and wildlife and continues through the detailed design and construction phases. For example, the Corps should consider a multiple-cell design for the FEB to increase operational and management flexibility.
- Prior to final design and the formulation and implementation of a final operating plan for the FEB, the Corps should consult with the Service to determine whether initiation of consultation for listed species, is needed. As more information becomes available in the detailed design documentation and operations manual, the Service will continue its review of the potential effects of FEB components on listed species (and fish and wildlife in general).
- Although drydowns within the FEBs may concentrate and improve prey availability, the Service recommends optimizing operations to prevent or minimize drydown to land surfaces in order to minimize the potential for remobilization of nutrients and/or contaminants that could be directly ingested by, or ingested by prey of, the bald eagle or the endangered wood stork (Service 2005). If the ecological risks from nutrients and/or contaminants to listed species become evident through sampling plans and monitoring, the Corps and Service will determine if re-initiation of consultation in accordance with section 7 of the Act is necessary.
- The Service recommends that the Corps notifies the Service and FWC in the event colonial or solitary wading bird nests are observed within the FEB construction footprint.
- The Service recommends that the Corps and District cooperate with research-based efforts to provide for long-term ecological monitoring of indigo snake densities and habitats in the project area.
- The Service recommends the Corps and the District consult with the FWC regarding habitat needs and additional conservation recommendations for state-listed species.
- The Florida burrowing owl is a State-listed species of special concern and protected under the Federal Migratory Bird Treaty Act (MBTA). During a site visit in 2003, burrowing owls were observed within Compartment A of the EAA Project footprint (Service 2003) which is adjacent to FEB A-2. In accordance with MBTA, the Corps and the District must perform a

burrowing owl nest survey within the FEB footprint prior to construction. The Service further recommends the survey take place immediately prior to construction in order to ensure owls have not nested in the area between the time of the survey and construction. If the project is to be phased, surveys should be performed immediately prior to construction of the various phases. Burrowing owls could also potentially be present along canal banks and embankments.

D. Greater Everglades

- The Service believes that there was a missed opportunity for this project to help resolve the long-standing problem of restoring the historic flow path from WCA-3A through WCA-3B into NESRS. During this project the Department of Interior and National Park Service indicated their intent to render the Tamiami Trail hydrologically invisible, the most critical feature on the road to restoring the historic flow path. Additionally, throughout the planning process, we were told that WCA-3B seepage management would be a part of the project. We recommend the Corps start the planning process for the next phase of CEPP as soon as this Final PIR/EIS is approved. The next CEPP phase should include adequate WCA-3B seepage management and increased WCA-3B outflow capacity such that the historic flow path can be re-established.

- The Service recommends that the Blue Shanty Levee be constructed last and only if necessary. An adequate monitoring plan for WCA-3B resources should be implemented and the full project, minus the Blue Shanty levee, should be allowed to function for several years to assess the need for the levee.

- If the Blue Shanty Levee is constructed in WCA-3B, it should be placed on the same footprint as the existing agricultural canal as much as possible, to minimize impacts to relatively pristine wetlands. North of the existing agricultural canal the levee should jog east or west to avoid bisecting three healthy tree islands. The leading tree island researchers in the Everglades should be consulted to determine whether the tree islands should be contained within the flow way or outside of it.

- The Service recommends the Corps implement a robust endangered species monitoring plan and assesses the data in coordination with the Service and other wildlife agencies to timely modify operations for the protection of those species. This is most critical for the imperiled CSSS which stands to receive the most impact from this project. It will be imperative, as will be stated in the Service's forthcoming Preliminary Biological Opinion, that consecutive years, with either a reduction in dry nesting days or longer than recommended hydroperiods in CSSS-E, will need to be avoided. Likewise, all S-12, S-343 and S-344 seasonal closures for protection
of CSSS should be followed consistent with ERTP. Service sparrow biologists have recommended that closure dates for S-12B be modified to coincide with those for S-12A to ensure appropriate nesting conditions are consistently met in CSSS-A.

- The initial operating plan has not been thoroughly defined for this project. We have compared alternatives and selected a plan based solely on the model's general interpretation of operations. The Service recommends that the Corps define an operational plan to the extent possible and assess any changes to performance it may have.

- The Corps should immediately begin a new study to modify the WCA-2A regulation schedule. As the system is decompartmentalized and WCA-2A is no longer needed to hold large amounts of water, more attention should be paid to its ecological restoration.

E. Southern Coastal System

- Given the possible flow reduction that may occur in central and southern Biscayne Bay as a result of CEPP, the Service recommends frequent evaluation of flow data collected at the coastal water management structures in Miami-Dade County to ensure that any reductions in flow can be detected early and alleviated through operational modifications. Flow reductions, if they occur, would increase salinity in this region of Biscayne Bay which may negatively impact flora and fauna in nearshore areas, including juvenile crocodiles. This monitoring should be included in the CEPP Adaptive Management (AM) Plan.
- A robust water quality monitoring network should be established at primary discharge areas along the southwest Florida coast and Florida Bay that would be poised to detect changes in nutrient concentrations in these areas.
- The ENP Marine Monitoring Network (MMN) should be maintained at its current level of operation. This network is critical to determining if CEPP implementation will, in fact, result in ecologically-beneficial salinity changes in Florida Bay. If salinity was to increase as a result of CEPP, this could cause impacts to Federally-threatened crocodiles and other flora and fauna. ENP's MMN is our primary tool to evaluate salinity in Florida Bay.
- Current funding provided by the CERP Monitoring and Assessment Plan for juvenile spotted seatrout and SAV should be continued and expanded, if possible, to determine if predicted ecological benefits to seatrout and SAV result from salinity improvements provided under CEPP.
- Monitoring of juvenile crocodiles and pink shrimp in Florida Bay should be reinitiated to determine if predicted ecological benefits to these species are realized.
- Upstream storage components (reservoirs, STAs, private land incentive programs) should be considered in any future CERP increments to provide increased water to Florida Bay and Biscayne Bay.

VI. SUMMARY OF POSITION

A. Northern Estuaries

The Service finds that the modeling simulations of hydrology, salinity, and associated ecology of the CRE showed some reductions in high-flow discharges from Lake Okeechobee when comparing the TSP to the FWO. Although the difference was not substantial, the change is "in the right direction" for reducing high peak flow events which is a project objective. Modeling predictions of the TSP indicated a substantial decrease in high-flow events in the SLE as well as a decrease in the number of times low-flow criteria were not met. These combined flow differences should increase the amount of time that the estuary is in the preferred salinity range and may prove to be beneficial to seagrass and oyster abundance when suitable substrate is available. Since this project is only the first increment of a larger CEPP we believe that future increments should include increased storage to provide operational flexibility to further reduce high flows and increase base flows needed to achieve optimal estuarine habitat restoration. Future operations of the IRL-South and C-43 Reservoir CERP projects should also be optimized to assist in estuary restoration.

B. Lake Okeechobee

The Service also finds that the project would provide benefits south of Lake Okeechobee with an acceptable balance of risks to the ecology of Lake Okeechobee. Until all of the additional storage proposed in the CERP for the areas around Lake Okeechobee is available, the threat of damaging high and low lake stages will continue. The CEPP takes advantage of flexibility of the LORS08 by hedging slightly towards retaining water in the lake to provide flows to the south through the FEBs. The net result is a slight benefit of reducing the likelihood of lower lake stages (that could cause either minor ecological harm or more serious MFL violations). The risk is that management of Lake Okeechobee under the CEPP increases the possibility that severe storms could cause a greater magnitude of ecological damage both in the lake and from larger discharges to the estuaries. If storms like Tropical Storm Fay (August 2008, where lake levels rose about 4 feet in 30 days) will occur at even moderate lake stages instead of the low lake stage prior to the storm, the adverse effects of high water in Lake Okeechobee and regulatory releases to the estuaries would be exacerbated. However, the Service believes that, on balance, the proposed regulation of Lake Okeechobee is necessary to provide benefits to the plan, and the study has recognized the limitations of increased average water storage in the lake until additional storage, beyond that modeled in the FWO assumptions, becomes available.

C. Everglades Agricultural Area

While the Service is pleased that nearly 29,000 acres of fallow agricultural land will be converted to shallow FEB, as this will slightly enhance its value to natural resources and yield considerable water quality benefits, it is highly recommended that more land within the EAA is converted to deeper storage reservoirs which will be needed to fully restore the Everglades. Prior to final design and the formulation and implementation of a final operating plan for the FEB, the Corps should consult with the Service to determine whether initiation of consultation for listed species, is needed. As more information becomes available in the detailed design documentation and operations manual, the Service will continue its review of the potential effects of FEB components on listed species (and fish and wildlife in general).

D. Greater Everglades

CEPP modeling predicts that all of the alternatives are capable of providing the targeted 200,000 ac-ft average annual flow to the Everglades during the dry season. In fact, the operational refinement runs Alts 4R and 4R2 provided an additional 10,000 – 15,000 ac-ft. It is less clear at what frequency this target will be met, given that the project will only construct shallow storage (up to 4 feet) in the EAA and make only minor changes to the LORS. Regardless of the frequency, the project will provide additional water during the dry season and improve downstream conditions. This new water, in combination with the proposed hydropattern restoration feature and backfilling of the Miami Canal, will vastly improve the degraded ecological conditions in the northern part of WCA-3A north of Interstate 75. Less benefit will be seen in southern WCA-3A where depth and durations will be maintained at their current levels which have been identified by the Service and others as being too wet.

It should be noted here that while the operational refinement runs (Alts 4R and 4R2) performed better than the FWO overall, as did all of the other final array Alts 1 through 4, they did result in a reduction of HUs for most areas within the system. Examples of HU reductions include 7.4 percent in WCA-3A northeast, 7.8 percent in WCA-3A Miami Canal, 7.8 percent in ENP north and 30 percent in ENP south. There were slight increases in some areas, most notably WCA-3B. The Service expects that any operational flexibility employed on behalf of endangered species protection could infrequently affect the distribution of HUs as described above and we hope that the Corps and other partnering agencies would accept these changes as acceptable.

WCA-3B, NESRS and Florida Bay were disconnected from the rest of the system for decades by canals, levees and roads. The CEPP will take a critical first step in restoring this flow path and provide environmental lift. However, the Service finds that the project will not achieve the full restoration targets. CEPP is the first increment of restoration allowing for the establishment of essential monitoring for evaluation of full restoration in future phases.

E. Southern Coastal System

The Service finds the CEPP TSP provides overall hydrologic and ecologic benefits in the SCS compared to ECB and FWO. CEPP modeling simulations for the TSP predicts flow increases in major sloughs providing freshwater to Florida Bay and the southwest Florida coast. These flow increases are reflected in the salinity improvements which show noticeable lift from the TSP over FWO. Model-predicted salinity improvements from the TSP translated to a subtle lift in juvenile spotted seatrout, pink shrimp, and juvenile crocodile HSIs. Based on the hydrologic connections between SRS and the southwest coastal areas of Florida (*e.g.*, Whitewater Bay), there is high likelihood that the southwest coastal areas will experience significant ecological benefits from the TSP, probably more benefits than those predicted for Florida Bay.

CEPP model results indicate increased annual flows to the north and south-central areas of Biscayne Bay by the TSP compared to ECB. However, when evaluated on a seasonal basis, dry season flows are reduced and wet season flows are increased at the S28 and S27 coastal structures in the north region; whereas, seasonal flows are increased during both seasons in the south-central region at all structures except for S123. In the central region, simulations indicate dry season flow reductions of 2 to 10 percent from the TSP compared to ECB, with little change in wet season flows. Results also show significant reductions in flow to Manatee Bay (via the C-111) under the TSP compared to ECB. These reductions in Biscayne Bay flows, if realized by an implemented CEPP, could impact fish and wildlife resources in Biscayne National Park, the Biscayne Bay Aquatic Preserve, and reduce the effectiveness of CERP's Biscayne Bay Coastal Wetlands Project. Even though the TSP model output appears to alleviate more serious flow reductions to Biscayne Bay observed in previous CEPP alternative simulations, given the uncertainties inherent in hydrologic models, the Service believes it would be prudent to incorporate periodic evaluation of flow data at the Biscayne Bay coastal water management structures into the CEPP Adaptive Management Plan. Doing so would allow managers to modify operations, if needed, to avoid harmful reductions in flow to Biscayne Bay.

A.3 Recommendations and responses under the Fish and Wildlife Coordination Act Report

RECOMMENDATIONS/CONSERVATION MEASURES

Objectives identified by the Service in providing recommendations on this project are to protect and conserve fish and wildlife resources in the project area, while assuring that maximum ecological benefits are delivered to the CEPP Project area consistent with the basic project purpose. This includes developing recommendations to make this project more environmentally compatible and to further conserve and enhance the diversity and abundance of fish and wildlife resources in the study area.

A. Northern Estuaries

1. It is imperative that all of the IRL-S components (not just C-44 reservoir/STA) and C-43 reservoir are operating when CEPP is implemented to ensure that dry season water is delivered to the CRE and SLE as obligated prior to routing the water south. The Service recommends that the Master Implementation Sequencing Plan and Integrated Delivery Schedule be updated to ensure that interdependent projects and/or project components are linked in an effort to provide restoration optimization and avoid unanticipated adverse effects.

Response: Concur. The Corps and the SFWMD will undertake integration of the CEPP plan and the other CERP projects awaiting authorization into the CERP Programs' integrated delivery schedule through a robust public process.

2. The Service believes that in future increments of CEPP, the Corps should explore opportunities to provide additional storage to protect the CRE, SLE, and IRL estuaries from damaging Lake Okeechobee regulatory releases. The Service recommends that the Corps start the planning process for the next increment of CEPP as soon as this Final PIR/EIS is completed. The next CEPP increment should include adequate storage of high volume lake regulatory releases that could be held and redirected south when needed.

Response: Concur. This is just the first increment of CEPP. Based on public and agency feedback, there is a strong desire to have the next increment of CEPP look at additional storage.

3. The Service recommends that a re-evaluation of base flow criteria for the CRE and SLE, especially in the dry season, be conducted during the development of the CEPP Operations Manual. This effort must include, but is not limited to, "lessons learned" from the Corps' Periodic Scientists conference calls for Lake Okeechobee and the Northern Estuaries as well as data from the RECOVER oyster mesocosm studies currently underway.

Response: Noted. Up to date scientific input will be used to the extent possible when the CEPP Operations Manual is being developed and the Manual will be updated in conjunction with knowledge gained from monitoring and CEPP adaptive management.

4. The Service recommends that the Corps or the District pursue funding for oyster reef restoration in the CRE and SLE by placement of hard substrate to increase the likelihood of oyster reef expansion. The restoration target for the CRE is 400 acres of suitable oyster habitat with at least 100 acres of living oyster reefs. The restoration target for the SLE is to provide approximately 900 acres of

suitable oyster habitat. Although the CEPP TSP may improve salinity conditions for oysters and associated flora and fauna, oyster expansion is directly tied to the availability of hard substrate for recruitment and colonization.

Response: Noted. The availability of hard substrate is tied to oyster reef restoration and the opportunity to secure funding for that effort will be pursued when possible.

B. Lake Okeechobee

1. The water regulation schedules that agencies use to decide when, where, and how much water to release from the lake is a critical component in maintaining a proper water balance throughout south Florida. The CEPP is an added feature in south Florida that will increase the amount of lake level management needed for both the existing regulation schedule and the yet to be proposed regulation schedule that is to be implemented prior to the A-2 FEB. Prudent water management under the LORS is served when agencies can coordinate with stake holders in a timely manner so that management decisions can be made quickly (within days) across the full range of water conditions affecting Lake Okeechobee and surrounding areas.

Response: Noted.

2. We recommend that Lake Okeechobee stage not be kept higher than what would be expected under the existing LORS until the FEB has been in operation for at least 6 months to allow testing of the integrity and flow capacity of the water management infrastructure for the FEBs. This would help to preclude the FEB going off-line for an unknown structural reason and then having to potentially release additional "stored" water from the lake to the estuaries where it may be ecologically damaging.

Response: Noted. Independent of CEPP implementation, there is an expectation that revisions to the 2008 LORS will be needed following the implementation of other CERP projects and Herbert Hoover Dike infrastructure remediation. The USACE expects to operate under the 2008 LORS until there is a need for revisions due to the earlier of either of the following actions: (1) system-wide operating plan updates to accommodate CERP "Band 1" projects, as described in ***Section 6.1.3.2****, or (2) completion of sufficient HHD remediation for reaches 1, 2 and 3 and associated culvert improvements, as described in* ***Section 2.5.1.*** *When HHD remediation is completed and the HHD DSAC Level 1 rating is lowered, higher maximum lake stages and increased frequency and duration of high lake stages may be possible to provide the additional storage capacity assumed with the CEPP TSP . The future Lake Okeechobee Regulation Schedule which may be developed in response to actions (1) and/or (2) is unknown at this time. It is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of CEPP. Therefore, the CEPP PIR will not be the mechanism to propose or conduct the required NEPA evaluation of modifications to the Lake Okeechobee Regulation Schedule. However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements.*

3. There was at least one event in the modeling which indicated a potentially significant beneficial effect of CEPP on the littoral zone of Lake Okeechobee (1987 event). We recommend that the Corps evaluate and discuss in the PIR why that year indicated a benefit when other low-stage events in the

simulation did not respond similarly to Alt 4R2 (or Alt 4R). It is possible that project benefits to alleviating environmental impacts from droughts were not fully recognized. We also recommend that the Corps evaluate severe drought water years outside of the Period of Record (*e.g.*, 1954-56, 2007) to assess whether or not CEPP provides environmental benefits during those occurrences.

Response: The CEPP ecological benefit evaluation did not calculate habitat units for Lake Okeechobee, since the performance of this area was considered a constraint during formulation. The Final CEPP PIR/EIS, including the POM, will not be the mechanism to propose or conduct the required National Environmental Policy Act (NEPA) evaluation of modifications to the Lake Okeechobee Regulation Schedule. Revisions to the 2008 LORS would be conducted through a separate effort, and it is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of CEPP. However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements. The CEPP TSP includes a placeholder set of Lake Okeechobee Regulation Schedule modifications that represent reasonable and likely implementable future operating conditions under CEPP. The CEPP PIR does not claim ecological benefits within Lake Okeechobee, given the uncertainty of these future actions outside of CEPP.

During CEPP screening above the red line, Lake Okeechobee model output from the LOOPS model was evaluated using four RECOVER performance measures and assigned weighting factors: standard score above 17 feet NGVD (50%), standard score below 10 feet NGVD (25%), standard score above stage envelope (15%), and standard score below stage envelope (10%). It was decided to assign relative weights to each of the four performance measures, which themselves are all normalized to a scale of 0 to 100%, and then to combine the weighted scores to obtain a Lake Okeechobee total value for each screening alternative. The CEPP assignment of weighting factors was based on nearly 20 years of Lake Okeechobee data which generally indicate that the most significant factor affecting Lake ecological health are stages above 17 feet NGVD which tend to have devastating and cascading effects on lake vegetation and their associated faunal communities. Following stages over 17 feet NGVD, the most important ecological factors in descending order are then considered to be stages under10 feet NGVD which dry out the entire littoral zone, and deviations above and below the stage envelope which, though ecologically sub-optimal do not necessarily mediate against a viable vegetation community although the relative ratio and distribution of terrestrial, emergent wetland, and submerged vegetation may vary over a wide geographic range.

Future USACE efforts to revise the Lake Okeechobee Regulation Schedule may establish different weighting methods for the Lake Okeechobee ecological performance measures, different criteria for evaluating discharges to the Northern Estuaries, and/or may need to consider new or modified constraints. The resulting formulation outcome may not mirror the speculated revisions of the CEPP TSP. Recommendations for Lake Okeechobee drought benefits evaluations may be considered by the USACE during these efforts, outside of CEPP.

4. The existing PM for evaluating project effects on snail kites is difficult to apply to Lake Okeechobee. The Service is committed to assist in developing reliable and sufficiently sensitive PMs to specifically analyze the effects of water levels on snail kite feeding and nesting and in the lake.

Response: The USACE has determined that the project may affect the Everglades snail kite and its critical habitat. The USACE encourages the incorporation of updated science, new information, and improved hydrologic modeling tools to further develop performance measures to evaluate potential effects to federally listed species.

C. Everglades Agricultural Area

1. The initial operating plan should specifically address when water would be discharged from Lake Okeechobee and the EAA to the FEBs. The final operating plan should also specifically address when water would be discharged from the FEBs to the STAs.

Response: Noted. Based on the hydrologic modeling conducted for the CEPP TSP, preliminary operational guidance included in the DPOM (Annex C) provides a template for the operational information that will be included in Final Operating Plan, including the Lake Okeechobee stage ranges in which a basic decision was made as to when to deliver water from the lake to either the STAs and/or the combined CEPP FEB and FEB operational constraints. Further Water Management operational guidance for Lake Okeechobee and the FEB will be developed during the PED phase for PPA New Water components. It is anticipated that changes to 2008 LORS would be needed in order to achieve the complete ecological benefits envisioned through implementation of CEPP and to address the minor to moderate adverse effects indicated with the CEPP future without project condition. These changes are part of the final operational assumptions within the CEPP modeling. The CEPP PIR, including the POM, will not be the mechanism to propose or conduct the required National Environmental Policy Act (NEPA) evaluation of modifications to the Lake Okeechobee Regulation Schedule. Revisions to the 2008 LORS would be conducted through a separate effort, and it is anticipated that the need for modifications to the 2008 LORS will be initially triggered by non-CEPP actions and that these actions will occur earlier than implementation of CEPP. However, depending on the ultimate outcome of these future Lake Okeechobee Regulation Schedule revisions, including the level of inherent operational flexibility provided with these revisions, CEPP implementation may still require further Lake Okeechobee Regulation Schedule revisions to optimize system-wide performance and ensure compliance with Savings Clause requirements.

2. The operating manual(s) should be consistent with project assurances.

Response: Concur. The Programmatic Regulations [Section 385.28(a)(6)(vi)] for CERP require that the operating manual be consistent with the reservation or allacation of water for the natural system made by the State (in accordance with section 601 of WRDA 2000). The operating criteria within the CEPP DPOM (Annex C) are consistent with the operating criteria used to identify the water available for the natural system during wet, average, and dry periods as described in the Project Assurances section of the PIR. The operating criteria contained in this DPOM will be in accordance with section 601 of WRDA 2000. The operating criteria may be further refined during detailed design and captured in the Preliminary POM phase. These refinements would also need to be consistent with any reservation or allacation of water for the natural system.

3. The Service supports the inclusion of existing agricultural canals in the FEB to serve as deep water refugia for aquatic organisms during extreme dry periods or when it is emptied for operations or maintenance.

Response: Noted. Specific details regarding the backfilling of existing agricultural canals within the footprint of the A-2 FEB will be determined during the PED phase of the project.

4. The Service recommends optimization of FEB design, construction, and operations in a manner that considers potential impacts to fish and wildlife and continues through the detailed design and construction phases. For example, the Corps should consider a multiple- cell design for the FEB to increase operational and management flexibility.

Response: Noted. A multiple-cell design is not currently planned within the footprint of the A-2 FEB. Specific details regarding the design of the A-2 FEB will be determined during the PED phase of the project. During the CEPP screening discussions, the FEB was deemed more flexible and adaptable than STAs due in part to the lack of internal cells and structures. This was part of the "adaptability" screening of management measures discussed in Section 3.

5. Prior to final design and the formulation and implementation of a final operating plan for the FEB, the Corps should consult with the Service to determine whether initiation of consultation for listed species, is needed. As more information becomes available in the detailed design documentation and operations manual, the Service will continue its review of the potential effects of FEB components on listed species (and fish and wildlife in general).

Response: Concur. The USACE recognizes the need for re-initiation of consultation if modifications to the project are made and/or additional information involving potential effects to listed species becomes available. NEPA documentation and Section 7 ESA consultation will be updated if applicable, as revisions are made to Water Control Plans and/or Project Operating Manuals associated with the project. The USACE commits to maintaining ongoing communications with the FWS in the event of project modifications.

6. Although drydowns within the FEBs may concentrate and improve prey availability, the Service recommends optimizing operations to prevent or minimize drydown to land surfaces in order to minimize the potential for remobilization of nutrients and/or contaminants that could be directly ingested by, or ingested by prey of, the bald eagle or the endangered wood stork (Service 2005). If the ecological risks from nutrients and/or contaminants to listed species become evident through sampling plans and monitoring, the Corps and Service will determine if re-initiation of consultation in accordance with section 7 of the Act is necessary.

*Response: The A-2 FEB will be operated in conjunction with the A-1 FEB and STAs. As additional design details are developed during the PED phase, the operational criteria for the A-2 FEB, including the integrated relationship with the A-1 FEB operations, will become more refined. Refinements will also include lessons learned from the A-1 FEB, as described in the CEPP Adaptive Management Plan (**Annex D Part 1**). Based on the results of the initial optimization for the CEPP hydrologic modeling, no supplemental water supply will be provided to the FEB to prevent dryout. See **Annex C (Draft Project Operating Manual) Section 7.1.2 (FEB Operations)**. The USACE recognizes the need for re-initiation of consultation if modifications to the project are made and/or additional information involving potential effects to listed species becomes available.*

7. The Service recommends that the Corps notifies the Service and FWC in the event colonial or solitary wading bird nests are observed within the FEB construction footprint.

Response: Noted. Standard construction conservation measures will be included in the plans and specifications to minimize impacts to migratory bird species. Monitoring for migratory birds and the creation of a buffer zone around active nests or nestling activity will be required by the construction contractor during the nesting season.

8. The Service recommends that the Corps and District cooperate with research-based efforts to provide for long-term ecological monitoring of indigo snake densities and habitats in the project area.

Response: Noted.

9. The Service recommends the Corps and the District consult with the FWC regarding habitat needs and additional conservation recommendations for state-listed species.

Response: Coordination with resource agencies, including the FWC, has been ongoing throughout the planning process of this project. Additionally, the FWC provided formal comments on the draft PIR/EIS during the public and agency review period.

10. The Florida burrowing owl is a State-listed species of special concern and protected under the Federal Migratory Bird Treaty Act (MBTA). During a site visit in 2003, burrowing owls were observed within Compartment A of the EAA Project footprint (Service 2003) which is adjacent to FEB A-2. In accordance with MBTA, the Corps and the District must perform a burrowing owl nest survey within the FEB footprint prior to construction. The Service further recommends the survey take place immediately prior to construction in order to ensure owls have not nested in the area between the time of the survey and construction. If the project is to be phased, surveys should be performed immediately prior to construction of the various phases. Burrowing owls could also potentially be present along canal banks and embankments.

Response: Concur. A pre-construction survey and nest inventory will be included in the construction contract. If either are present, the Corps will coordinate with the FWS on implementing a protection plan prior to construction.

D. Greater Everglades

1. The Service believes that there was a missed opportunity for this project to help resolve the long-standing problem of restoring the historic flow path from WCA-3A through WCA-3B into NESRS. During this project the Department of Interior and National Park Service indicated their intent to render the Tamiami Trail hydrologically invisible, the most critical feature on the road to restoring the historic flow path. Additionally, throughout the planning process, we were told that WCA-3B seepage management would be a part of the project. We recommend the Corps start the planning process for the next phase of CEPP as soon as this Final PIR/EIS is approved. The next CEPP phase should include adequate WCA-3B seepage management and increased WCA-3B outflow capacity such that the historic flow path can be re-established.

Response: Concur. The CEPP is composed of increments of project components that were identified in CERP. The term "increment" is used to underscore that the study formulated portions (scales) of individual CERP components. The USACE acknowledges that additional actions are needed to achieve the restoration envisioned in CERP.

2. The Service recommends that the Blue Shanty Levee be constructed last and only if necessary. An adequate monitoring plan for WCA-3B resources should be implemented and the full project, minus the Blue Shanty levee, should be allowed to function for several years to assess the need for the levee.

*Response: Noted. WRDA 2000 requires (Savings Clause) that CERP does not reduce the level of service for flood protection as of 2000 and in accordance with applicable law. The function and integrity of the C&SF flood protection system provided by the L-67 A and L-67 C levee system must be maintained following CEPP implementation, and CEPP degradation of portions of the L-67 C and L-29 levees must be offset with additional infrastructure and operational constraints that maintain the pre-project level of flood protection and account for any potential increased design risk. The details of additional infrastructure, and how it would interface with operations and existing infrastructure, will be determined in the future as adaptive management, PED, and as other information becomes available for this area. Consideration of a new L-67 D levee (currently included as a component of the CEPP recommended plan), including its footprint (width/height), costs, and permanency, will be cautiously considered and subject to applicable policies and permitting. Please see the CEPP Adaptive Management Plan (**Annex A Part 1 Section 1.4.2.8 WCA 3B Structures and Blue Shanty Flowway**) for a description of information that will be gathered to inform future decisions about implementation of this component of CEPP.*

3. If the Blue Shanty Levee is constructed in WCA-3B, it should be placed on the same footprint as the existing agricultural canal as much as possible, to minimize impacts to relatively pristine wetlands. North of the existing agricultural canal the levee should jog east or west to avoid bisecting three healthy tree islands. The leading tree island researchers in the Everglades should be consulted to determine whether the tree islands should be contained within the flow way or outside of it.

Response: The initial location for the new L-67D was aligned along the existing Blue Shanty canal since that area is an existing alteration in the landscape. The northern end of the proposed levee was angled slightly westward to avoid impacting several large tree islands that exist north of the terminus of the Blue Shanty Canal. Although the initial location of the new levee generally along the Blue Shanty canal minimized impacts to unexcavated wetlands, it created other concerns: 1) it was directly in the center of the western 2.6 mile Tamiami Trail Next Steps bridge and would fail to fully take advantage of the new bridge span opening, and 2) excluding the tree islands would result in a levee alignment that intercepts the desired southerly flow path dictated by landscape patterning in the area. The proposed alignment of the new L-67D is identified in Section 6.10.2.2 (Blue Shanty Levee) of the Final PIR/EIS. Consideration of a new L-67 D levee (currently included as a component of the CEPP recommended plan), including its footprint (width/height), costs, and permanency, will be cautiously considered.

4. The Service recommends the Corps implement a robust endangered species monitoring plan and assesses the data in coordination with the Service and other wildlife agencies to timely modify operations for the protection of those species. This is most critical for the imperiled CSSS which stands to receive the most impact from this project. It will be imperative, as will be stated in the Service's forthcoming Programmatic Biological Opinion, that consecutive years, with either a reduction in dry nesting days or longer than recommended hydroperiods in CSSS-E, will need to be avoided. Likewise, all S-12, S-343 and S-344 seasonal closures for protection of CSSS should be followed consistent with ERTP. Service sparrow biologists have recommended that closure dates for S-12B be modified to coincide with those for S-12A to ensure appropriate nesting conditions are consistently met in CSSS-A.

Response: Noted. The Programmatic BO does not provide incidental take of potentially affected species, but does provide preliminary terms and conditions to support species management and recovery in *anticipation of incidental take associated with future project implementation and subsequent consultations under the Endangered Species Act. FWS provided preliminary terms and conditions including monitoring and restoration projects to support species recovery. Terms and conditions within a Programmatic BO are considered to be preliminary and are not mandated until a Final BO is issued. Once more details regarding project scope, implementation schedule, interdependent projects, and operational plans are provided, FWS will coordinate with the Corps to determine the proper path for completion of consultation. Completion of consultation will involve finalization of terms and conditions in conjunction with authorization of incidental take as appropriate.*

5. The initial operating plan has not been thoroughly defined for this project. We have compared alternatives and selected a plan based solely on the model's general interpretation of operations. The Service recommends that the Corps define an operational plan to the extent possible and assess any changes to performance it may have.

Response: Noted. Further Water Management operational guidance will be developed during the PED phase.

6. The Corps should immediately begin a new study to modify the WCA-2A regulation schedule. As the system is decompartmentalized and WCA-2A is no longer needed to hold large amounts of water, more attention should be paid to its ecological restoration.

Response: The Corps of Engineers can start a process towards revision of a regulation schedule if requested or if the Corps of Engineers deems it appropriate at any time. If a change to a regulation schedule is requested, the requesting agency should provide the Corps of Engineers with appropriate justification containing any new information ascertained which would deem the current regulation schedule no longer the most preferred option, the goals and objectives which would be strived for, and any constraints which were considered necessary by the requesting agency. Having such information the Corps of Engineers could then choose to move forward with a change to the regulation schedule and as a result the corresponding Water Control Plan.

Absent any specific planning study, this effort would need to be funded from the Corps of Engineers' Operations and Maintenance budget. The revision to the regulation schedule and Water Control Plan a scope and schedule would need to be determined in order to ensure there was appropriate funding for the effort. In regards to the WCA-2A Interim Regulation Schedule, appropriate means of funding would have to be budgeted into the Operations and Maintenance budget for the appropriate fiscal years to come. This specific effort is envisioned to be a somewhat complex one due to the already existing expectation that there will likely need to be cultural resource surveys in WCA-2A eventually likely leading to a Programmatic Agreement.

In addition, it is premature to suggest that the system is decompartmentalized as a result of CEPP and that WCA-2A is no longer needed to hold large amounts of water.

E. Southern Coastal System

1. Given the possible flow reduction that may occur in central and southern Biscayne Bay as a result of CEPP, the Service recommends frequent evaluation of flow data collected at the coastal water management structures in Miami-Dade County to ensure that any reductions in flow can be detected early and alleviated through operational modifications. Flow reductions, if they occur, would increase

salinity in this region of Biscayne Bay which may negatively impact flora and fauna in nearshore areas, including juvenile crocodiles. This monitoring should be included in the CEPP Adaptive Management (AM) Plan.

*Response: Noted. The CEPP Adaptive Management Plan (**Annex D Part 1 Section 1.4.3 Southern Coastal Systems Strategies and Management Options**) describes monitoring that will take place to assure that CEPP will remain within its legal constraints regarding water deliveries to Biscayne Bay. As with all of the monitoring described in the AM Plan, monitoring in this area will require networking with local monitoring efforts and other CERP monitoring programs.*

2. A robust water quality monitoring network should be established at primary discharge areas along the southwest Florida coast and Florida Bay that would be poised to detect changes in nutrient concentrations in these areas.

*Response: Noted. While the CEPP water quality monitoring plan focuses mostly on permit-required monitoring at outflow structures, the CEPP Adaptive Management Plan contains a section on potential nutrient changes within the Everglades (**Annex D Part 1 Section 1.4.3.1 Avoiding Legacy Nutrients in Everglades Soils**). Incorporating the suggestion into this part of the monitoring program would only be undertaken if the results could be used directly to adjust and improve CEPP and CERP. The Adaptive Management Plan will be refined once CEPP is authorized and closer to implementation, at which time this suggestion will be discussed in light of the criteria in Section 1.2 of the Adaptive Management Plan.*

3. The ENP Marine Monitoring Network (MMN) should be maintained at its current level of operation. This network is critical to determining if CEPP implementation will, in fact, result in ecologically-beneficial salinity changes in Florida Bay. If salinity was to increase as a result of CEPP, this could cause impacts to Federally-threatened crocodiles and other flora and fauna. ENP's MMN is our primary tool to evaluate salinity in Florida Bay.

*Response: Noted. The CEPP Adaptive Management Plan (**Annex D Part 1 Section 1.4.3 Southern Coastal Systems Strategies and Management Options**) describes monitoring that will take place in the Southern Coastal Systems. As with all of the monitoring described in the AM Plan, monitoring in this area will require networking with local monitoring efforts and other agency monitoring programs. The networks that will be relied upon should highlight whenever possible their role of informing CEPP; likewise many of these programs have been named in the AM Plan. The ENP MMN has been named in the AM Plan.*

4. Current funding provided by the CERP Monitoring and Assessment Plan for juvenile spotted seatrout and SAV should be continued and expanded, if possible, to determine if predicted ecological benefits to seatrout and SAV result from salinity improvements provided under CEPP.

Response: The CEPP Adaptive Management Plan (Annex D) identifies estuarine submerged aquatic vegetation, and juvenile seatrout as attributes to be monitored to address uncertainties (CEPP Uncertainty #62 and #65) related to the ecological effects of CEPP hydrology within the Southern Coastal Systems. See Section 1.4.3 (Southern Coastal Systems Strategies and Management Options) of Annex D.

5. Monitoring of juvenile crocodiles and pink shrimp in Florida Bay should be reinitiated to determine if predicted ecological benefits to these species are realized.

Response: The CEPP Adaptive Management Plan (Annex D) identifies juvenile crocodiles, juvenile pink shrimp, and associated estuarine epifauna as attributes to be monitored to address uncertainties (CEPP Uncertainty #62 and #65) related to the ecological effects of CEPP hydrology within the Southern Coastal Systems. Please see Section 1.4.3 (Southern Coastal Systems Strategies and Management Options) of Annex D.

6. Upstream storage components (reservoirs, STAs, private land incentive programs) should be considered in any future CERP increments to provide increased water to Florida Bay and Biscayne Bay.

Response: Concur. The CEPP is composed of increments of project components that were identified in CERP. The term "increment" is used to underscore that the study formulated portions (scales) of individual CERP components. The USACE acknowledges that additional actions are needed to achieve the restoration envisioned in CERP.

A.4 Listing of Threatened and Endangered Species

The list of federally threatened and endangered species within the CEPP study area was received from U.S. Fish and Wildlife Service (FWS) on May 10, 2013. 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

May 10, 2013

Eric Summa
Chief, Environmental Branch
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232

Service Consultation Number: 2012-F-0290
Applicant: U.S. Army Corps of Engineers
Date Received: January 21, 2012
Project: Central Everglades Planning Project
Counties: Multiple

Dear Mr. Summa:

The U.S. Fish and Wildlife Service (Service) has reviewed your letter dated January 21, 2012, requesting confirmation of federally-listed species or their designated critical habitat and candidate species for listing that may be present within the study area for the Central Everglades Planning Project (CEPP). The species list is a National Environmental Policy Act (42 U.S. Code (USC) § 4321) requirement for the environmental analysis. This species list is also provided in accordance with the Endangered Species Act of 1973, as amended (Act) (87 stat. 884; 16 U.S.C. 1531 *et seq*. The project area includes portions of Broward, Collier, Glades, Hendry, Highlands, Lee, Martin, Miami-Dade, Monroe, Okeechobee, and Palm Beach Counties, Florida.

The Service has reviewed our Geographic Information System (GIS) database and other information for recorded locations of federally listed threatened and endangered species and critical habitats on or adjacent to the project site. The GIS database is a compilation of data received from several sources. CEPP occurs mainly in wetland habitats in the planning area, however, effects of the proposed project could reach into adjacent habitats as well. State-listed species and those proposed for Federal listing are included due to the projected life of the proposed project. The following table is a list of species with both Federal and State status that should be considered in the planning process for CEPP.

Table 1. List of federally Threatened and Endangered Species within the CEPP study area (E: Endangered, T: Threatened, C: Candidate, SC: Species of Special Concern, Pr E: Proposed Endangered, SA: Similarity of Appearance, CH: Critical Habitat).

Common Name	Scientific Name	Status	Agency	Location[1]
Mammals				
Big Cypress fox squirrel	*Sciurus niger avicennia*	T	State	4
Everglades mink	*Mustela vison evergladensis*	T	State	4,5
Florida bonneted bat	*Eumops floridanus*	Pr E	Federal	1,2,3,5
Florida manatee	*Trichechus manatus latirostris*	E, CH	Federal	6
Florida mastiff bat	*Eumops glaucinus floridanus*	E	State	5
Florida mouse	*Podomys floridanus*	SC	State	1,2,3
Florida panther	*Puma concolor coryi*	E	Federal	6
Shermans fox squirrel	*Sciurus niger shermani*	SC	State	1,2
Birds				
American oystercatcher	*Haematopus palliatus*	SC	State	1,5
Black skimmer	*Rynchops niger*	SC	State	1,2,5
Brown pelican	*Pelecanus occidentalis*	SC	State	6
Burrowing owl	*Athene cunicularia*	SC	State	1,2,3
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	Federal	4,5
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	Federal	6
Florida sandhill crane	*Grus canadensis pratensis*	T	State	6
Least tern	*Sterna antillarum*	T	State	1,2,5
Limpkin	*Aramus guarauna*	SC	State	6
Little blue heron	*Egretta caerulea*	SC	State	6
Northern crested caracara	*Caracara cheriway*	T	Federal	1,2,3
Piping plover	*Charadrius melodus*	T	Federal	1,5
Red-cockaded woodpecker	*Picoides borealis*	E	Federal	1
Reddish egret	*Egretta rufescens*	SC	State	2,6
Roseate spoonbill	*Platalea ajaja*	SC	State	6
Roseate tern	*Sterna dougallii dougallii*	T	Federal	1,5
Snowy egret	*Egretta thula*	SC	State	6
Snowy plover	*Charadrius alexandrinus*	T	State	1,2,5
Tricolored heron	*Egretta tricolor*	SC	State	6
White ibis	*Eudocimus albus*	SC	State	6
White-crowned pigeon	*Columba leucocephalus*	T	State	4,5
Wood stork	*Mycteria americana*	E	Federal	6
Reptiles				
American alligator	*Alligator mississippiensis*	T/SA	Federal	6
American crocodile	*Crocodylus acutus*	T, CH	Federal	4,5
Eastern indigo snake	*Drymarchon corais couperi*	T	Federal	6

[1] Numbers indicate the locations within the project area where a species in the table is found. 1 represents the Northern Estuaries, 2 represents Lake Okeechobee, 3 represents the Everglades Agricultural Area, 4 represents the Greater Everglades, 5 represents the Southern Coastal Systems, and 6 is used to represent all locations considered in CEPP.

Florida pine snake	*Pituophis melanoleucus mugitus*	SC	State	2
Gopher tortoise	*Gopherus polyphemus*	SC	State	1,2,3,5
Green sea turtle[2]	*Chelonia mydas*	E, CH[2]	Federal	1,5
Hawksbill sea turtle[2]	*Eretmochelys imbricata*	E, CH[3]	Federal	1,5
Kemp's Ridley sea turtle[2]	*Lepidochelys kempii*	E	Federal	1,5
Leatherback sea turtle[2]	*Dermochelys coriacea*	E, CH[3]	Federal	1,5
Loggerhead sea turtle[2]	*Caretta caretta*	T	Federal	1,5
Miami black-headed snake	*Tantilla oolitica*	T	State	5
Fish				
Mangrove gambusia	*Gambusia rhizophorae*	SC	State	5
Mangrove rivulus	*Rivulus marmoratus*	SC	State	1,5
Opossum pipefish[2]	*Microphis brachyurus lineatus*	SC	Federal	1
Smalltooth sawfish[2]	*Pristis pectinata*	E, CH	Federal	1,5
Invertebrates				
Bartram's hairstreak butterfly	*Strymon acis bartrami*	C	Federal	5
Elkhorn coral[2]	*Acropora palmata*	T, CH	Federal	5
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C	Federal	5
Florida tree snail	*Liguus fasciatus*	SC	State	1,5
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E	Federal	5
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	Federal	5
Staghorn coral[2]	*Acropora cervicornis*	T, CH	Federal	5
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T	Federal	4,5
Plants				
Beach jacquemontia	*Jacquemontia reclinata*	E	Fed	5
Cape Sable thoroughwort	*Chromolaena frustrata*	Pr E, Pr CH		5
Crenulate lead plant	*Amorpha crenulata*	E	Federal	5
Deltoid spurge	*Chamaesyce deltoidea* spp. *deltoidea*	E	Federal	5
Eatons spikemoss	*Selaginella eatonii*	E	State	5
Garber's spurge	*Chamaesyce garberi*	T	Federal	5
Johnson's seagrass[2]	*Halophila johnsonii*	E, CH	Federal	1,5
Lattace vein fern	*Thelypteris reticulate*	E	State	1,4
Mexican vanilla	*Vanilla mexicana*	E	State	1,5
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeenis*	E	Federal	2
Pine-pink orchid	*Bletia purpurea*	T	State	6
Small's milkpea	*Galactia smallii*	E	Federal	5
Tiny polygala	*Polygala smallii*	E	Federal	5
Tropical fern	*Schizaea pennula*	E	State	1,4,3,5
Wright's flowering fern	*Anemia wrightii*	E	State	4,5

[2] Indicates Critical Habitat for the designated species is not within the action study area (in status column).

The complete species list provided in the table above and the accompanying designated critical habitat maps (Figures 1-4) concludes the statutory requirements set forth in 50 CFR §402.12(d) of the Act. Please be aware that verification of current accuracy of the species list is for a time period not to exceed 90 days as stated in 50 CFR §402.12(e) of the Act. If the Corps does not begin preparation of the biological assessment within 90 days of receipt of (or concurrence with) the species list, then they must verify (formally or informally) with the Service the current accuracy of the species list at the time the preparation of the biological assessment is begun. Further, the Corps shall complete the biological assessment within 180 days after its initiation (receipt of or concurrence with the species list) consistent with 50 CFR §402.12(i) of the Act.

For your convenience, we are also providing updated maps for known wood stork (*Mycteria americana*) and Everglades snail kite (*Rostrhamus sociabilis*) nests, Florida panther (*Puma concolor coryi*) telemetry locations, and bald eagle (*Haliaeetus leucocephalus*) and Audubon's crested caracara (*Polyborus plancus audubonii*) nests in the CEPP study area.

Thank you for your cooperation in the effort to conserve fish and wildlife resources. If you have additional questions concerning the incidental take permit process and the options available to you, please contact Kevin Palmer at 772-469-4280.

Sincerely yours,

Donald R. Progulske
For Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc:
Corps, Jacksonville, Florida (Stacie Auvenshine, Gina Ralph)
ENP, Homestead, Florida (Dan Kimball)
DEP, West Palm Beach, Florida (Inger Hansen)
District, West Palm Beach, Florida (Tom Teets)
FWC, West Palm Beach, Florida (Barron Moody)
Miccosukee Tribe, Miami, Florida (James Erskine)
Miami-Dade County DERM, Miami, Florida (Marcia Levinson)
NOAA Fisheries, Miami, Florida (Joan Browder)
Service, Atlanta, Georgia (David Horning)
Service, Jacksonville, Florida (Miles Meyer)

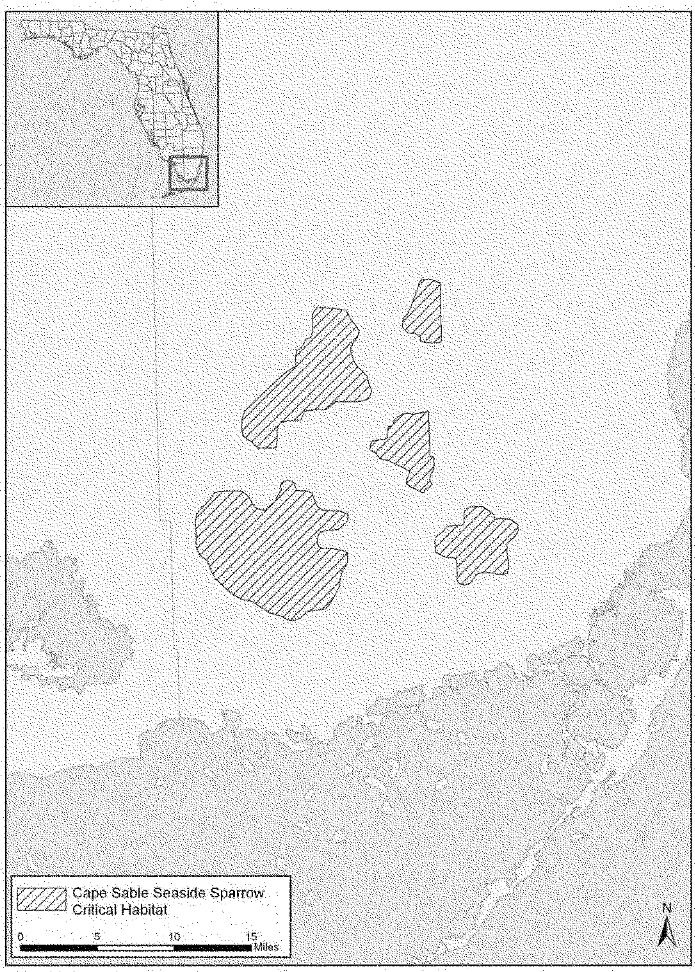

Figure 1: Cape Sable Seaside Sparrow *(Ammodramus maritimus mirabilis)* Designated Critical Habitat.

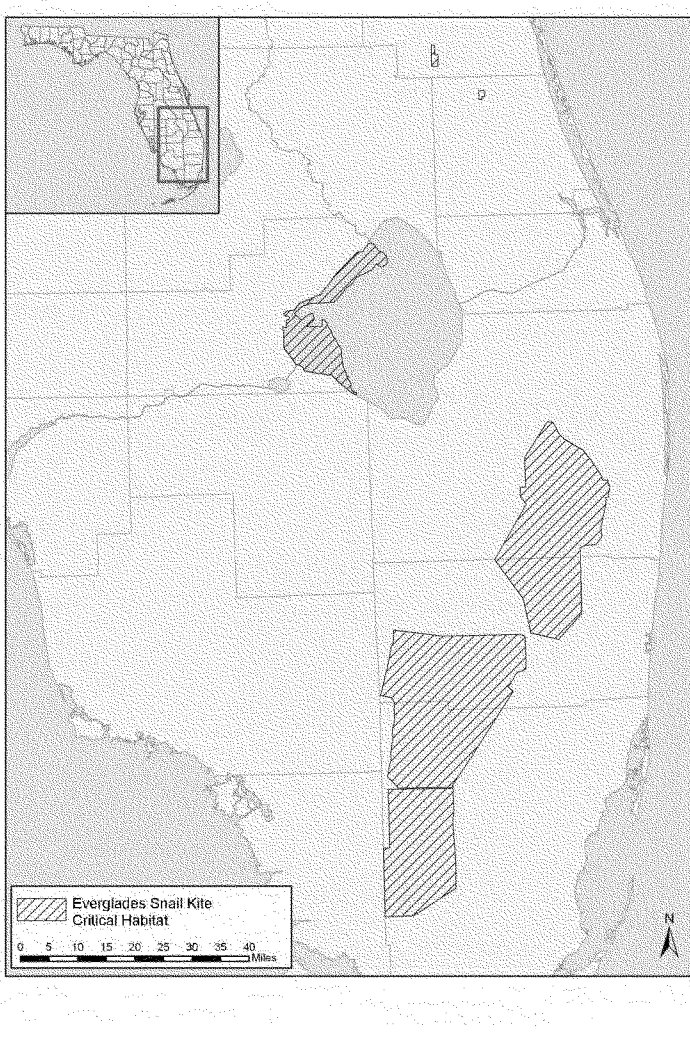

Figure 2: Everglade Snail Kite Designated Critical Habitat.

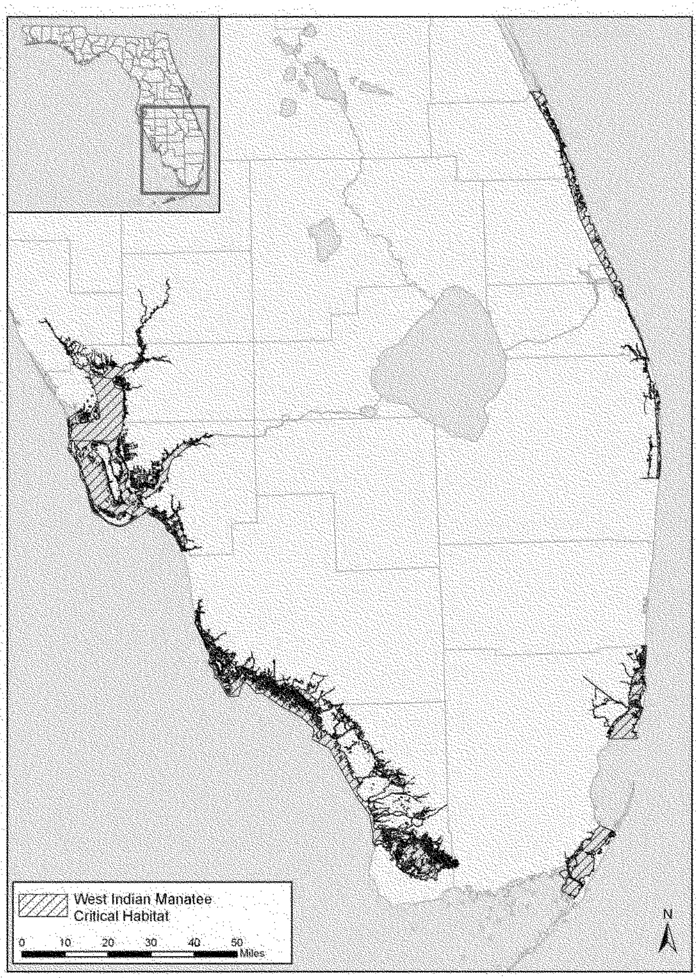

Figure 3: West Indian Manatee (*Trichechus manatus*) Designated Critical Habitat.

Figure 4: American Crocodile (*Crocodylus acutus*) Designated Critical Habitat.

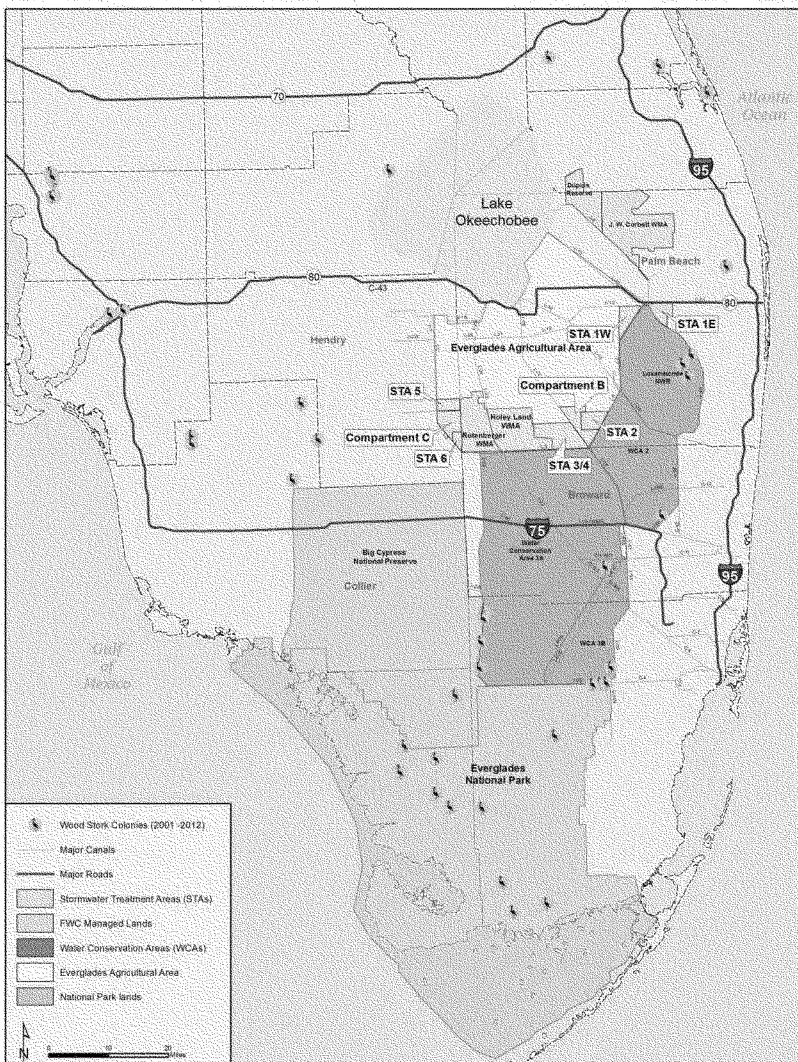

Figure 5. Known wood stork colony locations from 2001 to 2012.

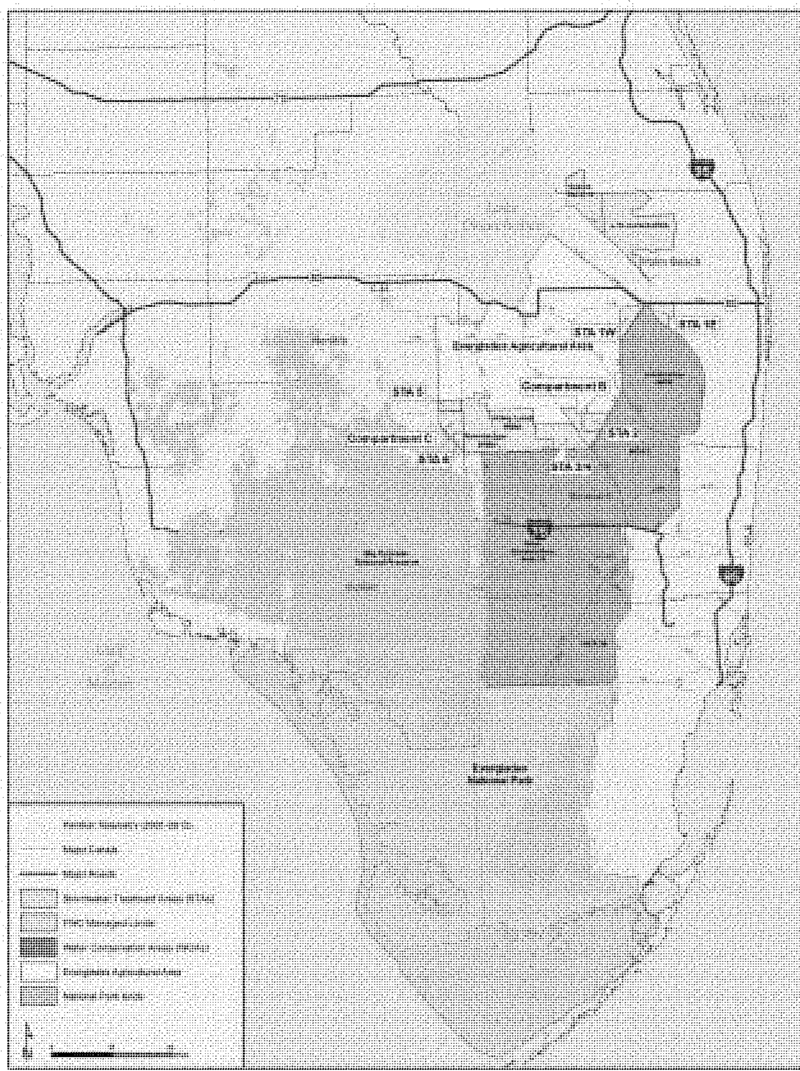

Figure 6. Florida panther telemetry locations between 2001 and 2012.

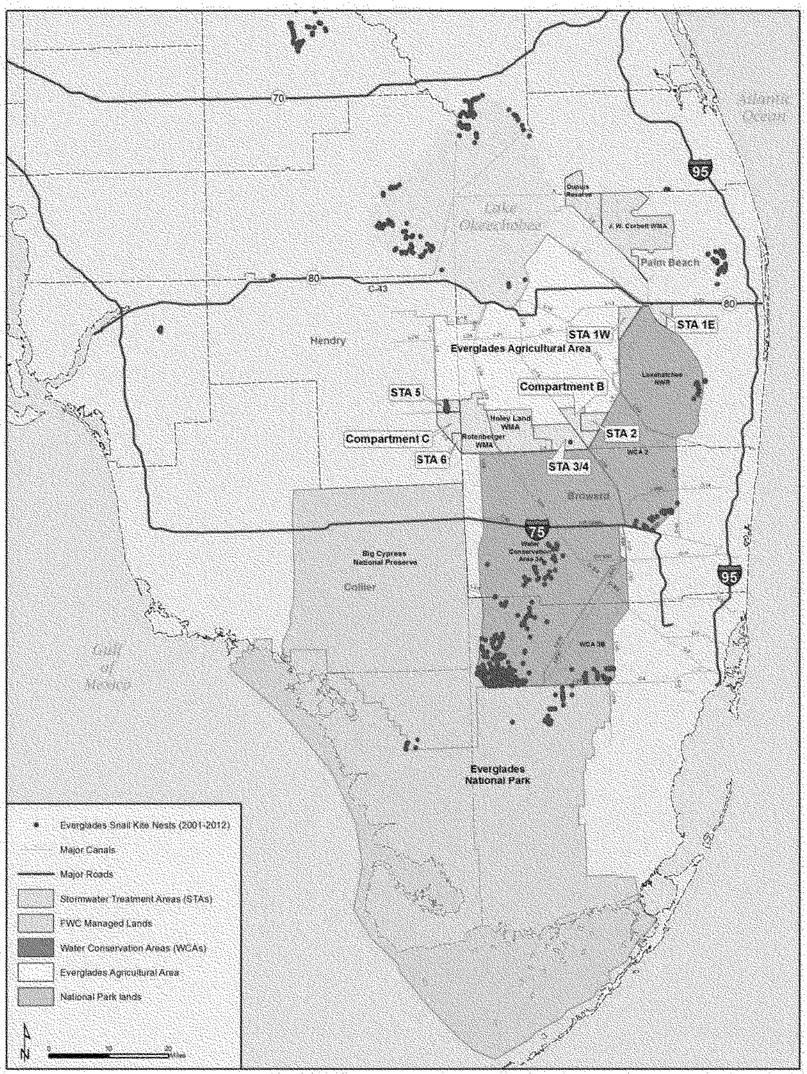

Figure 7. Known Everglade snail kite nest locations between 2001 and 2012.

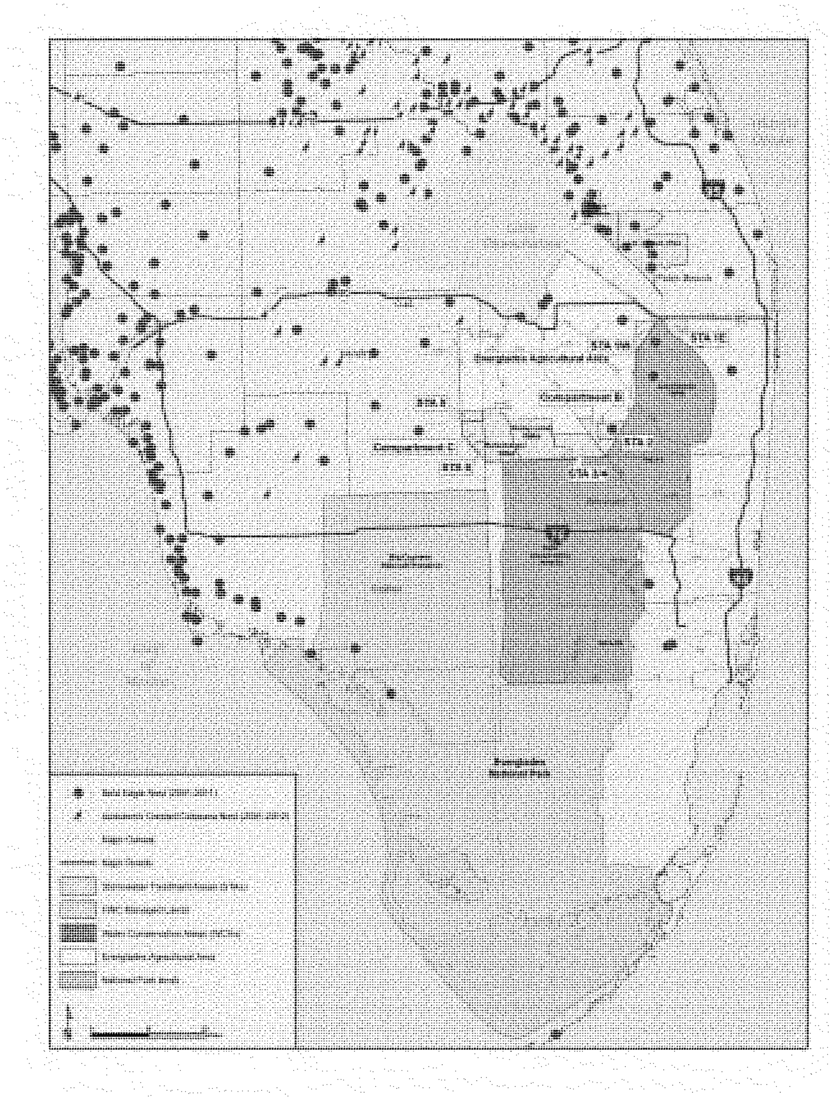

Figure 8. Known bald eagle and Audubon's crested caracara nest sites from 2001 to 2011 and 2012, respectively.

A.5 Endangered Species Act Biological Assessment

The USACE provided NMFS with the Endangered Species Act Programmatic Biological Assessment for the Comprehensive Everglades Restoration Plan (CERP) in July 2013 that included CEPP.

The USACE provided USFWS with the Central Everglades Planning Project Endangered Species Act Biological Assessment on August 5, 2013. On September 4, 2013, the USFWS provided comments and a request for additional information. On October 24, 2013 the USACE provided the USFWS with a Supplemental Technical Analysis in Response to Fish and Wildlife Service Request for Information and a comment response matrix to address the Request for Additional Information.

A.5.1 Comprehensive Everglades Restoration Plan (CERP) Programmatic Biological Assessment submitted to the National Marine Fisheries Service

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning Division
Environmental Branch

Roy E. Crabtree, PhD
Regional Administrator
NOAA Fisheries Service
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701

Re: Request for Consultation under Section 7 of the Endangered Species Act

Dear Dr. Crabtree:

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 the enclosed 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 BA, therefore, is to reference the Central and Southern Florida Project Comprehensive Review Study (C&SF); 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.

Enclosed is a Programmatic BA to initiate informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA). Based on the information contained in this BA, the Corps has determined that implementation of CERP "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. We request your concurrence with the Corps' determination, and hereby request informal consultation under Section 7 of the ESA.

Please contact Mr. Brad Tarr at 904-232-3582 or by email at bradley.a.tarr@usace.army.mil of my staff regarding this consultation request.

Sincerely,

David L. Tipple for
Eric Summa
Chief, Environmental Branch

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

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

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As a result, this consultation effort entails the submittal of a Programmatic Biological Assessment (BA) addressing all CERP projects. The intent of this BA, therefore, is to reference the Central and Southern Florida Project Comprehensive Review Study (C&SF); 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.

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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.

Enclosed is a Programmatic BA to initiate informal consultation under Section 7(a)(2) of the Endangered Species Act (ESA). Based on the information contained in this BA, the Corps has determined that implementation of CERP "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. We request your concurrence with the Corps' determination, and hereby request informal consultation under Section 7 of the ESA.

Please contact Mr. Brad Tarr at 904-232-3582 or by email at bradley.a.tarr@usace.army.mil of my staff regarding this consultation request.

Sincerely,

Eric Summa
Chief, Environmental Branch

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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.**

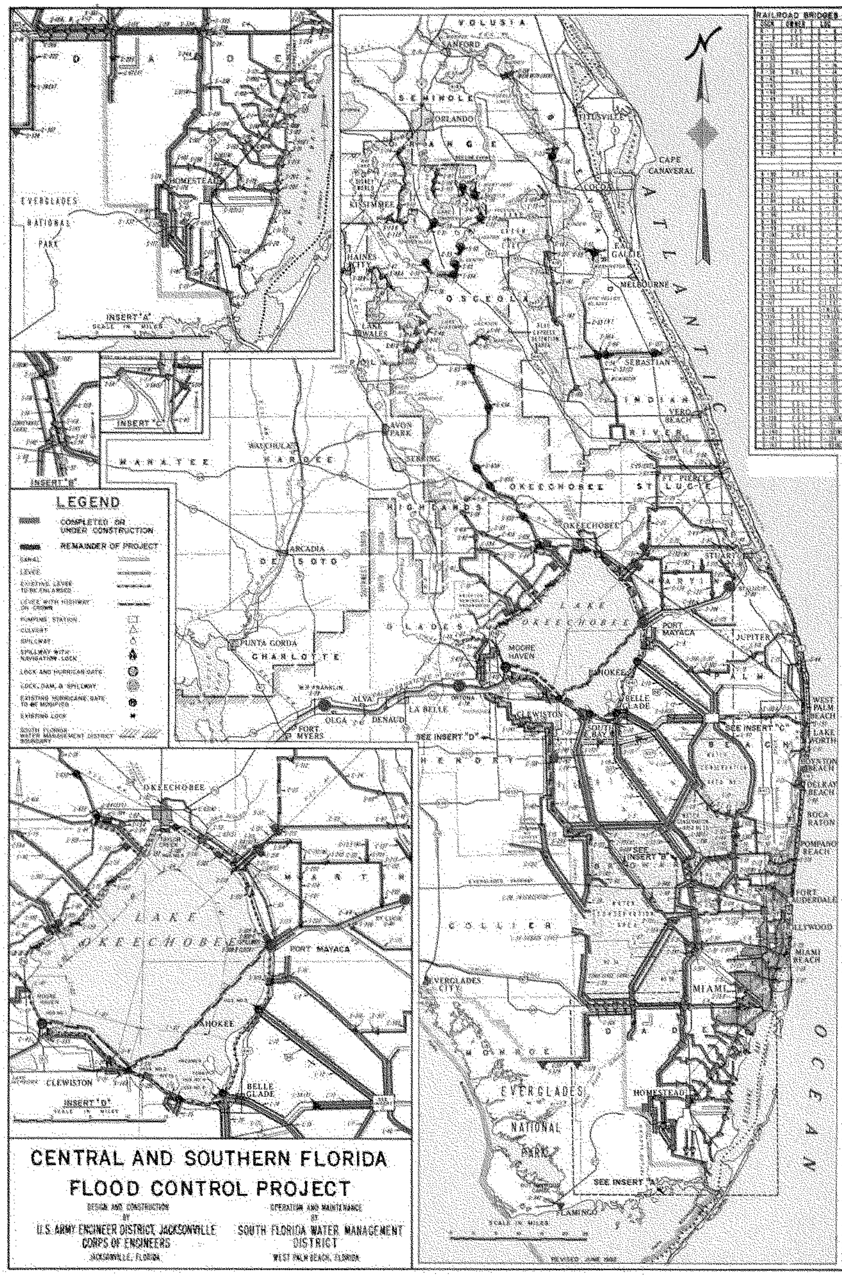

Figure 4-1. C&SF Study Map

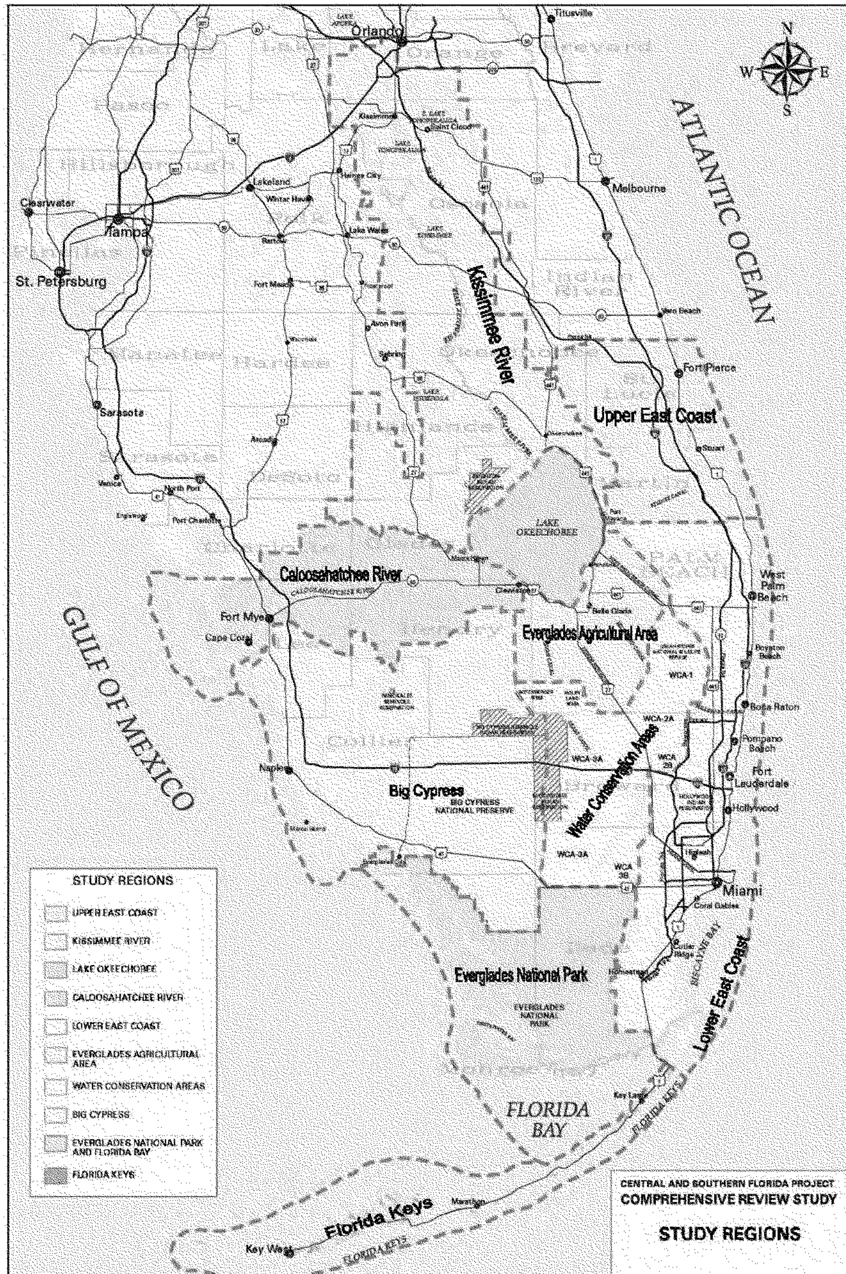

Figure 4-2. Study Regions

4.4.1 <u>Kissimmee River Basin</u>

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 <u>Lake Okeechobee</u>

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 Lower East Coast Area

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**

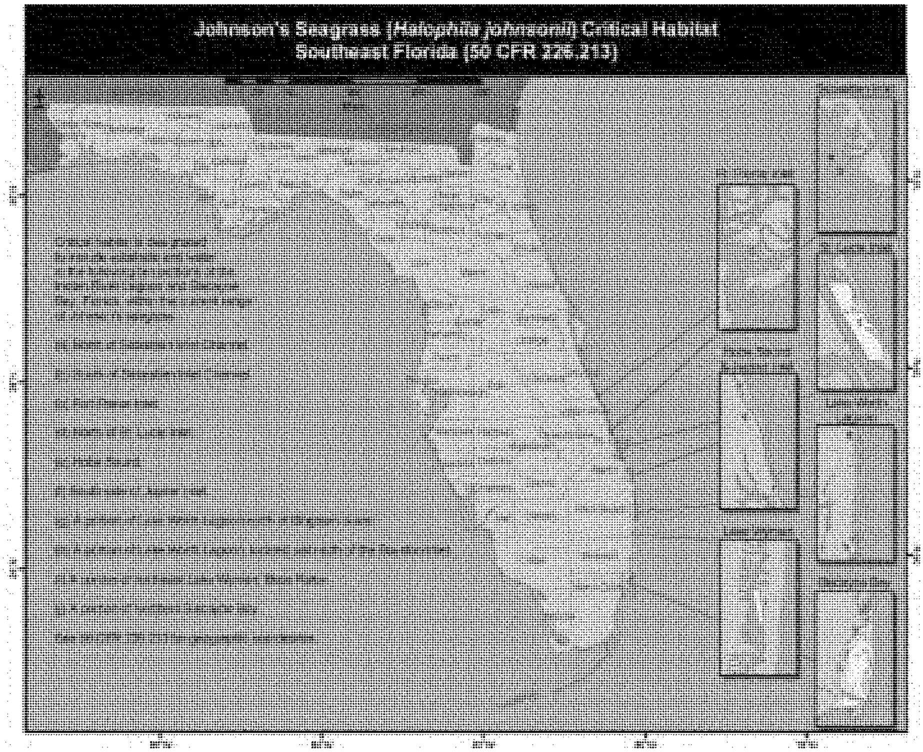

Figure 6-1. Critical Habitat for the Johnson's Seagrass

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.

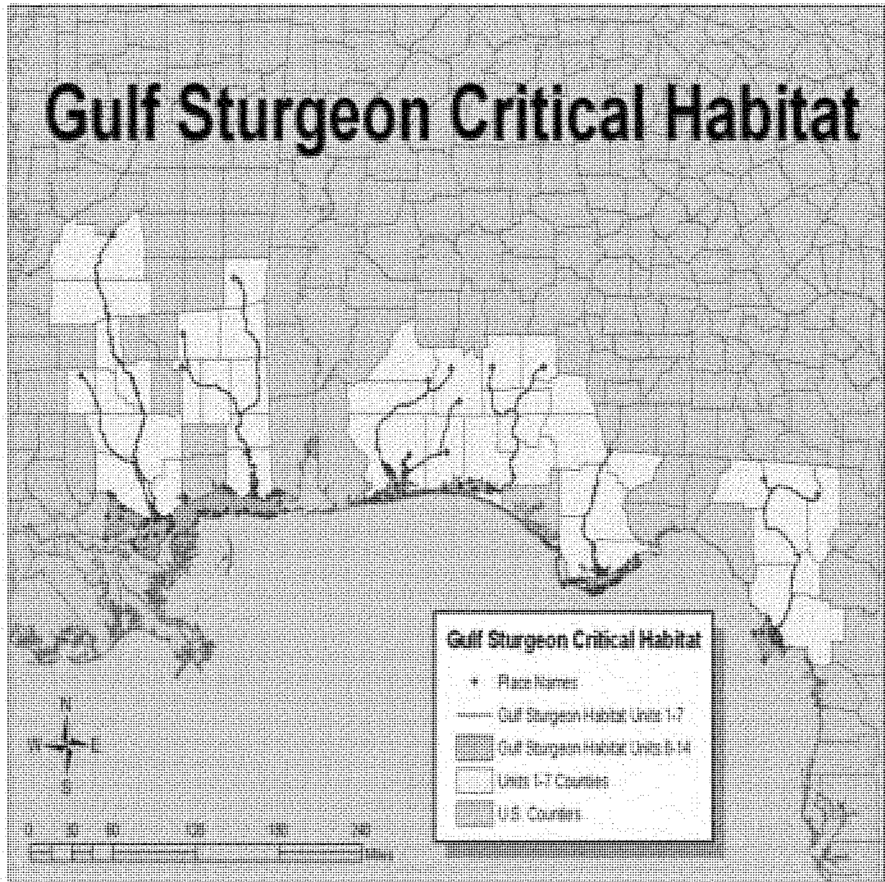

Figure 6-2. Critical Habitat for the Gulf Sturgeon

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.

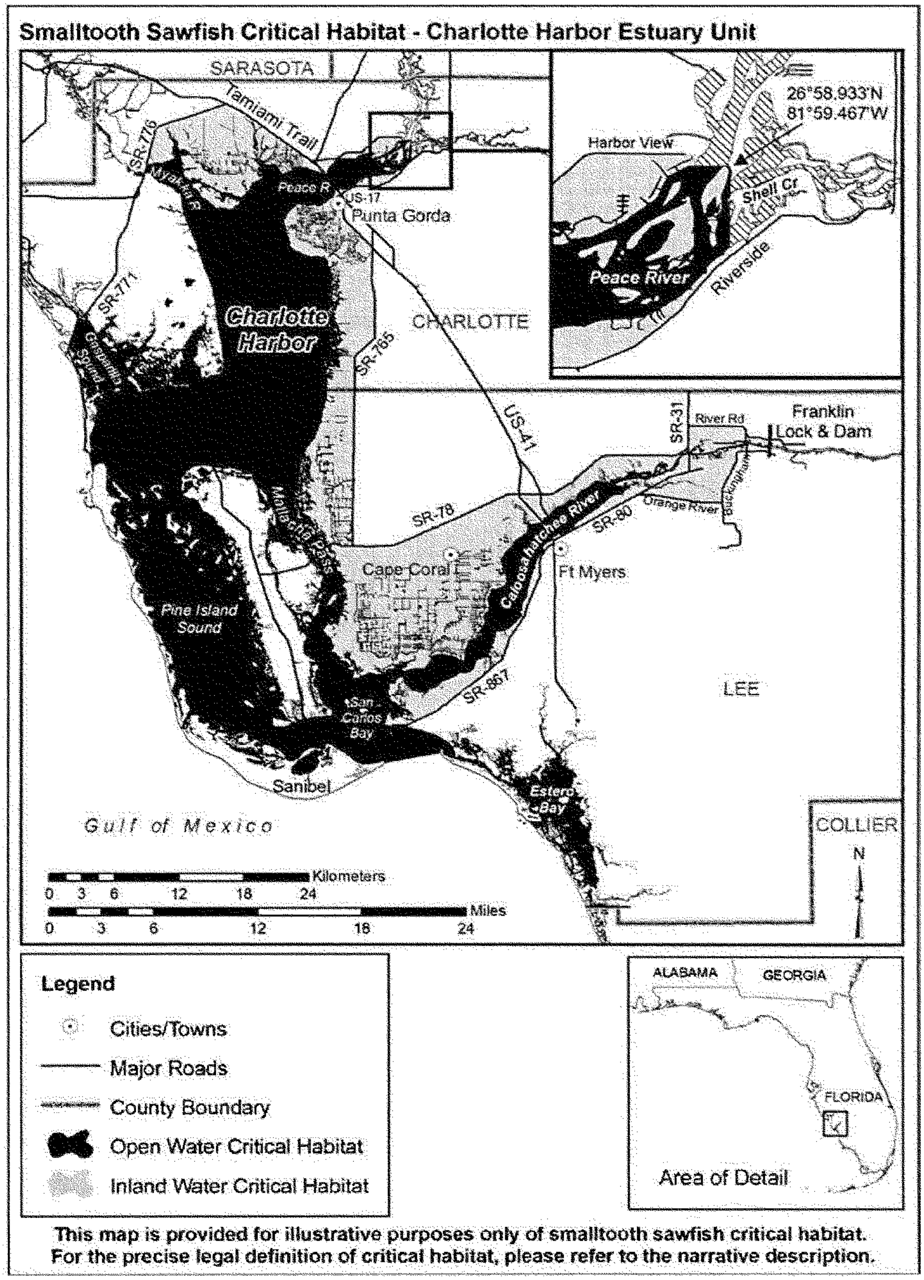

Figure 6-3. Critical Habitat for the Smalltooth Sawfish – Charlotte Harbor Everglades Unit

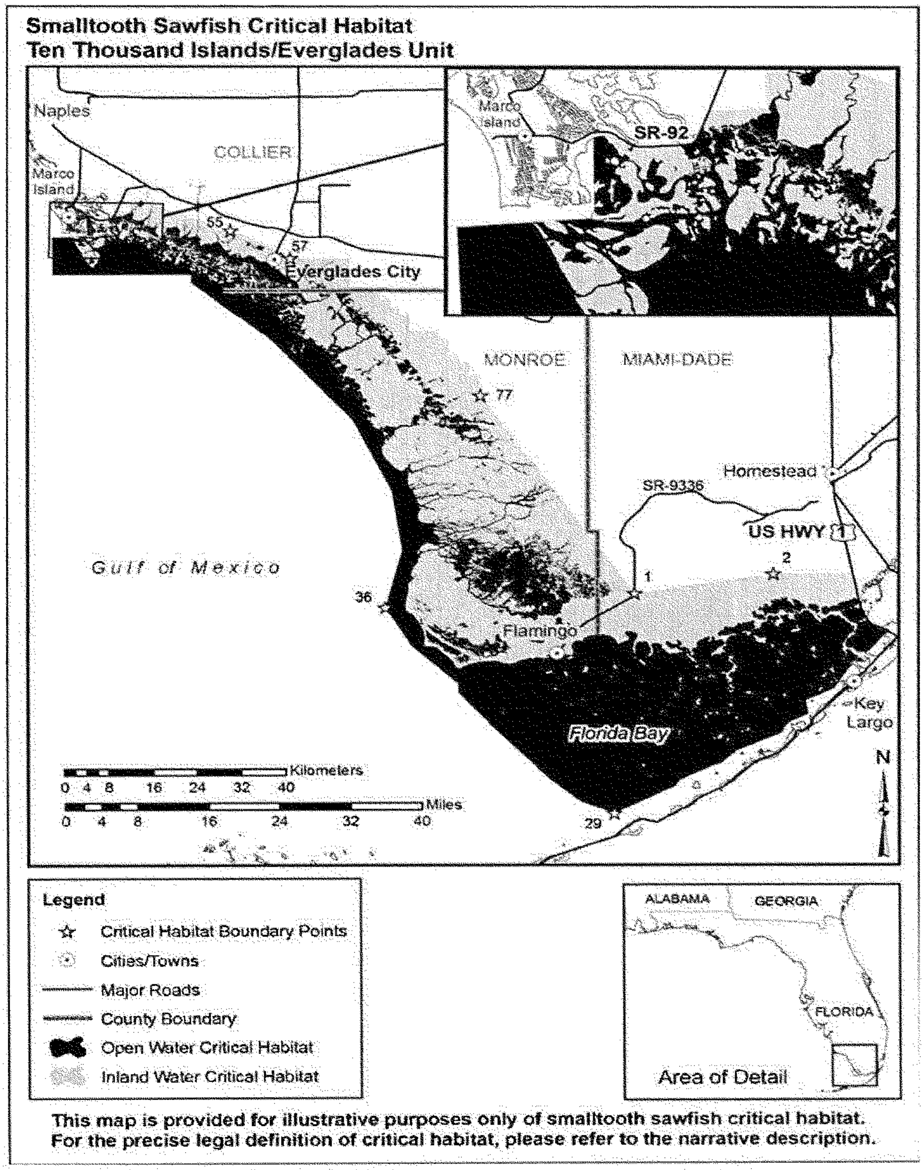

Figure 6-4. Critical Habitat for the Smalltooth Sawfish – 10,000 Islands

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.

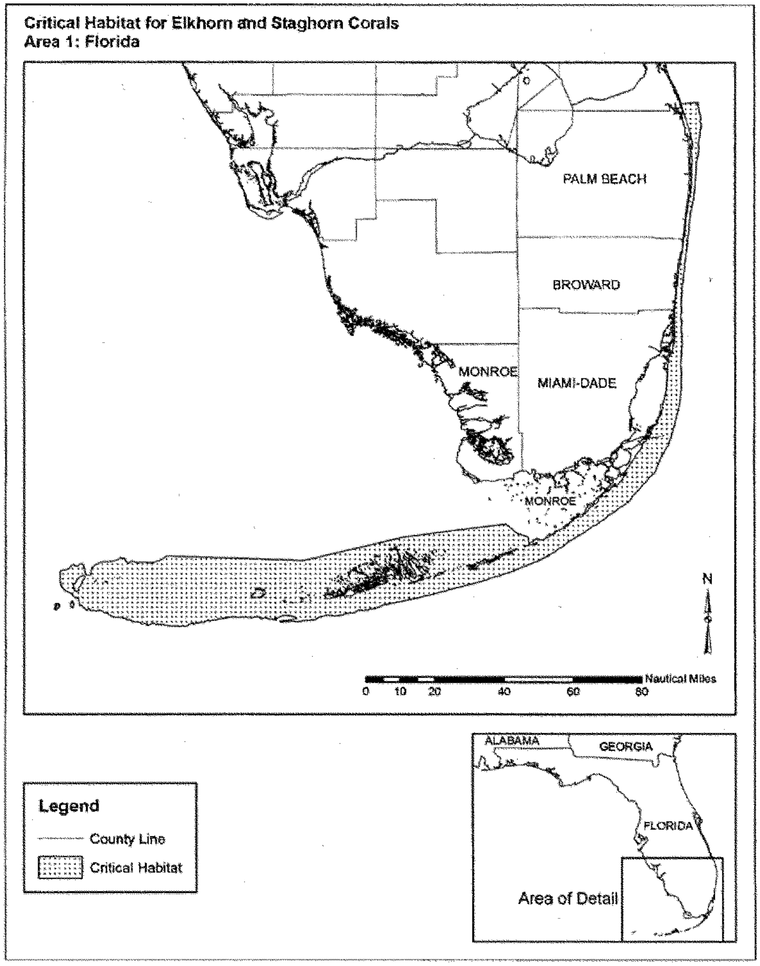

Figure 6-5. Critical Habitat for Elkhorn and Staghorn Corals

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.

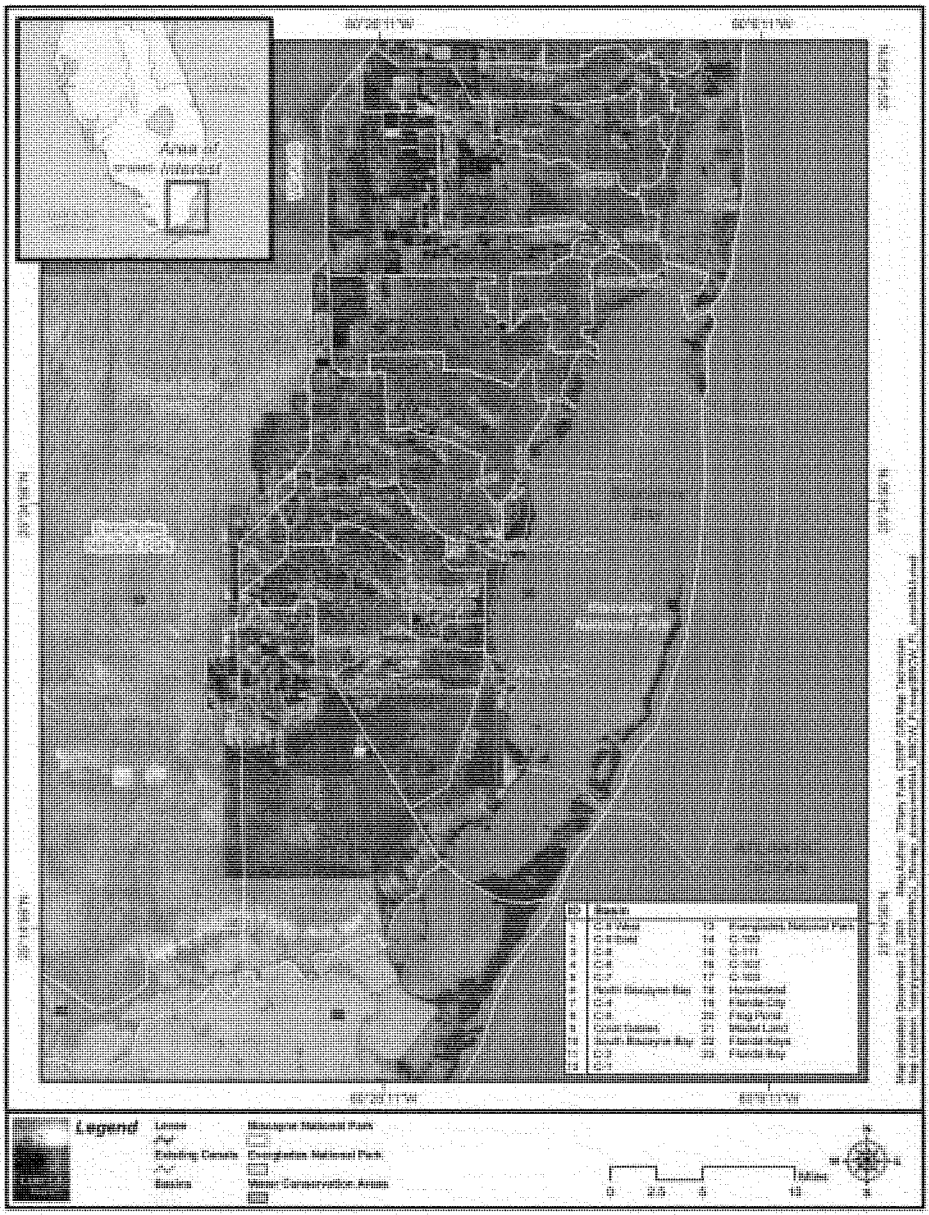

Figure 7-1. Biscayne Bay Coastal Wetlands Location Map

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.

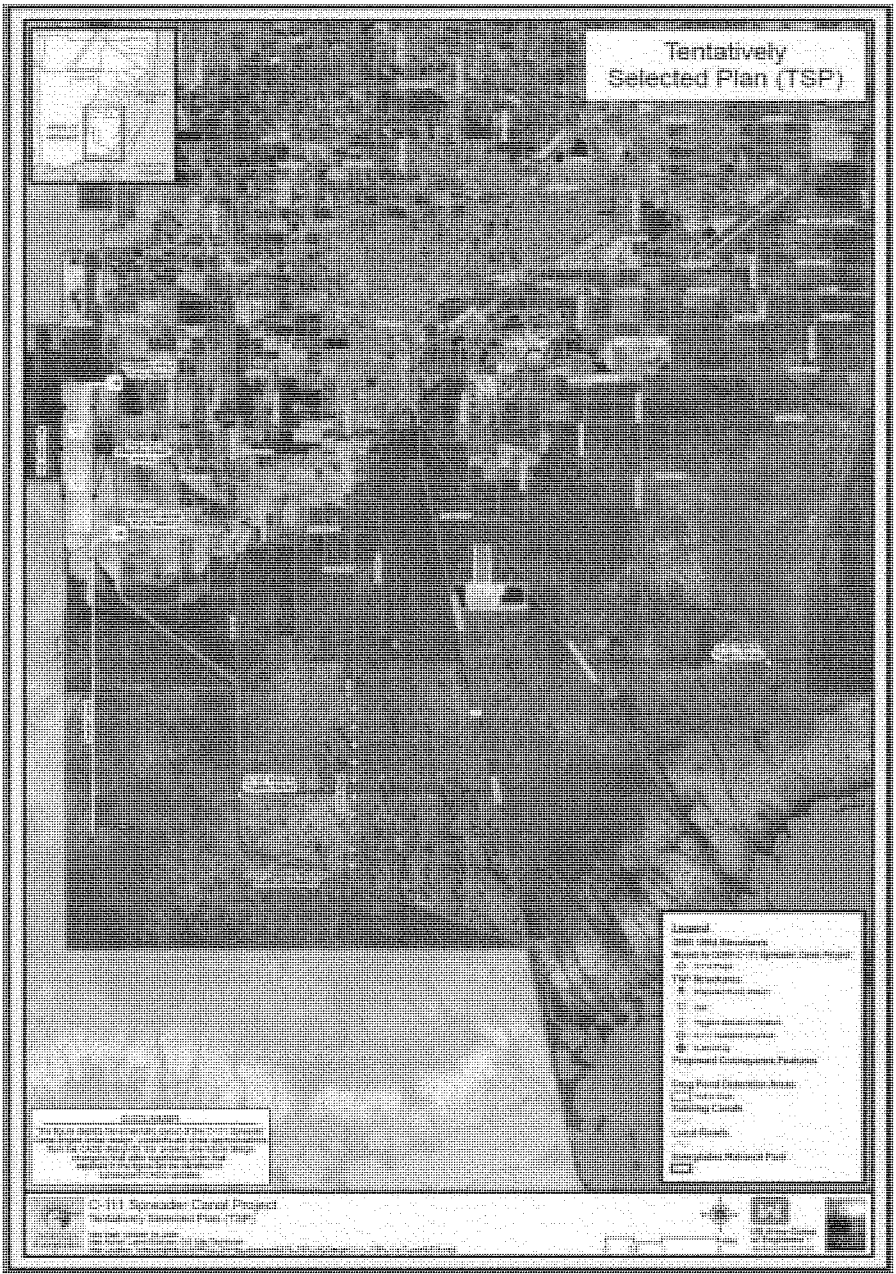

Figure 7-2. C-111 Spreader Canal Tentatively Selected Plan

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.

<u>Leatherback Sea Turtle and "No Effect" Determination</u>

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.

<u>Kemp's Ridley Sea Turtle and "No Effect" Determination</u>

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.

<u>Loggerhead Sea Turtle and "No Effect" Determination</u>

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.

<u>Elkhorn Coral and "No Effect" Determination</u>

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.

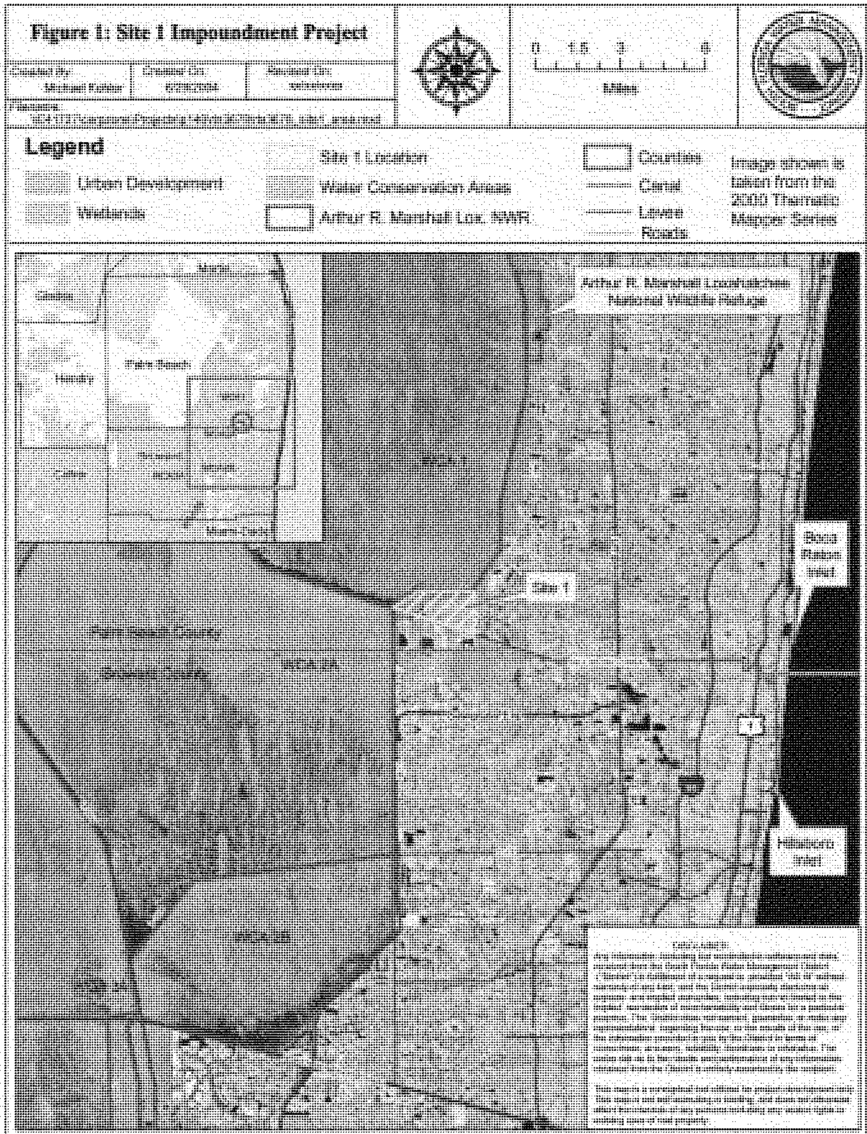

Figure 7-3. Site 1 Impoundment Project Area Map

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.

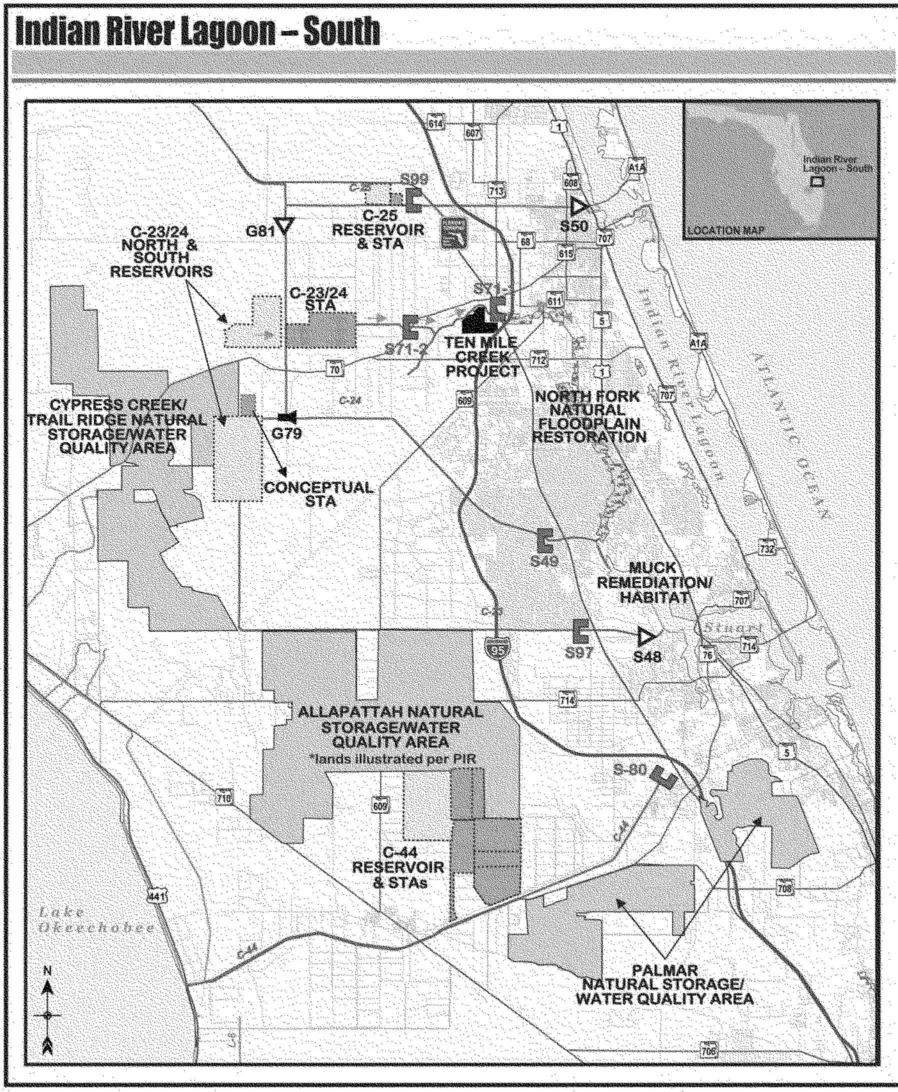

Figure 7-4. Indian River Lagoon South Project Area Map

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.

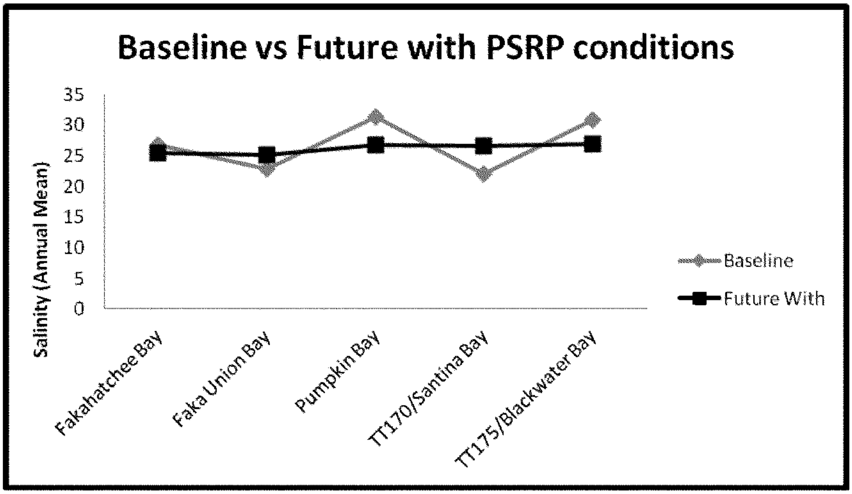

Figure 7-7. Baseline vs. Future conditions for average annual salinity

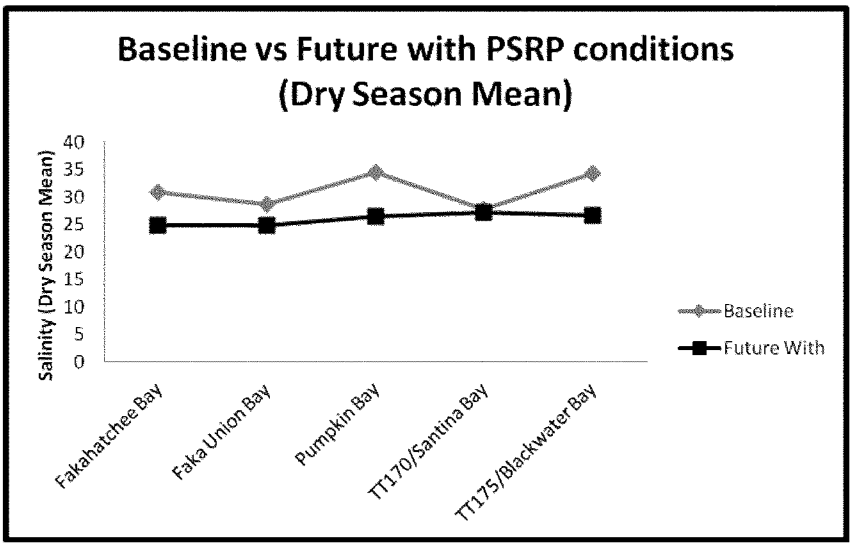

Figure 7-8. Baseline vs. Future with project conditions for dry season mean

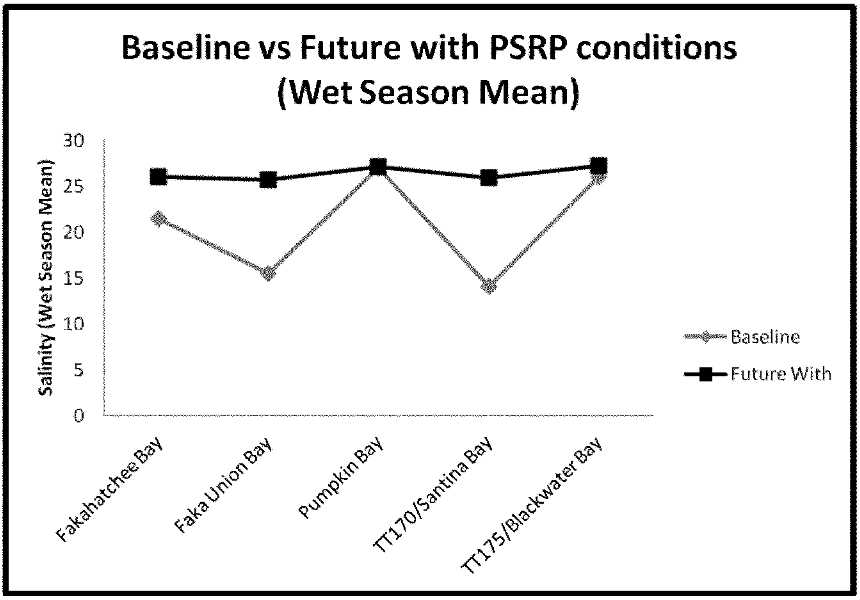

Figure 7-9. Baseline vs. Future with project conditions for wet season mean

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.

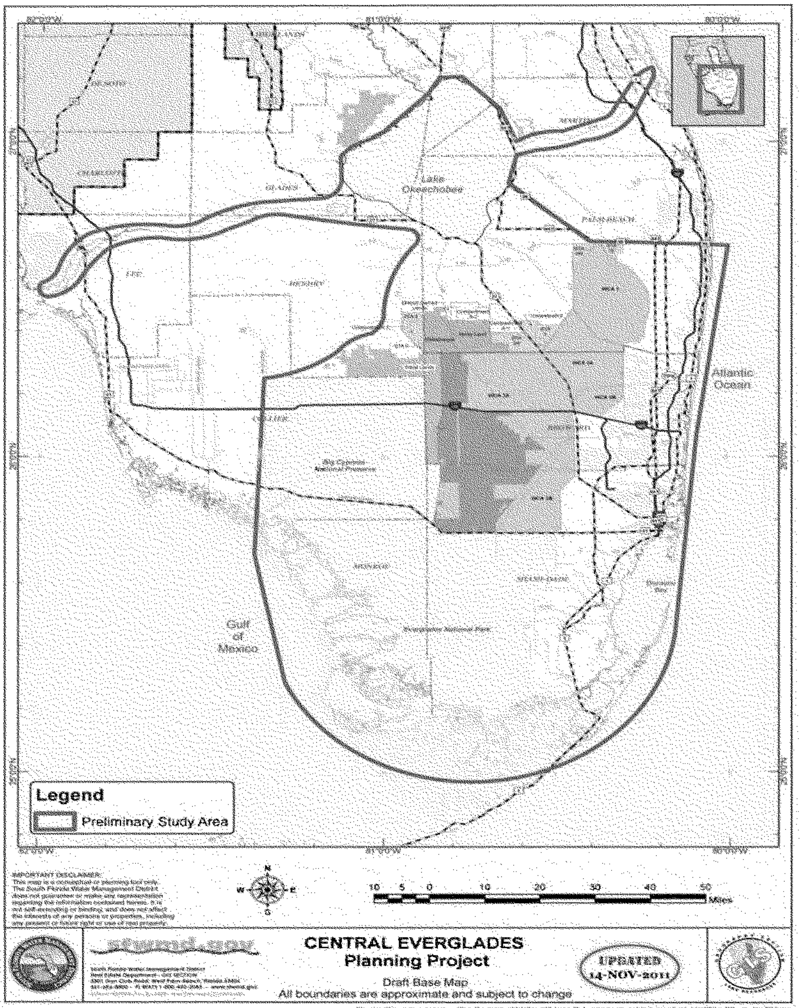

Figure 7-10: Central Everglades Planning Project Study Area

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**)).

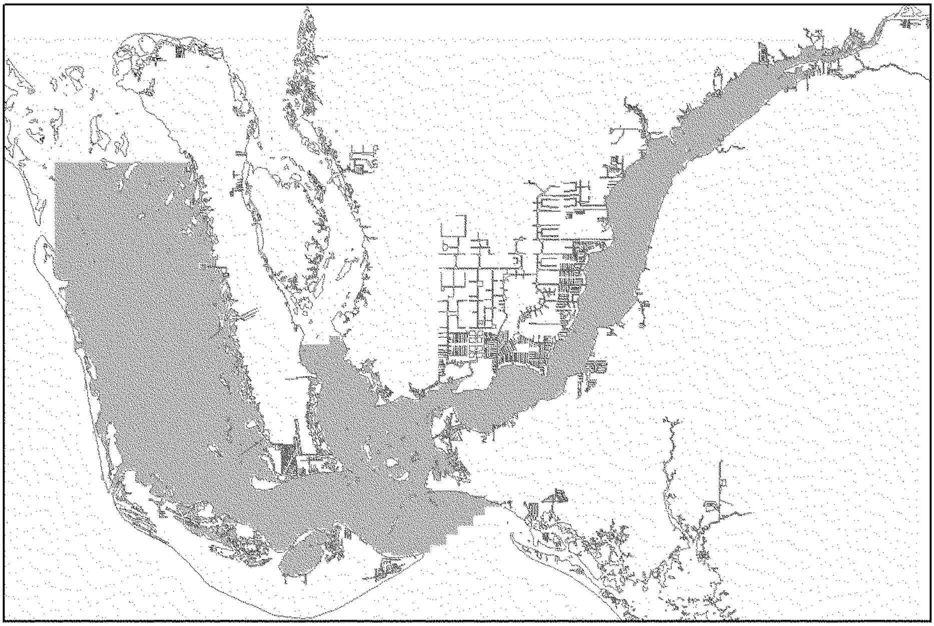

Figure 7-11: Estimate of the Maximum Area of Potential Ecological Benefit for the Caloosahatchee Estuary (Zone CE-1)

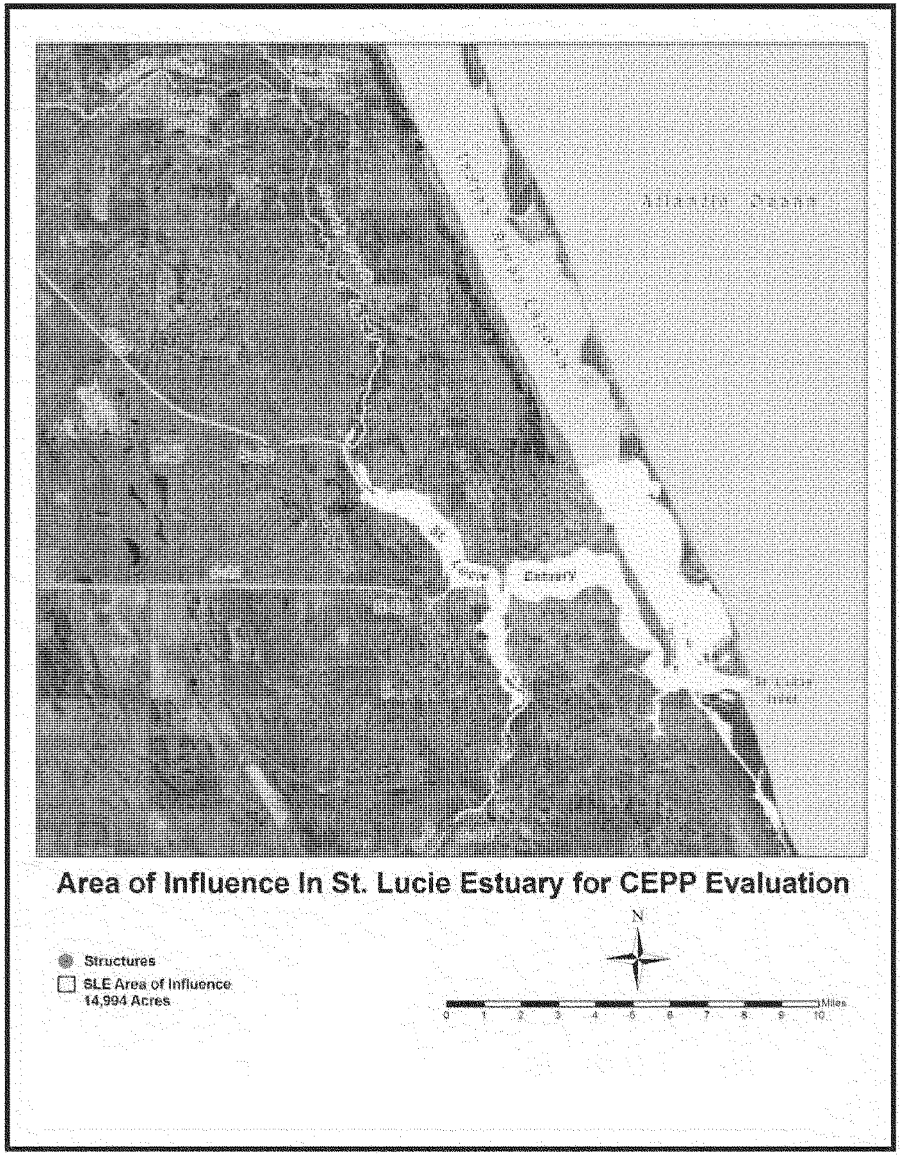

Figure 7-12. Estimate of the Maximum Area of Potential Ecological Benefit for the St. Lucie Estuary (Zone SE-1)

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 m^2 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**).

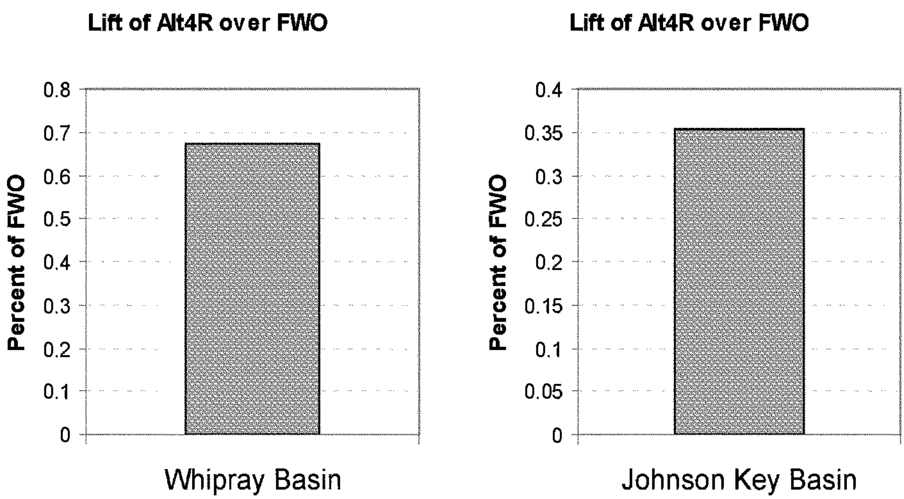

Figure 7-13. Lift of Alternative 4R over Future Without Project Conditions

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.

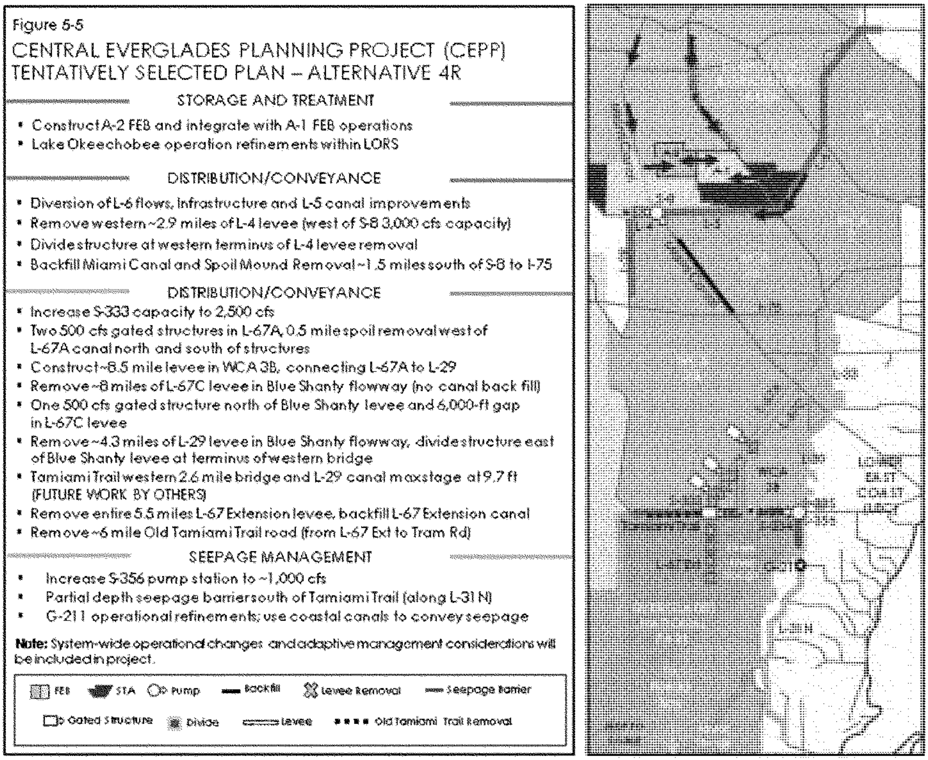

Figure 7-14. Project Features of the CEPP Recommended Plan

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	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.5.2 Central Everglades Planning Project Biological Assessment submitted to the US Fish and Wildlife Service

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

0 5 AUG 2013

Mr. Larry Williams, Field Supervisor
South Florida Ecological Services Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Williams,

In accordance with provisions of Section 7 of the Endangered Species Act, as amended, the U.S. Army Corps of Engineers (Corps) is hereby initiating consultation with the U.S. Fish and Wildlife Service (FWS) on the 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 including Water Conservation Area 3 (WCA 3) and Everglades National Park (ENP). CEPP includes project components identified in the 1999 Comprehensive Everglades Restoration Plan (CERP), approved by Congress as a framework for restoration of the south Florida ecosystem in Section 601 of the Water Resources Development Act of 2000.

The CEPP study was initiated in November 2011. Staff from your office have participated in the development and evaluation of alternative plans throughout the study. To facilitate progress, Mr. Kevin Palmer of your office provided a list of species on May 10, 2013 that occur or have the potential to occur within the CEPP study area. The Service advises that federally threatened, endangered, and candidate species that may occur within the study area include: Florida panther (*Puma concolor coryi*), Florida population of West Indian Manatee (Florida manatee) (*Trichechus manatus*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), Everglade snail kite (*Rostrhamus sociablis plumbeus*), Northern crested caracara (*Caracara cheriway*), piping plover (*Charadrius melodus*), red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork (*Mycteria americana*), American alligator (*Alligator mississippiensis*), Florida bonneted bat (*Eumops floridanus*), American crocodile (*Crocodylus acutus*), Eastern indigo snake (*Drymarchon corais couperi*), Miami black-headed snake (*Tantilla oolitica*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), Miami blue butterfly (*Cyclargus thomasi bethunebakeri*), Florida leafwing butterfly (*Anaea troglodyta floridalis*), Bartram's hairstreak butterfly (*Strymon acis bartrami),* Stock Island tree snail (*Orthalicus reses* [not incl. *nesodryas*]), crenulate lead-plant (*Amorpha crenulata*), Cape Sable thoroughwort (*Chromolaena frustrata*) deltoid spurge (*Chamaesyce deltoidea* ssp. *deltoidea*), Garber's spurge (*Chamaesyce garberi*), Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeenis*), Small's milkpea (*Galactia smallii*), and tiny polygala (*Polygala smallii*).

The bald eagle (*Haliaeetus leucocephalus*) was delisted under the Endangered Species Act but continues to be protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. In addition, the study area contains designated critical habitat for the American crocodile, Everglade snail kite, Cape Sable seaside sparrow, and Florida manatee.

Based upon the best available scientific analysis and information along with biological information obtained from scientific publications and discussions with species researchers, the Corps has determined the following effects associated with implementation of CEPP:

- The plan will result in no effect on Florida bonneted bat, Northern crested caracara, piping plover, red-cockaded woodpecker, roseate tern, Miami black-headed snake, Bartram's hairstreak butterfly, Florida leafwing butterfly, Schaus swallowtail butterfly, Stock Island tree snail, Miami blue butterfly, Cape Sable thoroughwort, crenulate lead-plant, Okeechobee gourd, deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala.
- The plan may affect, but is not likely to adversely affect Florida manatee and its critical habitat and American crocodile and its critical habitat.

The Corps requests formal consultation on the Cape Sable seaside sparrow and its critical habitat, Everglade snail kite and its critical habitat, wood stork, Florida panther, and Eastern indigo snake. Due to the necessity of having completed consultation prior to release of the Final Environmental Impact Statement and submitting a recommendation to the Assistant Secretary of the Army for Civil Works, the Corps respectfully requests a Biological Opinion within the 135-day timeframe after receipt of the enclosed Biological Assessment.

The Corps is also coordinating with National Marine Fisheries Service (NMFS) pertaining to potential effects on listed species under their purview by letter and programmatic Biological Assessment. The NMFS is expected to provide concurrence with the Corps' findings of effects on listed species that may be encountered or adjacent to the study area.

Your concurrence on the above determinations is requested. We sincerely appreciate the effort that you and your staff have put into this tremendously important restoration project. We look forward to our continued partnership as we move forward with Everglades restoration through the implementation of CEPP. If you have any questions or need additional information, please contact Stacie Auvenshine at stacie.j.auvenshine@usace.army.mil or 904-232-3694.

Sincerely,

Ralph for

Eric P. Summa
Chief, Environmental Branch

Enclosures

ENDANGERED SPECIES ACT BIOLOGICAL ASSESSMENT

Central Everglades Planning Project

Prepared by
Department of the Army
U.S. Corps of Engineers, Jacksonville District

August 2013

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A

B

BA Biological Assessment
BCNP Big Cypress National Preserve
BO Biological Opinion

C

C-111 Canal-111
C-111 SC C-111 Spreader Canal
C-x Canal
C&SF Central & south Florida Project
CEPP Central Everglades Planning Project
CEM Conceptual Ecological Models
CERP Comprehensive Everglades Restoration Plan
CFA Core Foraging Area
CFR Code of Federal Regulation
cfs Cubic Feet per Second
COP Combined Operational Plan
Corps U.S. Army Corps of Engineers (see also the Corps)
CM Centimeters
CSSS Cape Sable seaside sparrow (or sparrow)

D

E

EAA Everglades Agricultural Area
ECB Existing Conditions Baseline 2012
EIS Environmental Impact Statement
ENP Everglades National Park
EPA Environmental Protection Agency
ERTP Everglades Restoration Transition Plan
ESA Endangered Species Act
ET Ecological Target

F

FEB Flow Equalization Basin
FWC Florida Fish and Wildlife Conservation Commission
FWS U.S. Fish and Wildlife Service
FEIS Final Environmental Impact Statement
FWCA Fish and Wildlife Coordination Act
FWO Future Without Project Condition
FWS U.S. Fish and Wildlife Service (see also USFWS)

G

G-x Gauging Station or Culvert Structure

H

HSI Habitat Suitability Index

I

IAR Incremental Adaptive Restoration
IOP Interim Operational Plan
ISOP Interim Structural and Operational Plan

J

K

KCOL Kissimmee Chain of Lakes

L

L-x Levee
LEC Lower East Coast

M

MSTS Multi-Species Transition Strategy
MWD Modified Water Deliveries (to ENP)

N

NESRS Northeast Shark River Slough
NGVD National Geodetic Vertical Datum
NMFS National Marine Fisheries Service
NRC National Research Council

O

P

PAL Planning Aid Letter
PDT Project Delivery Team
PL Public Law
PM Performance Measure
ppt parts per thousand
psu practical salinity units

Q

R

RECOVER Restoration, Coordination, and Verification
RPA Reasonable and Prudent Alternative

S

S-x Pump Station, Spillway or Culvert
SAV Submerged Aquatic Vegetation
SDCS South Dade Conveyance System (ENP)

SFWMD South Florida Water Management District
SRS Shark River Slough
STA Stormwater Treatment Area

T
TSP Tentatively Selected Plan
U
Corps U.S. Army Corps of Engineers (see also Corps)
USFWS U.S. Fish and Wildlife Service (see also FWS)
USGS U.S. Geological Survey

V
W
WCA Water Conservation Area
WCA-3 AVG Water Conservation Area 3 Gauge Average
WQ Water Quality
WRDA Water Resources Development Act
WSRS Western Shark River Slough

1.0 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 BA is also used in determining 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 or 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)).

2.0 CONSULTATION SUMMARY FOR CEPP

Beginning in November of 2011 and throughout the Central Everglades planning process, employees of the United States Fish and Wildlife Service (FWS) have attended CEPP Project Delivery Team (PDT) and core planning team meetings, as well as South Florida Ecosystem Task Force Working Group sponsored workshops. The FWS has provided substantive comments informally at meetings and through e-mails. Formal comments have been submitted in Planning Aid Letters (PALs) in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA), 16 U.S.C. 661 *et seq.*, and section 7 of the Endangered Species Act (ESA) of 1973, as amended (Act), 16 U.S.C. 1531 *et seq*. Provided below is a brief consultation summary of the PALs received to date. The FWS PALs are located within Appendix A.

- January 20, 2012: The FWS provided comments on the project goals and objectives, management actions that should be considered (i.e., project components), as well as ecological performance measures.
- March 27, 2012: The FWS provided comments on the planning process including, but not limited to management measure screening, alternative formulation, modeling strategy, and natural resource considerations.
- December 12, 2012: The FWS provided comments on the conceptual design and modeling of the final array of alternatives.
- May 10, 2013: The FWS provided a list of potentially occurring listed species within the project area.

In addition, the US Army Corps of Engineers (Corps) has consulted with FWS by letter dated January 23, 2013 on federally listed threatened and endangered species that may be present in the action study area. In an email dated February 19, 2013, FWS provided concurrence with the Corps' finding of listed species that may be encountered within or adjacent to the action area. Federally threatened and endangered species that may occur within the action area include Florida panther (*Puma concolor coryi*), Florida population of West Indian Manatee (Florida manatee) (*Trichechus manatus*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), Everglade snail kite (*Rostrhamus sociablis plumbeus*), Northern crested caracara (*Caracara cheriway*), piping plover (*Charadrius melodus*), red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork (*Mycteria americana*), American alligator (*Alligator mississippiensis*), American crocodile (*Crocodylus acutus*), Eastern indigo snake (*Drymarchon corais couperi*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), Miami blue butterfly (*Cyclargus thomasi bethunebakeri*), Stock Island tree snail (*Orthalicus reses* [not incl. *nesodryas*]), crenulate lead-plant (*Amorpha crenulata*), deltoid spurge (*Chamaesyce *deltoidea* ssp. *deltoidea*), Garber's spurge (*Chamaesyce garberii*), Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeenis*), Small's milkpea (*Galactia smallii*), and tiny polygala (*Polygala smallii*). The bald eagle (*Haliaeetus leucocephalus*) has been delisted under the ESA but continues to be protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. In addition, the study area contains designated critical habitat for the American crocodile, Everglade snail kite, Cape Sable seaside sparrow, and Florida manatee.

The Corps is coordinating with National Marine Fisheries Service (NMFS) pertaining to potential effects on listed species under their purview by letter and programmatic BA. NMFS will provide a letter to the Corps based on their concurrence with the Corps' finding of listed species that may be encountered or adjacent to the study area. Federally listed species under the purview of NMFS include the 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 study area contains designated critical habitat for the smalltooth sawfish, elkhorn coral, staghorn coral, and Johnson's seagrass.

3.0 STUDY AREA

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 (EAA), the Water Conservation Areas (WCA), Everglades National Park (ENP), the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast (LEC) (**Figure 3-1**).

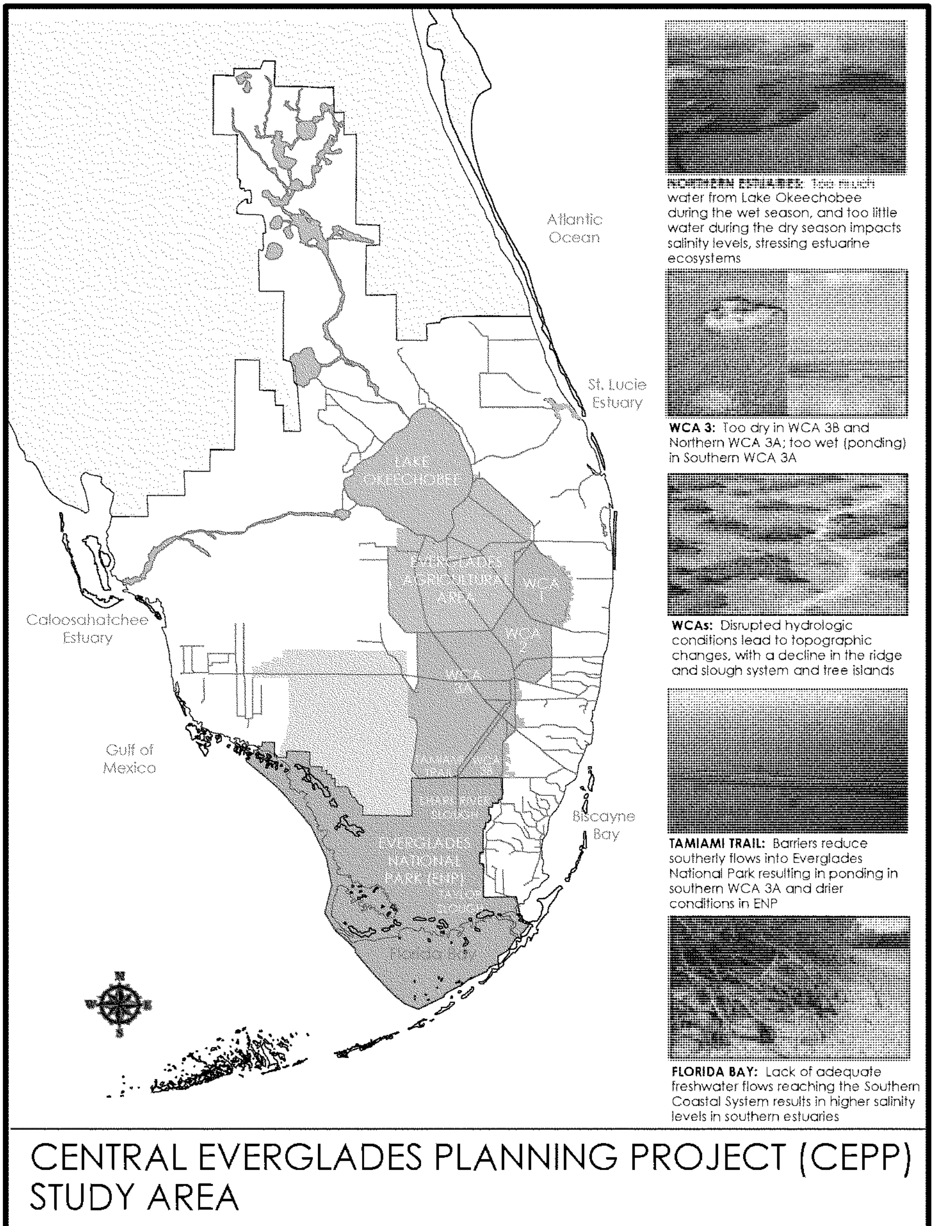


Figure 3-1. CEPP Study Area

4.0 CEPP PROJECT DESCRIPTION

The purpose of the Central Everglades Planning Project (CEPP) is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades (Water Conservation Area 3 [WCA 3] and ENP). The CEPP will be composed of project components that were identified in the Comprehensive Everglades Restoration Plan (CERP). This study approach is consistent with the recommendations from the National Resource Council (NRC) to utilize Incremental Adaptive Restoration (IAR) to both achieve timely, meaningful benefits of CERP and to lessen the continuing decline of the Everglades ecosystem.

Prior planning efforts and the development of scientific goals and targets for CERP have led to a determination that some components are interdependent features that necessitate formulation from a systems approach. Recently authorized CERP projects are "perimeter" projects that generally do not greatly depend upon or influence other CERP projects. However, the components in the central part of the Everglades (interior CERP projects) are hydraulically connected from Lake Okeechobee to Florida Bay, and are reliant on one another for both inflows and outflows. These interdependencies required system plan formulation and analysis in order to optimize structural and operational components, rather than formulating separable components that may not be compatible when looking at the cumulative effects.

The tentatively selected plan (TSP) will benefit the St. Lucie and Caloosahatchee Estuaries by decreasing the number and severity of high-volume regulatory flood control releases sent from Lake Okeechobee. This will be accomplished by redirecting approximately 210,000 acre feet of additional water to the historical southerly flow path south through flow equalization basins (FEBs) and existing stormwater treatment areas (STAs). The STAs reduce phosphorus concentrations in the water to meet required water quality standards. Rerouting this treated water south and redistributing it across the degraded L-4 Levee will facilitate hydropattern restoration in WCA 3A. This, in combination with Miami Canal backfilling and other CEPP components, is paramount to re-establishing a 500,000-acre flowing system through the northern most extent of the remnant Everglades. The treated water will be distributed through WCA 3A to WCA 3B and ENP via new gated control structures and creation of the Blue Shanty Flowway. The Blue Shanty Flowway will restore continuous sheet-flow and re-connection of a portion of WCA 3B to ENP (**Figure 4-1**).

CENTRAL EVERGLADES PLANNING PROJECT (CEPP)
TENTATIVELY SELECTED PLAN – ALTERNATIVE 4R2

STORAGE AND TREATMENT

- Construct A-2 FEB and integrate with A-1 FEB operations
- Lake Okeechobee operation refinements within LORS

DISTRIBUTION/CONVEYANCE

- Diversion of L-6 flows, Infrastructure and L-5 canal improvements
- Remove western ~2.9 miles of L-4 levee (west of S-8 3,000 cfs capacity)
- 360 cfs pump station at western terminus of L-4 levee removal
- Backfill Miami Canal and Spoil Mound Removal ~1.5 miles south of S-8 to I-75

DISTRIBUTION/CONVEYANCE

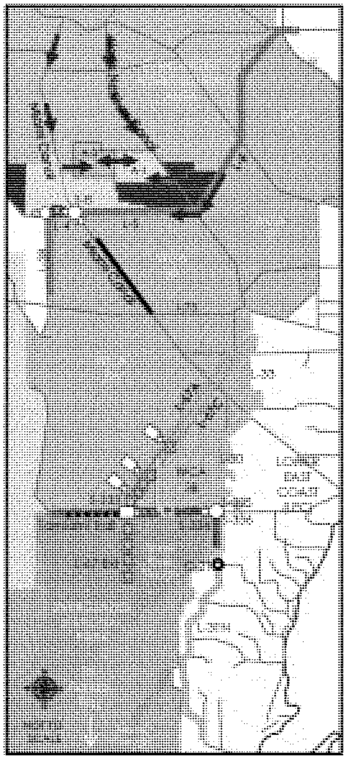
- Increase S-333 capacity to 2,500 cfs
- Two 500 cfs gated structures in L-67A, 0.5 mile spoil removal west of L-67A canal north and south of structures
- Construct ~8.5 mile levee in WCA 3B, connecting L-67A to L-29
- Remove ~8 miles of L-67C levee in Blue Shanty flowway (no canal back fill)
- One 500 cfs gated structure north of Blue Shanty levee and 6,000-ft gap in L-67C levee
- Remove ~4.3 miles of L-29 levee in Blue Shanty flowway, divide structure east of Blue Shanty levee at terminus of western bridge
- Tamiami Trail western 2.6 mile bridge and L-29 canal max stage at 9.7 ft (FUTURE WORK BY OTHERS)
- Remove entire 5.5 miles L-67 Extension levee, backfill L-67 Extension canal
- Remove ~6 mile Old Tamiami Trail road (from L-67 Ext to Tram Rd)

SEEPAGE MANAGEMENT

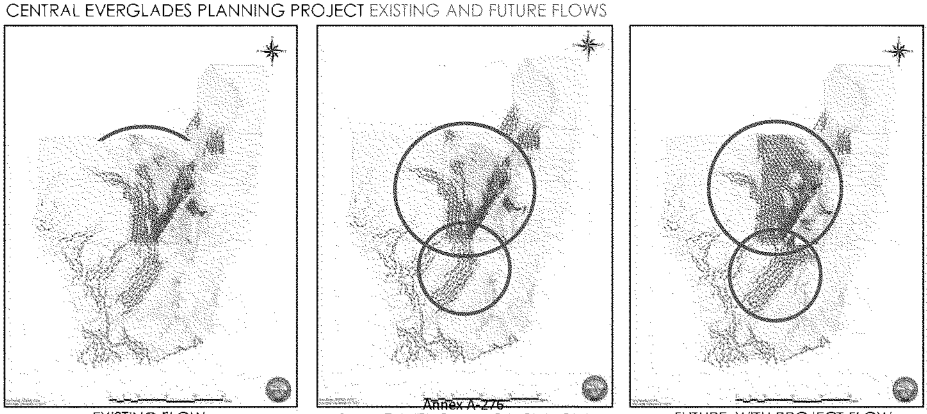
- Increase S-356 pump station to ~1,000 cfs
- Partial depth seepage barrier south of Tamiami Trail (along L-31N)
- G-211 operational refinements: use coastal canals to convey seepage

Note: System-wide operational changes and adaptive management considerations will be included in project.

FEB | STA | Pump | Backfill | Levee Removal | Seepage Barrier
Gated Structure | Divide | Levee | Old Tamiami Trail Removal



CENTRAL EVERGLADES PLANNING PROJECT EXISTING AND FUTURE FLOWS



EXISTING FLOW | FUTURE WITHOUT PROJECT FLOW | FUTURE WITH PROJECT FLOW

Figure 4-1. CEPP Project Components and Flows

4.1 Plan Features

The components of the TSP, Alternative 4R2 (Alt 4R2), are organized into four geographic areas: North of the Redline, South of the Redline, the Green/Blue lines and along the Yellowline.

4.1.1 Everglades Agricultural Area (EAA) (North of the Redline)

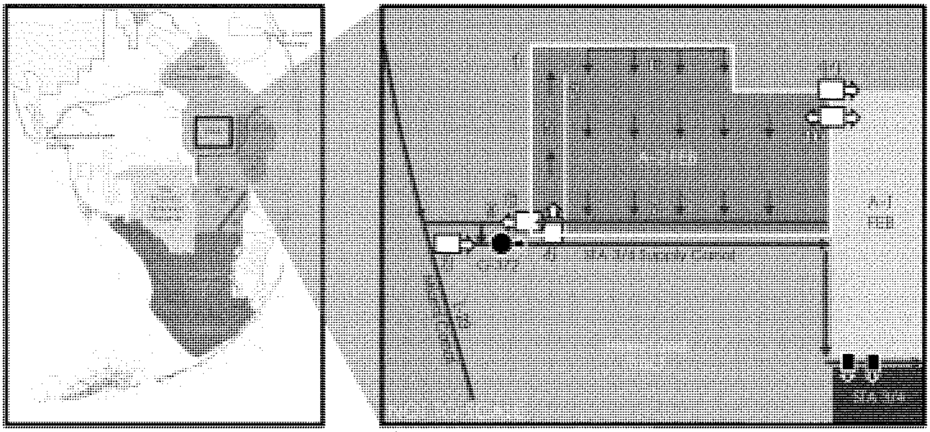
This includes construction and operations to divert, store and treat Lake Okeechobee regulatory releases **(Figure 4-2)**.

Storage and treatment of new water will be possible with the construction of a 14,000 acre FEB and associated distribution features on the A-2 footprint that is operationally integrated with the state-funded and state-constructed A-1 FEB and existing STAs. The A-2 FEB will accept EAA runoff and a portion of the Lake Okeechobee water currently discharged to the estuaries. This Lake Okeechobee water is diverted to the FEB when FEB/STAs and canals have capacity. The C-44 reservoir also collects water that would go to the St. Lucie Estuary and returns some of this water back to Lake Okeechobee, from where it can be delivered to the FEB.

It is anticipated that changes to the 2008 LORS will be needed in order to achieve the complete ecological benefits envisioned through implementation of CEPP. Operational changes to the LORS were incorporated into the hydrologic modeling conducted for the CEPP alternatives, including Alternative 4R2, in efforts to optimize CEPP system-wide performance within the current Zones of the 2008 LORS. More specifically, the hydrologic modeling of the CEPP alternatives included proposed revisions to the 2008 LORS decision tree outcome maximum allowable discharges dependant on the following criteria: Lake Okeechobee inflow and climate forecasts (class limits were modified for tributary hydrologic conditions, seasonal climate outlook, and multi-seasonal climate outlook), stage level (regulation zone), and stage trends (receding or ascending). While some refinements were made within the operational flexibility available in the 2008 LORS, assumptions ultimately extended beyond this flexibility due to adjustments made to the tributary/climatological classifications. Additional information of these assumptions are found in the **Appendix B**. The CEPP PIR will not be the mechanism to propose or conduct the required NEPA evaluation or biological assessment of modifications to the Lake Okeechobee Regulation Schedule.

NORTH OF THE REDLINE

STORAGE AND TREATMENT EQUALIZATION BASIN (FEB) – A2



LEGEND: Pump | Gated Structure | Levee | Spreader Canal | Existing Structure

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	L-624	Levee		Perimeter Levee (~ 20 miles, 11.3 feet high, 14 feet wide, 3:1 side slope)
2	L-625	Levee		Interior levee (~ 4 miles, 11.3 feet high, 12 feet wide, 3:1 side slope)
3	S-623	Gated Spillway	3700	Delivers water from Miami Canal to existing G-372 pump station
4	S-624	Gated Sag Culvert (FEB inflow structure)	1550	Receives water from existing pump station G-372 via STA 3/4 Supply Canal and delivers it to C-624 FEB inflow canal
5	C-624	FEB Inflow Canal	1550	Conveys water from FEB inflow structure S-624 to FEB C-624 E spreader canal (length: ~ 4 miles)
6	C-624E	FEB Spreader Canal		Distributes FEB inflows across northern FEB; sheetflow within FEB is generally north to south (length: ~ 4 miles)
7	C-625E	FEB Collection Canal	400	Existing seepage canal for STA 3/4 Supply Canal, used to supplement FEB sheetflow during normal operating conditions
8	S-625	Gated Culverts (FEB discharge structure)	1550	Delivers water to FEB outflow canal (C-625W)
9	C-625W	FEB Outflow Canal	1550	FEB Outflow Canal is the extended seepage canal for the STA 3/4 Supply Canal; delivers water via existing G-372 pump station to STA 3/4 for water quality treatment
10	S-628	Gated Culvert (FEB intake/discharge structure)	930	Delivers water in both directions between A-2 FEB and A-1 FEB for operational flexibility
11	S-627	Emergency Overflow weir	445	Location to be determined
A-2 FEB design also includes an exterior seepage collection system (not illustrated):				
	C-626	Seepage Canal	400	~ 11 miles
	S-626	Seepage Pump Station	500	Delivers seepage back into the FEB outflow canal C-625W

Figure 4-2. TSP Treatment and Storage Features and Location

4.1.2 WCA 2A and Northern WCA 3A (South of the Redline)

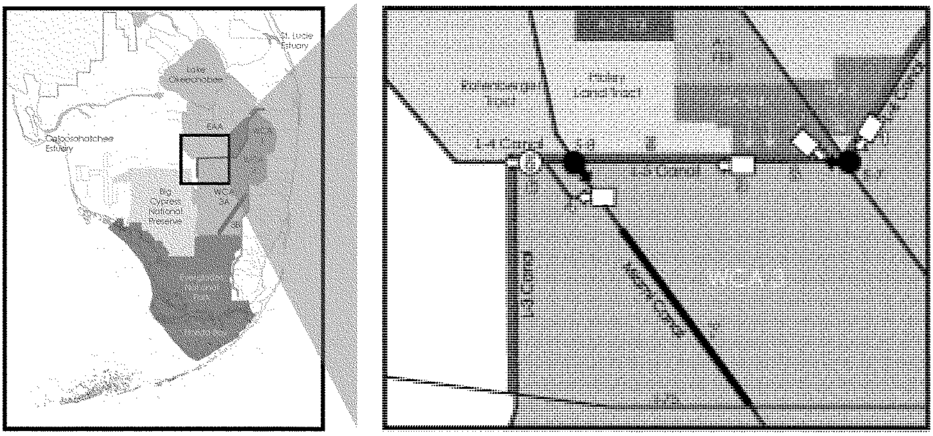
This includes conveyance features to deliver and distribute existing flows and the redirected Lake Okeechobee water through WCA 3A (**Figure 4-3**).

Backfilling 13.5 miles of the Miami Canal between I-75 and 1.5 miles south of the S-8 pump station, and converting the L-4 canal into a spreader canal by removing 2.9 miles of the southern L-4 levee are the key features needed to ensure spatial distribution and flow directionality of the water entering WCA 3A.

Conveyance features to move water into and through the northwest portion of WCA 3A include: a gated culvert to deliver water from the L-6 Canal to the remnant L-5 Canal, a new gated spillway to deliver water from the remnant L-5 canal to the western L-5 canal (during L-6 diversion operations); a new gated spillway to deliver water from STA 3/4 to the S-7 pump station during peak discharge events (eastern flow route is not typically used during normal operations), including L-6 diversion operations; a 360 cubic feet per second (cfs) pump station to maintain Seminole Tribe water supply deliveries west of the L-4 Canal; and new gated culverts to deliver water from the Miami Canal (downstream of S-8, which pulls water from the L-5 Canal) to the L-4 Canal.

The Miami Canal will be backfilled to approximately 1.5 feet below the peat surface of the adjacent marsh. Spoil mounds on the east and west side of the Miami Canal from S-8 to I-75 will be used as a source for Miami Canal backfill material. Refuge for fur-bearing animals and other upland species will continue to be provided by the retention of 22 of the highest priority Florida Fish and Wildlife Conservation Commission (FWC) enhanced spoil mounds between S-339 to I-75 and the creation of additional upland landscape (constructed tree islands) approximately every mile along the entire reach of the backfilled Miami canal section (S-8 to I-75) where historic ridges or tree islands once existed. The constructed tree islands will block flow down the backfilled canal due to the tree island having a profile across the landscape that varies, or undulates, in elevation. Miami Canal constructed tree island design details will be determined during CEPP preconstruction, engineering and design (PED) phase. Tree island design, construction/planting will be coordinated with appropriate science team members with expertise in these topics to accomplish the restoration vision and intent of CEPP's canal backfilling and tree island construction. A diverse array of species will be planted, including trees, shrubs, and herbaceous species that are appropriate for these tree islands.

SOUTH OF THE REDLINE
DISTRIBUTION AND CONVEYANCE



LEGEND: Pump | Gated Structure | Levee Removal | Existing Structure

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-620	Gated Culvert	500	Delivers water from L-6 Canal to L-5 Canal
2	S-621	Gated Spillway	2500	Closed to direct STA 3/4 discharges to western L-5 Canal during normal operations; controls water from STA 3 /4 to the existing S-7 pump station during peak events
3	S-622	Gated Spillway	500	Delivers water from east to west in L-5 Canal (replaces existing L-5 canal plug)
4	S-8A	Gated Culverts with Canal	3080 & 1020	Existing S-8 pump station delivers water from L-5 Canal to Miami Canal; S-8A delivers water from Miami Canal to L-4 Canal (3120 cfs) and remaining Miami Canal segment (1040 cfs); potential design modifications to the existing S-8/G-404 complex will be assessed during PED
5	S-630	Pump Station	360	Delivers water from L-4 Canal west to maintain existing water supply deliveries
6		L-4 Levee Removal		Removes ~2.9 miles of south L-4 Levee
7		Miami Canal Backfill with Tree Islands Mounds		Remove ~ 13.5 miles of Miami Canal , from 1.5 miles south of S-8 to I-75; tree island mounds create habitat and promote sheetflow in WCA-3A within the footprint of the former Miami Conal
8		L-5 Remnant Canal	500	Enlarging canal to expand capacity of L-5 Canal (between S-621 & S-622)
9		L-5 Canal	3000	Enlarging canal to expand capacity of L-5 Canal (between S-622 & S-8)

Figure 4-3. TSP Northern Conveyance and Distribution Features and Location

4.1.3 Southern WCA 3A, WCA 3B, and ENP (Green/Blue Lines)

This includes conveyance features to deliver and distribute water from WCA3A to WCA 3B and ENP (**Figure 4-4**).

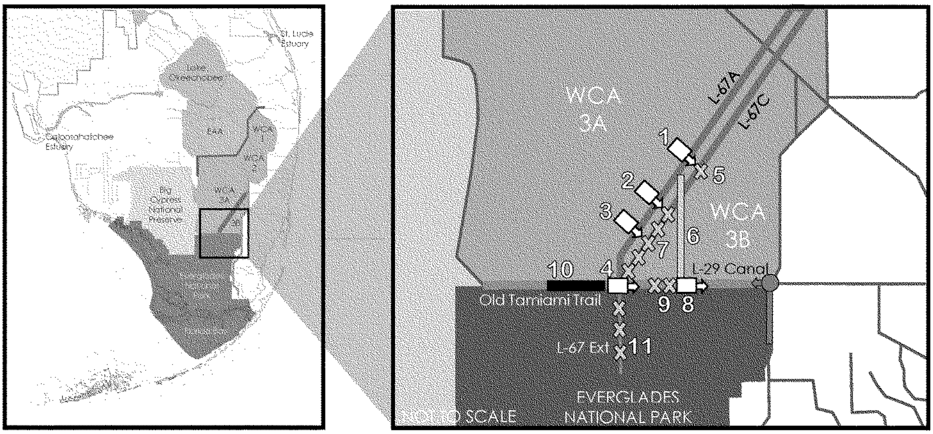
A new Blue Shanty levee extending from Tamiami Trail northward to the L-67A levee will be constructed. This Blue Shanty levee will divide WCA 3B into two subunits, a large eastern unit (3B-E) and a smaller western unit, the Blue Shanty Flowway (3B-W). A new levee is the most efficient means to restore continuous southerly sheetflow through a practicable section of WCA 3B and alleviates concerns over effects on tree islands by maintaining lower water depths and stages in WCA 3B-E. The width of the 3B-W flowway is aligned to the width of the downstream 2.6-Mile Tamiami Trail Next Steps bridge, optimizing the effectiveness of both the flowway and bridge.

In the western unit, construction of two new gated control structures on the L-67A, removal of the L-67C and L-29 Levees within the flowway, and construction of a divide structure in the L-29 Canal will enable continuous sheetflow of water to be delivered from WCA 3A through WCA 3B to ENP. A gated control structure will also be added to the L-67A, outside the flowway, to improve the hydroperiod of the eastern unit of WCA 3B.

Increased outlet capability at the S-333 structure at the terminus of the L-67A canal, removal of approximately 5.5 miles of the L-67 Extension Levee, and removal of approximately 6 miles of Old Tamiami Trail between the ENP Tram Road and the L-67 Extension Levee will facilitate additional deliveries of water from WCA 3A directly to ENP. Detailed design and construction of these features will consider improving recreation access and minimize project footprints due to the nature of these environmentally sensitive areas. Establishment of expanded maintenance easements along the old Tamiami Trail for existing and new infrastructure, to facilitate road modifications, maintenance and water delivery is recommended.

BLUE AND GREEN LINES

DISTRIBUTION AND CONVEYANCE



LEGEND: Pump | Gated Structure | Levee | Levee Removal | Road Removal | Yellow Line Features

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-631	Gated Culvert	500	Delivers water from WCA 3A to 3B, east of L-67D Levee
2	S-632	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
3	S-633	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
4	S-333 (N)	Gated Spillway w/new canal	1150	Delivers water from L-67A Canal to L-29 Canal; supplements existing S-333 gated spillway
5		L-67C Levee Removal Gap		Gap, ~ 6000 feet (corresponding to S-631)
6	L-67D	Blue Shanty Levee		Levee, ~ 8.5 miles, connecting from L-67A to L-29 (6 feet high, 14-foot crest width, 3:1 side slopes)
7		L-67C Levee Removal		Complete removal of ~ 8 miles from New Blue Shanty Levee (L-67D)south to intersection of L-67A/L-67C; L-67C canal is not backfilled
8	S-355W	Gated Spillway	1230	Maintains water deliveries to eastern L-29 Canal
9		Levee Removal (L-29)		Removal of ~ 4.3 miles between L-67A and Blue Shanty Levee intersection with L-29 Levee
10		Removal of remnants of Old Tamiami Trail roadway		Removal of ~ 6 miles of roadway west of L-67 Extension
11		L-67 Extension Levee Removal and Canal Backfill)		Complete removal of ~ 5.5 miles of remaining L-67 Extension, including S-346 culvert

Figure 4-4. TSP Southern Distribution and Conveyance Features and Location

4.1.4 Lower East Coast Protective Levee (Yellowline)

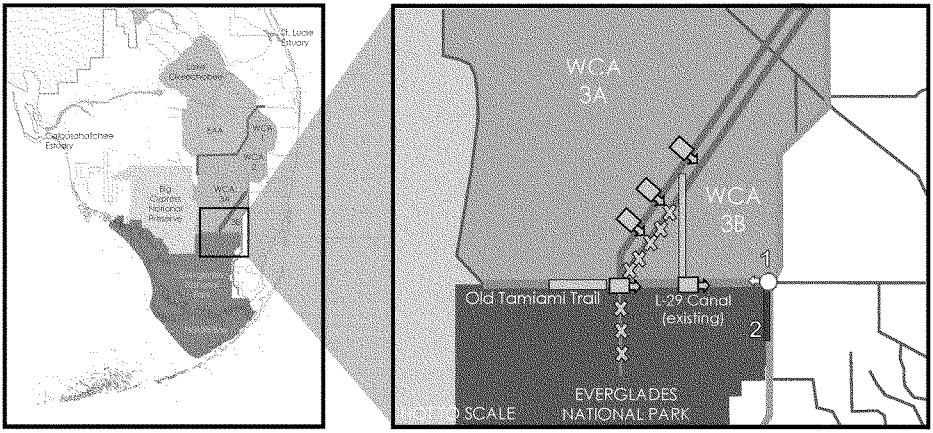
The LEC protective levee Includes features primarily for seepage management, which are required to mitigate for increased seepage resulting from the additional flows into WCA 3B and ENP (**Figure 4-5**).

A newly constructed pump station with a combined capacity of 1,000 cfs will replace the existing temporary S-356 pump station, and a 4.2 mile seepage barrier cutoff wall will be built along the L-31N Levee south of Tamiami Trail.

There is an existing 2-mile seepage cut-off wall in the same vicinity that was constructed by a permittee as mitigation. There is a possibility that the same permittee may construct an additional 5 miles of seepage wall south of the 2-mile seepage wall, if permitted. Since the capability and effectiveness of the existing seepage wall to mitigate seepage losses from ENP remains under investigation, the CEPP TSP conservatively includes an approximately 4.2 mile long, 35 feet deep tapering seepage barrier cutoff wall in the event construction is necessary.

YELLOW LINES

SEEPAGE MANAGEMENT



LEGEND: Pump | Gated Structure | Seepage Wall | Green Line/Blue Line Features

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-356	Pump Station	1000	Provides seepage management for WCA 3B and NESRS stages
2		Seepage Barrier Cutoff Wall		Soil cement bentonite (SCB) wall (~4.2 miles, 3 feet wide, 35 feet deep)

Figure 4-5. TSP Seepage Management Features and Location

4.2 PROJECT AUTHORITY

The 2000 Water Resources Development Act (WRDA) provided authority for future projects in Section 601(d)(1)(A) under the CERP project. Specific authorization for CEPP will be sought under Section 601(d) as a future CERP project:

(d) AUTHORIZATION OF FUTURE PROJECTS.—

(1) IN GENERAL.—Except for a project authorized by subsection (b) or (c), any project included in the Plan shall require a specific authorization by Congress.

(2) SUBMISSION OF REPORT.—Before seeking congressional authorization for a project under paragraph (1), the Secretary shall submit to Congress—

(A) a description of the project; and

(B) a project implementation report for the project prepared in accordance with subsections (f) and (h).

Sections 601(f) and (h) provide for evaluation of projects and assurance of project benefits. This is accomplished in Project Implementation Reports.

4.3 PROJECT GOAL, OBJECTIVES, CONSTRAINTS AND PERFORMANCE MEASURES

The goals of CEPP remain consistent with prior planning efforts of CERP (USACE 1999). Specific CEPP objectives were created to address the central part of the southern Florida ecosystem to improve the quantity, quality, timing, and distribution of water flows to the central Everglades, including WCA 3 and ENP.

4.3.1 Goal and Objectives

The six CEPP objectives were built upon the overall CERP goals and objectives (**Table 4-1**) in order to provide the needed linkages between the projects. 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"*.

Table 4-1. Goals and Objectives of CEPP. Goals and objectives for CERP are also depicted to acknowledge the direct linkage between the two projects.

CERP Objective	CEPP Objective
CERP GOAL: Enhance Ecological Values	
Increase the total spatial extent of natural areas	No corresponding CEPP objective; consider this objective in future increments
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 & industrial)	Increase availability of water supply to the Lake Okeechobee Service Area, Lower East Coast, and Broward
Reduce flood damages (agricultural/urban)	No corresponding CEPP objective; consider this objective in future increments
Provide recreational and navigation opportunities	Provide recreational opportunities
Protect cultural and archeological resources and values	Protect cultural and archeological resources and values

4.3.2 Constraints

Project constraints were recognized to ensure that the proposed project would not reduce the level of service for flood protection, protect existing legal users, and meet applicable water quality standards for the natural system. In accordance with Section 601(h)(5) of WRDA 2000 and Chapter 373.1501(4)(d), Federal Statute (F.S.), the following are constraints for CEPP implementation:

- Avoid any reduction in the existing level of service for flood protection caused by Plan implementation
- Provide replacement sources of water of comparable quantity and quality for existing legal users caused by Plan implementation
- Meet applicable Water Quality Standards

4.3.3 Performance Measures

The overall objective of CEPP is to rehydrate the Everglades through improvements in quantity, quality, timing, and distribution of flows. Rehydration within the Greater Everglades would improve habitat for some threatened and endangered species within the project area. The Corps and FWS, in conjunction with the multi-agency CEPP team, evaluated potential project effects on Everglade snail kite, wood stork, alligator, crocodile, vegetation, and Cape Sable seaside sparrow using performance measures (PMs) and ecological targets (ETs) for these species and their habitat previously developed for the Everglades Restoration Transition Plan (ERTP 2012). The ERTP PMs and ETs were adapted for use in CEPP and are defined as follows. The PMs are defined as a set of operational rules that identify optimal

WCA 3A water stages and recession rates to improve conditions in WCA 3A for Everglade snail kite, wood stork, wading birds, and tree islands. The ERTP PM-A addresses the nesting window for Cape Sable Seaside Sparrow subpopulation A (CSSS-A), as outlined in the 1999 FWS Reasonable and Prudent Alternative (RPA; FWS 1999). The ETs are designed to support the intention of PMs by providing hydroperiod guidelines to help maintain appropriate nesting and foraging habitat. For example, ET-1 outlines a NP-205 stage of less than 7.0 feet National Geodetic Vertical Datum (NGVD) by December 31. Based upon NP-205 recession rate calculations, a stage of less than 7.0 at NP-205 on December 31 will enable water levels to reach less than 6.0 feet NGVD by mid-March (PM-A). As referenced in the ERTP PMs and ETs, **Figure 4-6** shows the locations of the gages.

The FWS, along with Wiley Kitchens, Ph.D. of the University of Florida, Phil Darby, Ph.D. of the University of West Florida, and Christa Zweig, Ph.D. of the University of Florida, developed a series of water depth recommendations for WCA 3A that addresses the needs of the Everglade snail kite, apple snail, and vegetation characteristics of their habitat (**Figure 4-7**). This water management strategy is divided into three time periods representing the height of the wet season (September 15 to October 15), the pre-breeding season (January) and the breeding season (termed dry season low, May 1 to June 1) and illustrates appropriate water depths to attain within each time period. Water depth recommendations as measured at the WCA 3AVG (average of Site 63 [Gage 3A-3], Site 64 [Gage 3A-4] and Site 65 {Gage 3A-28]) proposed within the FWS Multi-Species Transition Strategy (MSTS, FWS 2010) form the basis for ERTP PMs and ETs. Please note that these water depths are not targets, but used as guidance and represent a compromise between the needs of the multiple species. Inter-annual variability is extremely important in the management of the system to promote recovery of the species.

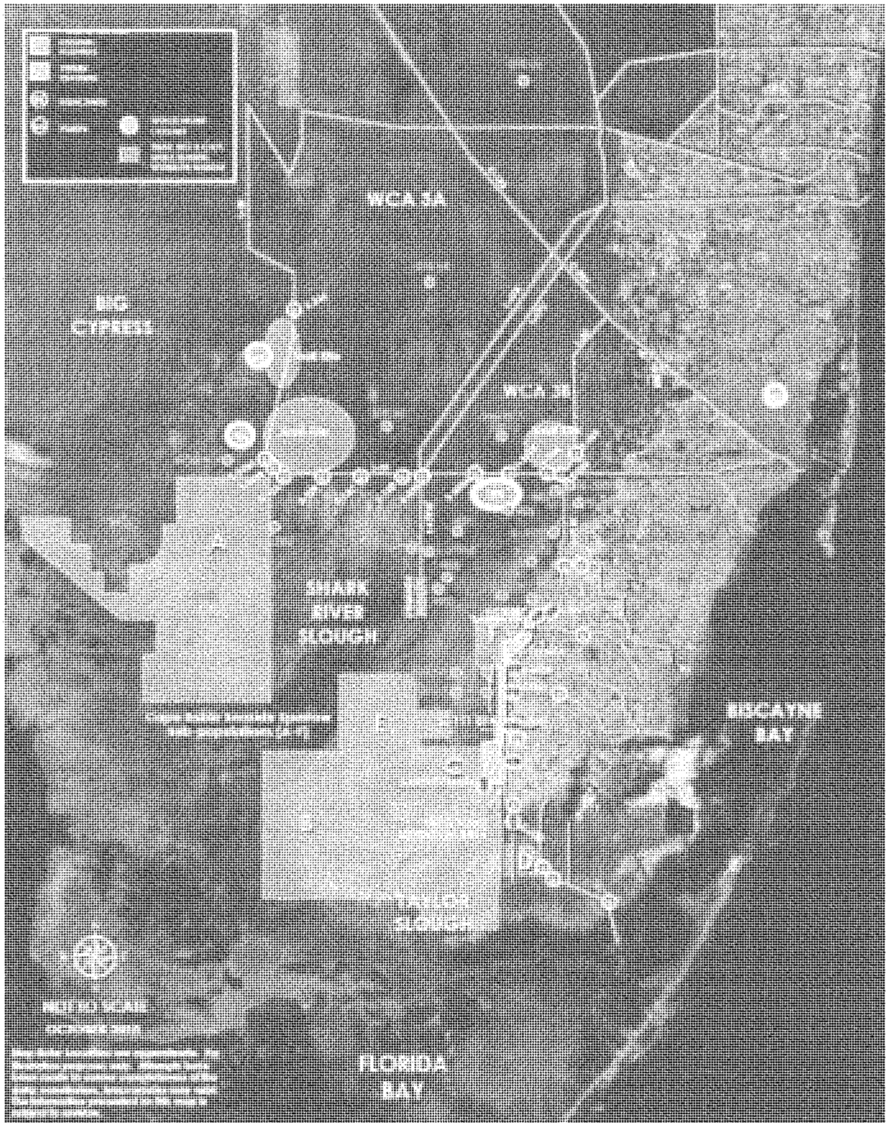


Figure 4-6. Location of gages within the CEPP action area as referenced in the Everglades Restoration Transition Plan Performance Measures and Ecological Targets

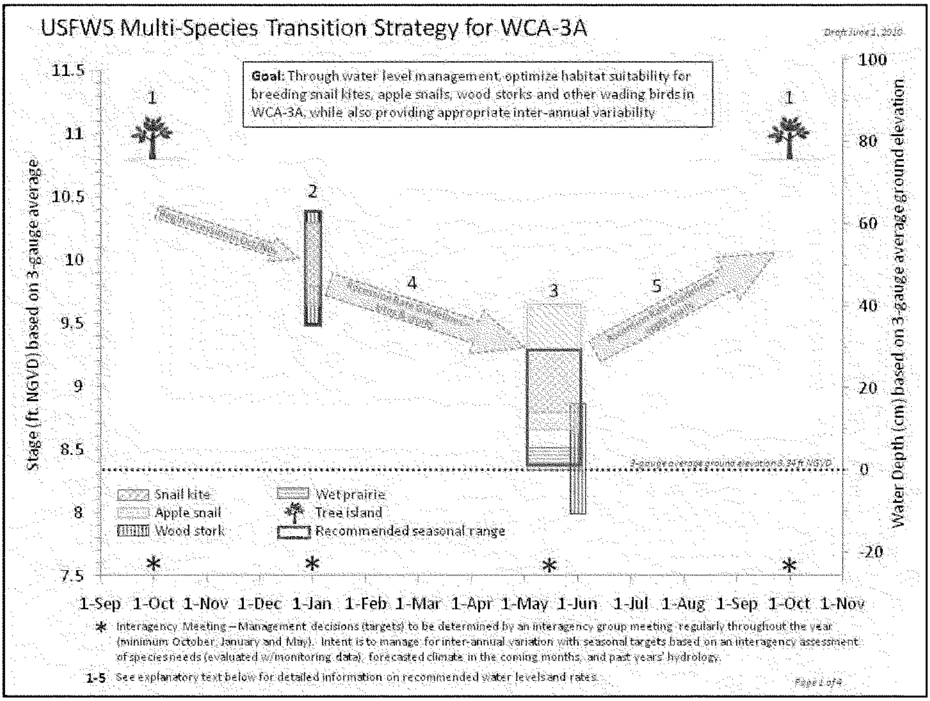


Figure 4-7. U.S. Fish and Wildlife Service Multi-Species Transition Strategy for Water Conservation Area 3A

The FWS MSTS (2010) for WCA 3A includes species-specific ranges (windows) which reflect water levels or water depths identified by species experts based on the best available science that are believed to provide optimal conditions for wading bird breeding and foraging as well as tree island considerations.

Many ERTP PMs and ETs were used to evaluate potential effects of CEPP on threatened and endangered species within the project area (**Table 4-2**). It is important to note that for the evaluation of potential effects on Everglade snail kite, PM-B and PM-C were adapted in order to evaluate depths within specific areas throughout WCA 3A and WCA 3B to give a broader spatial perspective of habitat suitability. Additional detail is located within **Section 6.2.6** of this document. In addition, Ecological Planning Tools were also used to evaluate potential project effects on listed species. Ecological Planning Tools used within this assessment include, Alligator Production Model (South Florida Natural Resources Center [SFNRC] 2013a), Juvenile Crocodile Habitat Suitability Index (Brandt 2013), Apple Snail Production Model (SFNRC 2013d), and Wood Stork Foraging Potential Model (SFNRC 2013b). Further details of these models and analyses are outlined in further detail within relevant sections of this document.

In addition to the PMs and ETs mentioned above, additional hydrologic and ecologic PMs developed by CERP's interagency science group, the Restoration, Coordination, and Verification group, (RECOVER) were used in the evaluation of alternative plans and assessment of CERP performance from a system-wide perspective. RECOVER PMs identify hydrologic and ecological indicators expected to respond to implementation of CERP and are developed from Conceptual Ecological Models (CEMs) 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.

Table 4-2. ERTP Performance Measures Used to Evaluate Potential CEPP Effects on Threatened and Endangered Species CEPP

Species	PM	Description of PM
CSSS	A	*NP-205 (CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 15*
Everglade Snail kite	B	*WCA-3A: For Everglade snail kites, strive to reach waters levels between 9.8 and 10.3 feet NGVD by December 31, and between 8.8 and 9.3 feet between May 1 and June 1.*
	C	*WCA-3A: For apple snails, strive to reach water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet between May 1 and June 1.*
	D	*WCA-3A (Dry Season Recession Rate): Strive to maintain a recession rate of 0.05 feet per week from January 1 to June 1 (or onset of the wet season). This equates to a stage difference of approximately 1.0 feet between January and the dry season low.*
	E	*WCA-3A (Wet Season Rate of Rise): Manage for a monthly rate of rise less than or equal to 0 .25 feet per week to avoid drowning of apple snail egg clusters.*

*Note: All stages for WCA-3A are as measured at WCA 3- gage average [WCA-3AVG] [Sites 63, 64, 65])

4.3.4 Ecological Targets

Cape Sable Seaside Sparrow

1. NP-205 (CSSS-A): Strive to reach a water level of less than ar equal to 7.0 feet NGVD at NP-205 by December 31 for nesting season water levels to reach 6.0 feet NGVD by mid- March.

2. CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation (hydroperiod depths depend upon averages of gauges).

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

The following describes existing conditions within the action area. **Table 5-1** provides a brief description of each region of the study area.

5.1 Existing Conditions

Table 5-1. Existing Conditions of the CEPP Study Area

CEPP Study Area Region	Description of the Study Area Region
Lake Okeechobee	Lake Okeechobee is a large, shallow lake (surface area 730 square miles) 30 miles west of the Atlantic coast and 60 miles east of the Gulf of Mexico. 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). The lake is surrounded by the 143 mile long Herbert Hoover Dike. The lake has many functions, including flood risk management, urban and agricultural water supply, navigation, recreation, fisheries, and wildlife habitat. It is critical for flood control during wet seasons and water supply during dry seasons. Agriculture in the Lake Okeechobee Service Area (LOSA), including the EAA, is the predominate user of lake water.

CEPP Study Area Region	Description of the Study Area Region
	The lake is an economic driver for both the surrounding areas and south Florida's economy.
Northern Estuaries	Lake Okeechobee discharges into the 2 Northern Estuaries. The St. Lucie Canal flows eastward into the St. Lucie Estuary, which is part of the larger Indian River Lagoon Estuary. The Caloosahatchee Canal/River flows westward into the Caloosahatchee Estuary and San Carlos Bay, which are part of the larger Charlotte Harbor Estuary. The St. Lucie and Caloosahatchee estuaries are designated Estuaries of National Significance, and the larger Indian River Lagoon and Charlotte Harbor estuaries are part of the U.S. Environmental Protection Agency (USEPA)-sponsored National Estuary Program. The landscape includes pine-flatwoods, wetlands, mangrove forests, submerged aquatic vegetation, estuarine benthic areas (mud and sand) and near-shore reefs.
Everglades Agricultural Area	The EAA is approximately 630,000 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. The landscape includes natural and man-made areas of open water such as canals, ditches, and ponds, wetlands, and lands associated with agricultural and urban use. Within the EAA there is approximately 45,000 acres of STAs and the Holey Land and Rotenberg Wildlife Management Areas.
Water Conservation Areas	WCA 1, WCA 2, and, WCA 3 (the largest of the three) are situated southeast of the EAA and are approximately 1,328 square miles. The WCAs extend from EAA to ENP. They provide floodwater retention, public water supply, and are the headwaters of ENP. The landscape includes open water sloughs, sawgrass marshes, and tree islands.
Everglades National Park	ENP was established in 1947, covering ~2,353 square miles (total elevation changes of only 6 feet from its northern boundary at Tamiami Trail south to include much of Florida Bay). The landscape includes sawgrass sloughs, tropical hardwood hammocks, mangrove forest, lakes, ponds, and bays.
Florida Bay	Florida Bay is a shallow estuarine system (average depth less than 3 feet comprising a large portion of ENP. It 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. The landscape includes saline emergent wetlands, seagrass beds, and mangrove forests.
Lower East Coast	The LEC encompasses Palm Beach, Broward, Monroe and Miami-Dade Counties. Water levels in this area are highly controlled by the Central and Southern Florida (C&SF) water management system to provide flood damage reduction and sufficient water supply to minimize the risk of detrimental saltwater intrusion. The CEPP is focused on the portions of the LEC adjacent to the natural areas and susceptible to seepage.

5.1.1 Vegetative Communities

5.1.1.1 Lake Okeechobee

The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. Historically the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, pond apple forests, and pine flatwoods. Freshwater marshes were the predominant cover type throughout, especially along the southern portion of Lake Okeechobee where it flowed into the Everglades. These marshes were 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*) occurred in riverine areas feeding Lake Okeechobee, while cypress swamps were found in depressional areas throughout the region. Pine flatwoods composed of slash pine (*Pinus elliottii*), cabbage palm (*Sabal palmetto*), and saw palmetto (*Serenoa repens*) were prevalent in upland areas especially to the north.

The majority of the surface of Lake Okeechobee is not vegetated and provides open water (pelagic) habitat. Open water habitat within Lake Okeechobee covers about 75% of the lake's surface area. Lake Okeechobee has an extensive littoral zone that occupies approximately 150 square miles (about 25 percent) of the lake's surface (Milleson 1987). Littoral vegetation occurs along much of Lake Okeechobee's perimeter, but is most extensive along the southern and western borders (Milleson 1987). The littoral zone plant community is composed of a mosaic of emergent and submergent plant species. Emergent vegetation within the littoral zone is dominated by herbaceous species such as cattail (*Typha spp.*), spike rush (*Eleocharis cellulose*), and torpedo grass (*Panicum repens*) an invasive exotic species. 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*), sourthern 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 melaleuca (*Melaleuca quiquenervia*), an invasive exotic species. Over the years, there has been an on-going effort to eradicate melaleuca. The eradictation effort has been extremely effective.

The submerged vegetation is composed almost entirely of hydrilla (*Hydrilla verticillata*), which is an invasive exotic species, pondweed (*Potoamogeton illinoensis*), bladderwort (*Utricularia spp.*), Chara (*Chara spp.*), 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*), water hyacinth (*Eichhornia crassipes*) which is an invasive exotic species, water lettuce (*Pistia stratiotes*), duckweed (*Lemna spp.*), coinwort (*Hydrocotyle umbellate*), and ludwigia (*Ludwigia leptocarpa*).

5.1.1.2 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 CCMP, 1996). Many commercial and recreational fisheries (i.e. clams, shrimp, lobster, fish) are associated with healthy seagrass beds (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.

5.1.1.2.1 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 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).

The effects of hurricane water releases in 2005 resulted in decreased plant cover and density in the latter half of 2005. Compounding the high turbidity effects from freshwater releases in 2005, precipitous increases in salinities beginning in October 2006 raised salinity levels from 10 to 25 psu from November 2006 through April 2008. During the December 2005 to April 2006 period, the lower water clarity 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 recovery has been slow. This may be related to a lack of propagules as nearly all the *V. americana* was lost during the 2007 to 2008 high salinity period. It may also be related to herbivory or other impacts on the initial recolonization of recruits into the area (RECOVER 2009).

5.1.1.2.2 Lower Caloosahatchee River 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.

5.1.1.2.3 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.

5.1.1.3 Everglades Agricultural Area

Currently, much of the native south Florida landscape has been destroyed or substantially reduced by development, hydrologic change, increased nutrients, and the invasion of exotic plants. South of Lake Okeechobee, the historic pond apple swamps and sawgrass marshes have been converted to agriculture. Habitat types within the EAA are divided into five general groups: aquatic, wetland, upland, disturbed (mostly agricultural), and urban/extractive.

The aquatic communities within the EAA include both natural and man-made areas of open water such as canals, ditches, and ponds. The primary canals include Bolles, Cross, Hillsboro, Miami, North New River, and West Palm Beach. All of Compartment A of the Talisman Land Exchange property is considered to be atypical jurisdictional wetlands based on hydric soils and hydrology. Wetland vegetation is anticipated to return to the site should agricultural practices cease. Upland land cover classes include dry prairie, hardwood hammock and forests, pinelands, and mixed hardwood pine forests. Disturbed communities consist of mostly agricultural lands including pasture (improved and unimproved), row crops, sugarcane, citrus, and other agricultural lands. Most of the urban and extractive lands are concentrated around the Belle Glade area. Low impact urban areas consist of either vegetated or non vegetated lands within areas such as lawns, golf courses, road shoulders, and grassy areas surrounding development. High impact urban areas are non vegetated sites such as buildings, roads, and parking lots. Extractive cover areas consist of surface mining operations such as limestone quarries, phosphate mines, and sand pits as well as the associated industrial complexes.

5.1.1.4 Greater Everglades

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 hydrologic regime (FWS 1999). These communities generally occur along a hydrologic 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 Everglades freshwater wetlands eventually grade into intertidal mangrove wetlands and sub tidal 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 2.96 million acres 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.

Many areas of WCA 3A still contain relatively good wetland habitat consisting of a complex of tree islands, sawgrass marshes, wet prairies, and aquatic sloughs. However, reduced freshwater inflow and drainage by the Miami Canal has overdrained the northern portion of WCA 3A, resulting in increased fire frequency and the associated loss of tree islands, wet prairie, and aquatic slough habitat. Northern WCA 3A is currently dominated largely by mono-specific sawgrass stands and lacks the diversity of communities that exists in southern WCA 3A. In southern WCA 3A, Wood and Tanner (1990) documented the trend toward deep water lily dominated sloughs due to impoundment. In approximately 1991, the hydrology of southern WCA 3A shifted to the deeper water and extended hydroperiods of the new, wet hydrologic era resulting in a northward shift in slough vegetation communities within the WCA 3A impoundment (Zweig and Kitchens 2008). Typical Everglades vegetation, including tree islands, wet prairies, sawgrass marshes, and aquatic sloughs also occurs throughout WCA 3B. However, a shift in vegetation has occurred in WCA 3B toward shorter hydroperiod sawgrass marshes.

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 et al. 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).

In contrast to the vast extent of wetland communities, upland communities comprise a relatively small component of the Everglades landscape and are largely restricted to Long Pine Key, the northern shores of Florida Bay, and the many tree islands scattered throughout the region. Vegetative communities of Long Pine Key include rockland pine forest and tropical hardwood forest. In addition, substantial areas of tropical hardwood hammock occur along the northern shores of Florida Bay and on elevated portions of some forested islands.

5.1.1.4.1 Slough/Open Water Marsh

The slough/open water marsh community occurs in the lowest, wettest areas of the Everglades. This community is a complex of open water marshes containing emergent, floating aquatic, and submerged aquatic vegetation components. The emergent marsh vegetation is typically dominated by spikerushes

(*Eleocharis cellulosa* and *E. elongata*), beakrushes (*Rhynchospora tracyi* and *R. inundata*), and maidencane (*Panicum hemitomon*). Common floating aquatic dominants include fragrant water lily (*Nymphaea odorata*), floating hearts (*Nymphoides aquatica*), and spatterdock (*Nuphar lutea*); and the submerged aquatic community is typically dominated by bladderwort (*Utricularia foliosa*) and periphyton. As shown by Davis et al. (1994), vegetative trends in ENP have included the conversion of slough/open-water marsh communities to shorter hydroperiod sawgrass marshes.

5.1.1.4.2 Sawgrass Marsh

Sawgrass marshes are dominated by dense to sparse stands of *Cladium jamaicense*. Sawgrass marshes occurring on deep organic soils (more than one meter) form tall, dense, nearly monospecific stands. Sawgrass marshes occurring on shallow organic soils (less than one meter) form sparse, short stands that contain additional herbaceous species such as spikerush, water hyssop (*Bacopa caroliniana*), and marsh mermaid weed (*Proserpinaca palustris*) (Gunderson et al. 1997). The adaptations of sawgrass to flooding, burning, and oligotrophic conditions contribute to its dominance of the Everglades vegetation. Sawgrass-dominated marshes once covered an estimated 300,000 acres of the Everglades. Approximately 70,000 acres of tall, monospecific sawgrass marshes have been converted to agriculture in the EAA. Urban encroachment from the east and development within other portions of the Everglades has consumed an additional 79,000 acres of sawgrass-dominated communities (Davis and Ogden 1997).

5.1.1.4.3 Wet Marl Prairies

Wet marl prairies occur on marl soils and exposed limestone and experience the shortest hydroperiods of the slough/marsh/prairie wetland complex. Marl prairie is a sparsely vegetated community that is typically dominated by muhly grass (*Muhlenbergia capillaris*) and short-stature sawgrass. Additional important constituents include black sedge (*Schoenus nigricans*), arrowfeather (*Aristida purpurascens*), Florida little bluestem (*Schizachyrium rhizomatum*), and Elliot's lovegrass (*Eragrostis elliottii*). Periphyton mats that grow loosely attached to the vegetation and exposed limestone also form an important component of this community. Marl prairies occur in the southern Everglades along the eastern and western periphery of Shark River slough (SRS). Approximately 146,000 acres of the eastern marl prairie have been lost to urban and agricultural encroachment (Davis and Ogden 1997). Prior to the modifications, plant communities at the sites analyzed by Bernhardt and Willard (2006) in western SRS consisted of sawgrass marshes. Based on their analysis of pollen records, the authors concluded that "the current spatial distribution and community composition of marl prairies are a response to water management and land cover changes of the twentieth century, and further sampling of modern marl prairie communities and adjacent communities is necessary to document the pre- and post-drainage distribution of marl prairie" (Bernhardt and Willard 2006).

5.1.1.4.4 Tree Islands

Tree islands occur within the freshwater marshes on areas of slightly higher elevation relative to the surrounding marsh. The lower portions of tree islands are dominated by hydrophytic, evergreen, broad-leaved hardwoods such as red bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), dahoon holly (*Ilex cassine*), and pond apple (*Annona glabra*). Tree islands typically have a dense shrub layer that is dominated by coco-plum (*Chrysobalanus icaco*). Additional constituents of the shrub layer commonly include buttonbush (*Cephalanthus occidentalis*) and large leather fern (*Acrostichum danaeifolium*). Elevated areas on the upstream side of some tree islands may contain an upland tropical hardwood hammock community dominated by species of West Indian origin (Gunderson et al. 1997), with species composition shifting toward the north toward more temperate hardwood hammock species. Extended periods of flooding may result in tree mortality and conversion to a non-forested community. In the over-drained areas of WCA 3A, historic wildfires have consumed tree island vegetation and soils. Overall, the spatial extent of tree islands in WCA 3 declined by 61% between 1940 and 1995 (Patterson and Finck 1999). Portions of the WCAs have been flooded to the extent that many forested islands have lost all tropical hardwood hammock trees. Tree islands are considered an extremely important contributor to habitat heterogeneity and overall species diversity within the Everglades ecosystem because they provide nesting habitat and refugia for birds and upland species and serve as hotspots of plant species diversity within the Greater Everglades (Sklar et al. 2002, FWS 1999).

5.1.1.4.5 Mangroves

Mangrove communities are forested wetlands occurring in intertidal, low-wave-energy, estuarine, and marine environments. 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 psu. Florida Bay experiences salinities in excess of 40 psu 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*).

5.1.1.4.6 Seagrass Beds

Seagrasses are submerged vascular plants that form dense rooted beds in shallow estuarine and marine environments. This community occurs in sub tidal 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 psu, but can tolerate considerable short-term salinity fluctuations. Large-scale seagrass die-off has occurred in Florida Bay since 1987, with over 18 percent 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).

5.1.1.4.7 Rockland Pine Forest

Pine rocklands within the project area occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. Pine rocklands occur on relatively flat terrain with moderately to well-drained soils. Most sites are wet for only short periods following heavy rains (Florida Natural Areas Inventory 1990). Limestone bedrock is close to the surface and the soils are typically shallow accumulations of sand, marl, and organic material. Pine rockland is an open, savanna-like community with a canopy of scattered south Florida slash pine (*Pinus elliottii* var. *densa*) and an open, low-stature understory. This is a fire-maintained community that requires regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson et al. 1997). The overstory is comprised of scattered south Florida slash pines. The shrub layer is comprised of a diverse assemblage of tropical and temperate species. Common shrubs include cabbage palm (*Sabal palmetto*), coco-plum (*Chrysobalanus icaco*), myrsine (*Rapanea punctata*), saw palmetto (*Serenoa repens*), southern sumac (*Rhus copallinum*), strangler fig (*Ficus aurea*), swamp bay (*Persea palustris*), wax myrtle (*Myrica cerifera*), white indigo berry (*Randia aculeata*), and willow-bustic (*Sideroxylon salicifolium*). The herbaceous stratum is comprised of a very diverse assemblage of grasses, sedges, and forbs. Common herbaceous species include crimson bluestem (*Schizachyrium sanguineum*), wire bluestem (*Schizachyrium gracile*), hairy bluestem

(*Andropogon longiberbis*), bushy bluestem (*Andropogon glomeratus* var. *pumilis*), candyweed (*Polygala grandiflora*), creeping morning-glory (*Evolvulus sericeus*), pineland heliotrope (*Heliotropium polyphyllum*), rabbit bells (*Crotolaria rotundifolia*), and thistle (*Cirsium horridulum*) (FWS 1999). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, fragmentation, fire suppression, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rockland (FWS 1999).

5.1.1.4.8 Tropical Hardwood Hammock

Tropical hardwood hammocks occur on upland sites where limestone is near the surface. Tropical hardwood hammocks within the action area occur on the Miami Rock Ridge, along the northern shores of Florida Bay, and on elevated outcrops on the upstream side of tree islands. This community consists of a closed canopy forest dominated by a diverse assemblage of hardwood tree species, a relatively open shrub layer, and a sparse herbaceous stratum. This community is dominated by native south Florida species that represent the northern extension of the ranges of species that occur throughout the West Indies, but nowhere else in the continental United States. Common canopy species include gumbo-limbo (*Bursera simaruba*), paradise tree (*Simarouba glauca*), pigeon-plum (*Coccoloba diversifolia*), strangler fig, wild mastic (*Sideroxylon foetidissimum*), willow-bustic, live oak (*Quercus virginiana*), short-leaf fig (*Ficus citrifolia*), and wild tamarind (*Lysiloma bahamense*). Common understory species include black ironwood (*Krugiodendron ferreum*), inkwood (*Exothea paniculata*), lancewood (*Ocotea coriacea*), marlberry (*Ardisia escallonoides*), poisonwood (*Metopium toxiferum*), satinleaf (*Chrysophyllum oliviforme*), and white stopper (*Eugenia axillaris*). Common species of the sparse shrub/herbaceous layer include shiny-leaf wild-coffee (*Psychotria nervosa*), rouge plant (*Rivinal humilis*), false mint (*Dicliptera sexangularis*), bamboo grass (*Lasciacis divaricata*), and woods grass (*Oplismenus hirtellus*). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. Fragmentation of remaining tracts, invasion by exotic species, and alterations of water table elevations have also had negative impacts on this community. Tropical hardwood hammocks on the Miami Rock Ridge have been affected by a lowered water table associated with the reduction of freshwater flow through the Everglades. In contrast, tree islands in the WCAs have been flooded to the extent that many have lost all tropical hardwood hammock trees.

5.1.2 Fish and Wildlife Resources

Aquatic macro invertebrates form a vital link between the algal and detrital food web base of freshwater wetlands and the fishes, amphibians, reptiles, and wading birds that feed upon them. Important macro invertebrates of the freshwater aquatic community include crayfish (*Procambarus alleni*), riverine grass shrimp (*Palaemonetes paludosus*), amphipods (*Hyallela aztecus*), Florida apple snail (*Pomacea paludosa*), Seminole ramshorn (*Planorbella duryi*), and numerous species of aquatic insects (USACE 1999).

Small freshwater marsh fishes are also important processors of algae, plankton, macrophytes, and macro invertebrates. Marsh fishes provide an important food source for wading birds, amphibians, and reptiles. Common small freshwater marsh species include the native and introduced golden topminnow (*Fundulus chrysotus*), least killifish (*Heterandria formosa*), Florida flagfish (*Jordenella floridae*), golden shiner (*Notemigonus crysoleucas*), sailfin molly (*Poecilia latipinna*), bluefin killifish (*Lucania goodei*), oscar (*Astronotus ocellatus*), eastern mosquitofish (*Gambusia holbrookii*), and small sunfishes (*Lepomis* spp.) (USACE 1999). The density and distribution of marsh fish populations fluctuates with seasonal changes in water levels. Populations of marsh fishes increase during extended periods of continuous flooding during the wet season. As marsh surface waters recede during the dry season, marsh fishes become concentrated in areas that hold water through the dry season. Concentrated dry season assemblages of marsh fishes are more susceptible to predation and provide an important food source for wading birds (USACE 1999).

Within the Greater Everglades, numerous sport and larger predatory fishes occur in deeper canals and sloughs. Common species include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), yellow bullhead (*Ameiurus natilis*), white catfish (*Ameiurus catus*), bowfin (*Amia calva*), and tilapia (*Tilapia* spp.) (USACE 1999). Larger fishes are an important food source for wading birds, alligators, otters, raccoons, and mink.

The freshwater wetland complex supports a diverse assemblage of reptiles and amphibians. Common amphibians include the greater siren (*Siren lacertina*), Everglades dwarf siren (*Pseudobranchus striatus*), two-toed amphiuma (*Amphiuma means*), pig frog (*Rana grylio*), southern leopard frog (*Rana sphenocephala*), Florida cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), squirrel tree frog (*Hyla squirela*), and green tree frog (*Hyla cinerea*) (USACE 1999). Amphibians represent an important forage base for wading birds, alligators, and larger predatory fishes (USACE 1999).

Common reptiles of freshwater wetlands include the American alligator (*Alligator mississippiensis*), snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*Kinosternon subrubrum*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), Florida softshell turtle (*Trionys ferox*), water snake (*Natrix sipidon*), green water snake (*Natrix cyclopion*), mud snake (*Francia abacura*), and Florida cottonmouth (*Agkistrodon piscivorus*) (USACE 1999).

The alligator was historically most abundant in the peripheral Everglades marshes and freshwater mangrove habitats, but is now most abundant in canals and the deeper slough habitats of the central Everglades. Drainage of peripheral wetlands and increasing salinity in mangrove wetlands as a result of decreased freshwater flows has limited the occurrence of alligators in these habitats (Mazzotti and Brandt 1994).

The freshwater wetlands of the Everglades are noted for their abundance and diversity of colonial wading birds. Common wading birds include the white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodius*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), green-backed heron (*Butorides striatus*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), roseate spoonbill (*Ajaia ajaja*), and wood stork (*Mycteria americana*) (USACE 1999). The number of wading birds nesting in the Everglades has decreased by approximately 90 percent, and the distribution of breeding birds has shifted away from ENP into the WCAs (Bancroft et al. 1994). The WCAs support fewer numbers of breeding pairs with relatively lower reproductive success (USACE 1999). Water management practices and wetland losses are believed to be the primary cause of the declines (Bancroft et al. 1994).

Mammals that are well-adapted to the aquatic and wetland conditions of the freshwater marsh complex include the rice rat (*Oryzomys palustris natator*), round-tailed muskrat, and river otter (*Lutra canadensis*). Additional mammals that may utilize freshwater wetlands on a temporary basis include the white-tailed deer (*Odocoileus virginianus*), Florida panther (*Puma concolor coryi*), bobcat (*Lynx rufus*), and racoon (*Procyon lotor*).

Many of the fish and wildlife resources that inhabit the freshwater aquatic community of the Everglades are also common to Lake Okeechobee, the Northern Estuaries, and the EAA. Native habitat for fish and wildlife does not comprise a significant amount of the EAA as the alteration of the landscape for agricultural uses has resulted in the removal of nearly all historically occurring native vegetation. Although abundant wetland habitat has been replaced by agriculture, the creation of ditches, canals, and the flooding of fallow agricultural fields provides some habitat for fish and wildlife, particularly during the rainy season.

The Northern Estuaries are also home to fish and wildlife species found in estuarine and marine habitats. Sea grasses and other submerged aquatic vegetation within the Northern Estuaries provide important habitat and nursery grounds for several fish species. Many fish species spend part or all of their life in the estuary. Common recreational and commercial fish species include mutton snapper (*Lutjanus analis*), yellowtail snapper (*Ocyurus chrysurus*), lane snapper (*Lutjanus synagris*), yellowtail parrot fish (*Sparisoma rubripinne*), gag grouper (*Mycteroperca microlepis*), pinfish (*Lagodon rhomboids*), tarpon (*Megalops atlanticus*), common snook (*Centropomus undecimalus*), crevalle jack (*Cranx hippos*), spotted sea trout (*Cynoscion nebulosus*), redfish (*Sciaenops ocellatus*), mullet (*Mugil spp.*), and sheepshead (*Archosargus probatocephalus*). In addition to finfish, the estuaries support a variety of shellfish. Blue crabs, stone crabs, hard clams, and oysters are important estuarine commercial species. Submerged aquatic vegetation and algal communities are also common foraging areas for the green sea turtle. The Northern Estuaries provides forage for seabords (gulls, terns, pelicans, and others), in addition to a large number of wading birds. The Northern Estuaries are also home to marine mammals such as the Atlantic bottlenose dolphin (*Tursiops truncatus*).

5.2 FEDERALLY LISTED SPECIES

Forty federally listed threatened and endangered species are either known to exist or potentially exist within the project area and, subsequently, may be affected by the proposed project. Many of these species have been previously affected by habitat impacts resulting from wetland drainage, alteration of hydroperiod, wildfire, and water quality degradation. The Corps has coordinated the existence of federally listed species with FWS and with NMFS, as appropriate. Specifically, coordination with NMFS includes listed fish, whales, and sea turtles at sea. Separate coordination with the NMFS has been initiated to assess potential affects to marine species. Coordination with FWS includes other listed plants and animals (**Table 5-2**).

Table 5-2. Status of Threatened and Endangered Species Potentially Affected by CEPP and the Corps' Affect Determination on Federally Listed Species (E: Endangered, T:Threatened, SC: Species of Special Concern, SA: Similarity of Appearance, CH: Critical Habitat; Pr E: Proposed Endangered; Pr CH: Proposed Critical Habitat).

Common Name	Scientific Name	Status	Agency	Determination
Mammals				
Florida bonneted bat	*Eumops floridanus*	Pr E	Federal	No Effect
Florida panther	*Puma concolor coryi*	E	Federal	May Affect
Florida manatee	*Trichechus manatus latirostris*	E, CH	Federal	May Affect
Big Cypress fox squirrel	*Sciurus niger avicennia*	T	State	
Florida black bear	*Ursus americanus floridanus*	T	State	
Everglades mink	*Mustela vison evergladensis*	T	State	

Common Name	Scientific Name	Status	Agency	Determination
Florida mouse	*Podomys floridanus*	SC	State	
Florida mastiff bat	*Eumops glaucinus floridanus*	E	State	
Shermans fox squirrel	*Sciurus niger shermani*	SC	State	
Blue whale*	*Balaenoptera musculus*	E	Federal	No Effect
Finback whale*	*Balaenoptera physalus*	E	Federal	No Effect
Humpback whale*	*Megaptera novaeangliae*	E	Federal	No Effect
Sei whale*	*Balaenoptera borealis*	E	Federal	No Effect
Sperm whale*	*Physeter macrocephalus*	E	Federal	No Effect
Birds				
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	Federal	May Affect
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	Federal	May Affect
Northern crested caracara	*Caracara cheriway*	T	Federal	No Effect
Piping plover	*Charadrius melodus*	T	Federal	No Effect
Red-cockaded woodpecker	*Picoides borealis*	E	Federal	No Effect
Roseate tern	*Sterna dougallii dougallii*	T	Federal	No Effect
Wood stork	*Mycteria americana*	E	Federal	May Affect
American oystercatcher	*Haematopus palliatus*	SC	State	
Black skimmer	*Rynchops niger*	SC	State	
Brown pelican	*Pelecanus occidentalis*	SC	State	
Burrowing owl	*Athene cunicularia*	SC	State	
Florida sandhill crane	*Grus canadensis pratensis*	T	State	
Least tern	*Sterna antillarum*	T	State	
Limpkin	*Aramus guarauna*	SC	State	
Little blue heron	*Egretta caerulea*	SC	State	
Reddish egret	*Egretta rufescens*	SC	State	
Roseate spoonbill	*Platalea ajaja*	SC	State	
Snowy egret	*Egretta thula*	SC	State	
Snowy plover	*Charadrius alexandrinus*	T	State	
Tricolored heron	*Egretta tricolor*	SC	State	
White-crowned pigeon	*Columba leucocephalus*	T	State	
White ibis	*Eudocimus albus*	SC	State	
Reptiles				
American alligator	*Alligator mississippiensis*	T/SA	Federal	May Affect
American crocodile	*Crocodylus acutus*	T, CH	Federal	May Affect
Eastern indigo snake	*Drymarchon corais couperi*	T	Federal	May Affect
Green sea turtle*	*Chelonia mydas*	E, CH**	Federal	May Affect
Hawksbill sea turtle*	*Eretmochelys imbricata*	E, CH**	Federal	May Affect
Kemp's Ridley sea turtle*	*Lepidochelys kempii*	E	Federal	May Affect
Leatherback sea turtle*	*Dermochelys coriacea*	E, CH**	Federal	May Affect
Loggerhead sea turtle*	*Caretta caretta*	T	Federal	May Affect
Gopher tortoise	*Gopherus polyphemus*	SC	State	
Miami black-headed snake	*Tantilla oolitica*	T	State	No Effect
Fish				
Gulf sturgeon*	*Acipenser oxyrinchus desotoi*	T, CH**	Federal	No Effect
Shortnose sturgeon*	*Acipenser brevirostrum*	T	Federal	No Effect
Smalltooth sawfish*	*Pristia pectinata*	E, CH	Federal	May Affect
Mangrove rivulus	*Kryptolebias marmoratus*	SC	State	
Opossum pipefish*	*Microphis brachyurus lineatus*	SC	Federal	No Effect
Mangrove gambusia	*Gambusia rhizophorae*	SC	State	

Common Name	Scientific Name	Status	Agency	Determination
	Invertebrates			
Bartram's hairstreak butterfly	*Strymon acis bartrami*	C	Federal	No Effect
Elkhorn coral*	*Acropora palmata*	T, CH	Federal	No Effect
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C	Federal	No Effect
Staghorn coral*	*Acropora cervicornis*	T, CH	Federal	No Effect
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	Federal	No Effect
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T	Federal	No Effect
Florida tree snail	*Liguus fasciatus*	SC	State	
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E	Federal	No Effect
	Plants			
Beach jacquemonia	*Jacquemontia reclinata*	E	Federal	No Effect
Cape Sable thoroughwort	*Chromolaena frustrata*	Pr E, Pr CH	Federal	No Effect
Crenulate lead plant	*Amorpha crenulata*	E	Federal	No Effect
Deltoid spurge	*Chamaesyce deltoidea* spp. *deltoidea*	E	Federal	May Affect
Garber's spurge	*Chamaesyce garberi*	T	Federal	May Affect
Johnson's seagrass*	*Halophila johnsonii*	E, CH	Federal	No Effect
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeenis*	E	Federal	No Effect
Small's milkpea	*Galactia smallii*	E	Federal	May Affect
Tiny polygala	*Polygala smallii*	E	Federal	May Affect
Eatons spikemoss	*Selaginella eatonii*	E	State	
Lattace vein fern	*Thelypteris reticulate*	E	State	
Mexican vanilla	*Vanilla mexicana*	E	State	
Pine-pink orchid	*Bletia purpurea*	T	State	
Tropical fern	*Schizaea pennula*	E	State	
Wright's flowering fern	*Anemia wrightii*	E	State	

*Marine species under the purview of NMFS

** Indicates critical habitat for the designated species is not within the action study area

A number of candidate animal species (**Table 5-3**) are also known to exist or potentially exist within the project area and include Bartram's hairstreak butterfly (*Strymon acis bartrami*) and Florida leafwing butterfly (*Anaea troglodyte floridalis*). Effects on these species are not anticipated due to their distribution and habitat requirements. A number of candidate plant species are known to exist or potentially exist in the study area, most of which are also associated with pine rocklands. Adverse effects to federally listed candidate plant species are not anticipated due to implementation of CEPP.

Table 5-3. List of species within CEPP project area that are candidate species for protection under the Endangered Species Act.

Common Name	Scientific Name	Federal Status
	Plants	
Big pine partridge pea	*Chamaecrista* var. *keyensis*	C
Blodgett's silverbush	*Argythamnia blodgettii*	C
Carter's small-flowered flax	*Linum carteri* var. *carteri*	C
Everglades bully	*Sideroxylon reclinatum* spp. *austrofloridense*	C
Florida brickell-bush	*Brickellia mosieri*	C
Florida bristle fern	*Trichomane spunctatum* spp. *floridanum*	C
Florida pineland crabgrass	*Digitaria pauciflora*	C

Common Name	Scientific Name	Federal Status
Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	C
Florida semaphore cactus	*Consolea corallicola*	C
Pineland sandmat	*Chamaesyce deltoidea* spp. *pinetorum*	C
Sand flax	*Linum arenicola*	C
Invertebrates		
Bartram's hairstreak butterfly	*Strymon acis bartrami*	C
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C

5.3 STATE LISTED SPECIES

The study area also provides habitat for several state listed species (**Table 5-2**). These species are discussed further in the CEPP Project Implementation Report.

5.4 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, Cape Sable seaside sparrow, Everglade snail kite, and American crocodile. Critical habitat for the smalltooth sawfish, elkhorn coral, staghorn coral, and Johnson's seagrass are covered under the purview of NMFS and therefore are discussed under a separate consultation. Maps of critical habitat locations for these species under FWS purview are depicted within the species effect determination sections of this BA as appropriate.

6.0 EFFECTS DETERMINATIONS

Species were evaluated based on the existing conditions baseline (ECB 2012), which includes ERTP operations, the Future Without Project Conditions (FWO), which includes ERTP operations and the assumption that several other CERP projects would be completed (see Appendix B for more detail on existing conditions and FWO), and Alt 4R2 that is described in **Section 4.0** of this BA.

6.1 "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 in detail below.

6.1.1 Crenulate Lead- Plant and "No Effect" Determination

A perennial, deciduous shrub, the crenulate lead-plant is endemic to Miami-Dade County. Agricultural, urban and commercial development within Miami-Dade County have destroyed approximately 98-99% of the pine rockland communities where this species occurred, prompting the FWS to list the crenulate lead-plant as endangered in 1985 (FWS 1999). Other threats to the continued existence of this species include fire suppression, drainage and exotic plant invasion.

Its present distribution is restricted to eight known locations within a 20-square mile area from Coral Gables to Kendall, Miami-Dade County. Four of the known sites are within public parks managed by the Miami-Dade County Parks Department (FWS 1999). As the crenulate lead-plant is not known to occur within WCA-3A or ENP, the Corps has determined that CEPP will have no effect on this species.

6.1.2 Cape Sable Thoroughwort and "No Effect" Determination

The Cape Sable thoroughwort is endemic to south Florida, an herb that is 8-40 inches tall. It occurs throughout coastal rock barrens and berms and sunny edges of rockland hammock. It was proposed to be listed as endangered in December 2012, along with critical habitat. Alt 4R2 is not expected to affect coastal rock barrens, therefore the Corps has determined that CEPP will have no effect on this species.

6.1.3 Deltoid Spurge, Garber's Spurge, Small's Milkpea, and Tiny Polygala "No Effect" Determinations

Pine rocklands are the primary habitat for deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala. This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, pine rocklands are a fire-maintained community and require regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). Fire suppression, fragmentation, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rocklands, prompting the listing of these species under the ESA (FWS 1999).

Within the project area, pine rocklands occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. These listed plant species have the potential to occur within the rocky glades surrounding the Frog Pond Detention Area. Under CEPP, there may be potential changes to the operations of this seepage reservoir, which could potentially affect hydroperiods within this region. Although these changes are not expected to significantly alter hydroperiods, potential effects on plant species within this region could occur with project implementation. However, these effects are expected to be insignificant. Therefore, the Corps has determined the project will have no effect on deltoid spurge, Garber's spurge, Small's milkpea, or tiny polygala.

6.1.4 Okeechobee Gourd and "No Effect" Determination

The Okeechobee gourd is a climbing annual or perennial vine possessing heart to kidney-shaped leaf blades. The cream-colored flowers are bell-shaped and the light green gourd is globular or slightly oblong. The Okeechobee gourd was locally common in the extensive pond apple forest that once grew south of Lake Okeechobee. Historically, the Okeechobee gourd was found on the southern shore of Lake Okeechobee in Palm Beach County and in the Everglades. Currently this species is limited to two disjunct populations, one along the St. Johns River in Volusia, Seminole, and Lake counties in northern Florida and a second around the shoreline of Lake Okeechobee in south Florida (FWS 1999). The conversion of the pond apple forested swamps and marshes for agricultural purposes as well as water-level regulation within Lake Okeechobee have been the principal causes of the reduction in both range and number of the Okeechobee gourd. Areas around Lake Okeechobee would likely not change due to Alt 4R2, therefore, the Corps determined that the project will have no effect on Okeechobee Gourd.

6.1.5 Miami Blue Butterfly and "No Effect" Determination

The Miami blue is a small butterfly endemic to Florida and is officially listed as endangered under the ESA in April 2012. The Miami blue has a forewing length of 10 to 13 millimeters. Males and females are both bright blue dorsally, but females have an orange eyespot near their hind wing. Both sexes have a gray underside with four black spots. The Miami blue occurs at the edges of tropical hardwood hammocks, beachside scrub, and occasionally in rockland pine forests. Larval host plants include the seed pods of nickerbeans (*Caesalpinia spp.*), blackbeards (*Pithecellobium spp.*), and balloon vine (*Cardiospermum* halicababum), a non-native species. Adults feed on the nectar of Spanish needles (*Bidens pilosa*), cat tongue (*Melanthera aspera*), and other weedy flowers near disturbed hammocks.

Primarily a south Florida coastal species, the Miami blue's historic distribution ranged as far north as Hillsborough County on the Gulf Coast and Volusia County on the Atlantic Coast and extended south to the Florida Keys and the Dry Tortugas (FWC 2013b). The butterfly was thought to be extinct following Hurricane Andrew in 1992, but was observed in November 1999 at Bahia Honda State Park in the Florida Keys. More than 329 surveys conducted at locations in mainland Florida and the Keys have failed to detect other colonies of this species.

Population declines are primarily a result of loss and degradation of suitable habitat due to residential, recreational, and commercial development. In coastal areas where undeveloped lands remain, the introduction of exotics has led to the direct loss of larval host plants and nectar sources. Other perceived threats include human-caused mortality from pesticide and herbicide use. CEPP project features would not affect rockland pine forests or beachside scrub and would therefore have no affect on this species.

6.1.6 Schaus Swallowtail Butterfly and "No Effect" Determination

The Schaus swallowtail butterfly is a large dark brown and yellow butterfly originally listed as an endangered species because of population declines caused by the destruction of its tropical hardwood hammock habitat, mosquito control practices, and over-harvesting by collectors. Schaus swallowtail butterfly distribution is limited to tropical hardwood hammocks and is concentrated in the insular portions of Miami-Dade and Monroe counties, from Elliott Key in Biscayne National Park and associated smaller Keys to central Key Largo (FWS 1999). It is estimated that remaining suitable habitat for this species is 43% of the historical suitable habitat in Biscayne National Park and 17 percent for north Key Largo. The decline has been attributed primarily to habitat destruction (FWS 1999). Due to the lack of preferred subtropical hardwood hammock habitat in the action area, the Corps has determined that the proposed action would have no effect on the Schaus swallowtail butterfly.

6.1.7 Stock Island Tree Snail and "No Effect" Determination

Measuring approximately 45-55 millimeters in length, the arboreal Stock Island tree snail inhabits hardwood hammocks consisting of tropical trees and shrubs such as gumbo limbo, mahogany, ironwood, poisonwood, marlberry and wild coffee, among others. Population declines, habitat destruction and modification, pesticide use, and over-collecting led to the listing of this species as threatened in 1978 (FWS 1999).

The historic distribution of the Stock Island tree snail was thought to be limited to hardwood hammocks on Stock Island and Key West and possibly other lower Keys hammocks. Recently, the range of this species has been artificially extended through the actions of collectors who have introduced it to Key Largo and the southernmost reaches of the mainland. At present, this snail occupies six sites outside of its historic range including ENP and Big Cypress National Preserve. The Corps has determined that CEPP would not affect the subtropical hardwood hammock habitat in ENP and Big Cypress National Preserve; therefore, Alt 4R2 would not affect the Stock Island tree snail.

6.1.8 Northern Crested Caracara and "No Effect" Determination

The Northern crested caracara is listed as threatened by both FWS and the FWC. This large raptor is a dietary generalist and opportunistic feeder. Prey species include invertebrates such as crayfish, beetles, grasshoppers and small mammals, amphibians, reptiles, fish, and birds (Morrison 1998). In Florida, the caracara historically occupied native prairies, but fire suppression has caused widespread conversion of prairies to open brushland. Currently, the bulk of Florida's caracara population has been found on large cattle ranches with improved pastures and scattered cabbage palms. Dry prairies with wetter areas and scattered cabbage palm comprise typical habitat. Caracaras also occur in some improved pasturelands and even in lightly wooded areas with more limited stretches of open grassland. Within these habitats, caracaras exhibit a propensity for nesting in cabbage palms, followed by live oaks, during a nesting season that typically continues from September through June with a concentration during November to April (Morrison 1998). Caracaras forage within a variety of habitats including improved pastures, adjacent to dwellings and farm buildings, newly plowed or burned fields, agricultural lands, including sod and cane fields, citrus groves, dairies, and wetland habitats (Morrison 1996). Caracaras are non-migratory and may be found in their home range year round. Home ranges average approximately 1,200 ha (approximately 3,000 acres), corresponding to a radius of two to three kilometers (1.2 to 1.9 miles) surrounding the nest site (Morrison and Humphrey 2001). Foraging typically occurs throughout the home range during nesting and non-nesting seasons. Due to lack of preferred habitat within the project area, the Corps has determined that CEPP will have no effect on this species (**Figure 6-1**).

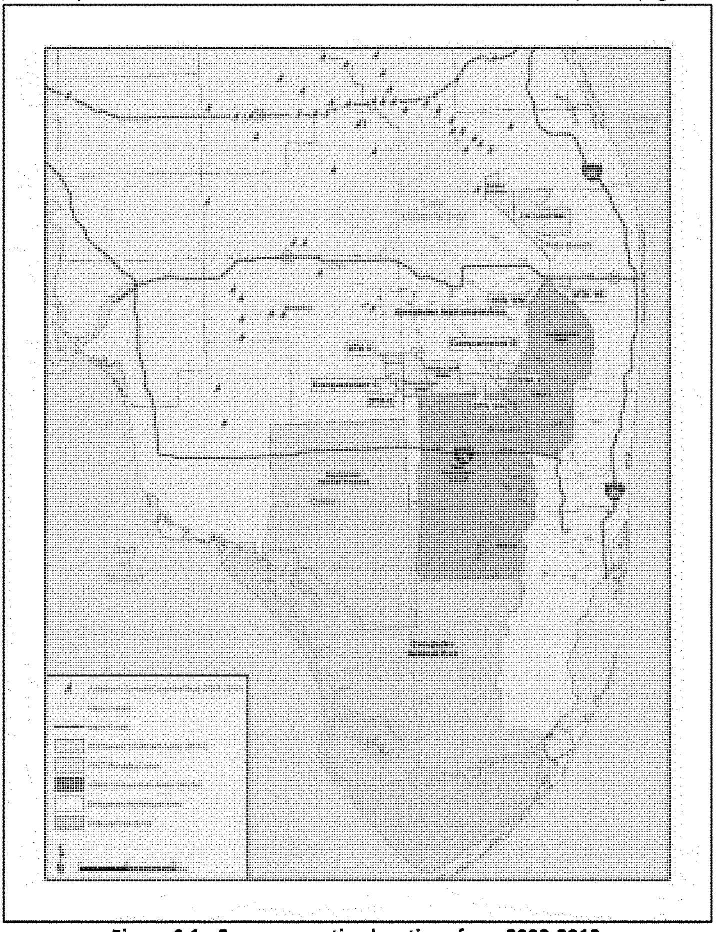


Figure 6-1. Caracara nesting locations from 2003-2013

6.1.9 Piping Plover and "No Effect" Determination

The piping plover is listed by FWS as threatened. The piping plover does not breed in Florida; breeding populations occur near the Great Lakes, the Northern Great Plains, and the Atlantic Coast. Piping plovers regularly winter in the south Florida counties of Broward, Collier, Indian River, Lee, Martin, Miami-Dade, Monroe, Palm Beach, St. Lucie, and Sarasota (Haig 1992). Piping plover nest and feed along coastal sand and gravel beaches throughout North America. Due to lack of preferred wintering habitat within the CEPP project area, the Corps has determined that implementation of CEPP would have no effect on piping plover.

6.1.10 Red-Cockaded Woodpecker and "No Effect" Determination

The red-cockaded woodpecker is identified by its conspicuous white cheek patch, black and white cross-barred back, black cap and nape, white breast and flanks with black spots. In addition, the males have a small bright red spot on each side of the black cap. The bird is approximately 8½ inches in length with a wingspan of 14½ inches. The female is somewhat smaller and resembles the male in coloration, with the exception of a red streak alongside the black cap. The female is approximately 7⅜ inches with a wingspan of 13¼ inches (FWS 1999).

Red-cockaded woodpeckers are a social species and live in groups with a breeding pair and up to four helpers, generally male offspring from the previous year. Approximately 200 acres of mature pine forests are necessary to support each group's nesting and foraging habitat needs. Juvenile females will leave the group prior to the breeding season and establish a breeding pair within a solitary male group. Breeding pairs are monogamous and will raise a single brood each breeding season. Three to four small white eggs will be laid within the roost cavity and incubated by members of the group for a period of ten to twelve days. Chicks are also fed by members of the group and remain within the roost cavity for approximately 26 days. Insects including ants, caterpillars, moths, grasshoppers, spiders, and beetle larvae comprise approximately 85 percent of their diet. The remainder of their diet consists of wild grapes, cherries, poison ivy berries, blueberries, and nuts such as pecans (FWS 1999).

Red-cockaded woodpeckers live in mature pine forests, specifically those with longleaf pines averaging 80 to 120 years old and loblolly pines averaging 70 to 100 years old. Destruction of its preferred long-leaf pine habitat by humans or disease (pines afflicted by fungus or red-ring rot) resulted in the woodpecker becoming listed as endangered in 1970. The current range is from eastern Texas to the southeastern United States and southern Florida. Historically, red-cockaded woodpeckers were found abundantly from Texas to New Jersey and as far inland as Tennessee.

The red-cockaded woodpecker is primarily an upland species, also inhabiting hydric pine flatwoods. Due to lack of lack of appropriate habitat, the Corps has determined that there would be no effect on this species from the implementation of CEPP.

6.1.11 Roseate Tern and "No Effect" Determination

A coastal species, the roseate tern nests on open sandy beaches away from potential predation and human disturbance. This species feeds in nearshore surf on small schooling fishes. In southern Florida, the roseate tern's main nesting areas are located in the Florida Keys and the Dry Tortugas where they nest on isolated islands, rubble islets, and dredge spoils. Although suitable foraging opportunities exist along the shoreline within the project area, the proposed project is not likely to adversely affect their feeding habits or nesting areas. Therefore, the Corps has determined that there would be no effect on this species from the implementation of CEPP.

6.2 "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 quality, quantity, timing, and distribution of flows to the Greater Everglades, including WCA 3A, WCA 3B, ENP, and Florida Bay. The Corps has determined that CEPP may affect federally listed species occurring within the project area including American alligator, American crocodile and its critical habitat, Eastern indigo snake, Florida panther, Florida manatee and its critical habitat, Everglade snail kite and its critical habitat, and wood stork. All standard protection measures for species would be followed during and post construction.

6.2.1 American Alligator and "May Affect" Determination

The American alligator is listed as threatened by the FWS due to similarity of appearance to American crocodile, an endangered species. A keystone species within the Everglades ecosystem, the American alligator (*Alligator mississippiensis*) is dependent on spatial and temporal patterns of water fluctuations that affect courtship and mating, nesting, and habitat use (Brandt and Mazzotti 2000). Historically, American alligators were most abundant in the peripheral Everglades marshes and freshwater mangrove habitats, but are now most abundant in canals and the deeper slough habitats of the central Everglades. Water management practices including drainage of peripheral wetlands and increasing salinity in mangrove wetlands as a result of decreased freshwater flows has limited occurrence of American alligators in these habitats (Craighead 1968, Mazzotti and Brandt 1994). A Habitat Suitability Index (HSI) for alligators was used to predict potential effects of implementation of CEPP Alt 4R2 (South Florida Natural Resources Center 2013a). The HSI measures habitat suitability annually for five components of alligator production: (1) land cover suitability, (2) breeding potential (female growth and survival from April 16 of the previous year - April 15 of the current year), (3) courtship and mating (April 16 – May 31), (4) nest building (June 15 – July 15), and egg incubation (nest flooding from July 01 – September 15).

Results indicate that implementation of Alt 4R2 would improve alligator habitat suitability throughout WCA 3A and ENP as compared with the existing conditions and FWO. The greatest increase in benefits is visible within northern WCA 3A (CEPP Zones 3A-MC, 3A-NE and 3A-NW), with improvements in alligator habitat over existing conditions (**Figure 6-2**) due to additional water deliveries within this region. Gains are smaller in central WCA 3A, WCA 3B, and ENP north and south zones, though they appear to have an increased spatial extent of slightly improved potential habitat in Alt 4R2 **(Figure 6-3).** Changes within southern WCA 3A show potential negative effects to alligator production, however, the effects appear relatively negligible (South Florida Natural Resources Center 2013a). In summary, increasing freshwater flow through the Greater Everglades into ENP under CEPP will provide increased benefits to alligators within these habitats in comparison with the existing conditions. Adverse effects to alligators that utilize the Miami Canal will occur due to backfilling of the Miami Canal. However, these effects are expected to be short-term as alligators will expand into other areas of suitable habitat created as a result of CEPP implementation.

Due to anticipated benefits with CEPP implementation, the Corps has determined that the project may affect American alligator.

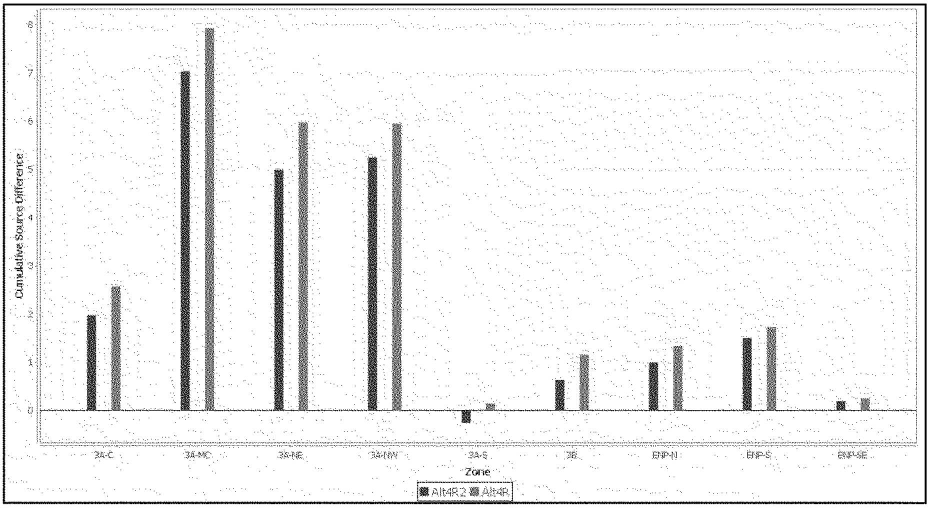


Figure 6-2. Cumulative alligator production habitat suitability (1965-2005) lift from existing conditions (ECB 2012) for Alt4R2 within each CEPP zone. A maximum score of 41 is possible if existing conditions has a suitability score of 0.0 every year and the alternative has a suitability score of 1.0 every year (South Florida Natural Resources Center 2013a)

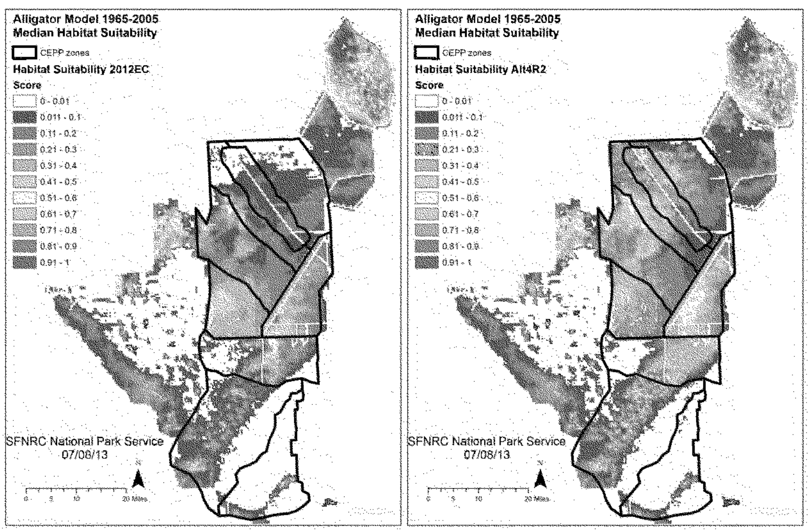


Figure 6-3. Suitable alligator habitat cumulative (1965-2005) lift above the existing conditions for the Alt 4R2 within each water conservation area (WCA) (South Florida Natural Resources Center 2013a)

6.2.2 American Crocodile and "May Affect" Determination

American crocodiles are known to exist throughout the project area, specifically around the coastal fringes from Miami to the bottom of the peninsula and up around Naples (Cherkiss 1999). The cooling canals of Florida Power and Light's Turkey Point Power Plant, which occur within the project boundary, support the most successful crocodile nesting population in south Florida (Mazzotti et al. 2007). These cooling canals offer premium nesting habitat because they satisfy the crocodile's two primary nesting requirements – suitable substrate above the normal high water level and adjacent deep-water refugia. While crocodiles prefer sandy substrates, they will often utilize canal spoil banks (Kushlan and Mazzotti 1989).

An HSI for juvenile American crocodiles was used to predict potential effects of implementation of CEPP Alt 4R2 in Florida Bay. The crocodile growth and survival index used in this analysis is one of the components of a crocodile HSI that characterizes suitable habitat for crocodiles based on habitat, location of known nest sites, salinity, and prey biomass. The growth and survival index is calculated for August through December, the period following hatching when hatchlings are most vulnerable to high salinities (Moler 1992, Mazzotti 1999, Mazzotti et al. 2007). For this analysis, data from salinity monitoring stations at Joe Bay, Trout Cove, Little Madeira Bay (the stations among the available stations closest to where the highest densities of crocodile nests are) and Long Sound, Little Blackwater Sound, Terrapin Bay, and Garfield Bight (generally closer to shoreline stations in areas where crocodiles could occur) are used as input to HSI. Each day between August 1 through December 31 is assigned a score based on the following salinity ranges: salinity <20 practical salinity units (psu) was assigned the highest score of 1 because salinity in this range is considered most favorable for juvenile crocodile growth and survival (Moler 1992, Mazzotti 1999, Mazzotti et al. 2007), salinity ≥ 20 and <30 psu was assigned a score of 0.6; ≥30 and <40 psu was assigned a score of 0.3, and >40 psu a score of 0. Average yearly and an average overall score were calculated (Brandt 2013).

Results from applying the salinity data into the juvenile crocodile HSI is shown in **Figure 6-4** (Brandt 2013). The plot shows the lift (Alt 4R2 minus existing conditions and FWO) of an index of juvenile crocodile growth and survival at sites along the northern Florida Bay shoreline for all years of the model runs. Sites in the orange box historically have had the most crocodile nesting. Results of the juvenile crocodile HSI performance for an extremely dry (1989) year are shown in **Figure 6-5.** Salinities increase during dry years, therefore, a dry year is representative of a worst case scenario. As indicated by **Figure 6-4** and **Figure 6-5**, implementation of Alt 4R2 will directly benefit juvenile crocodiles within the CEPP project area.

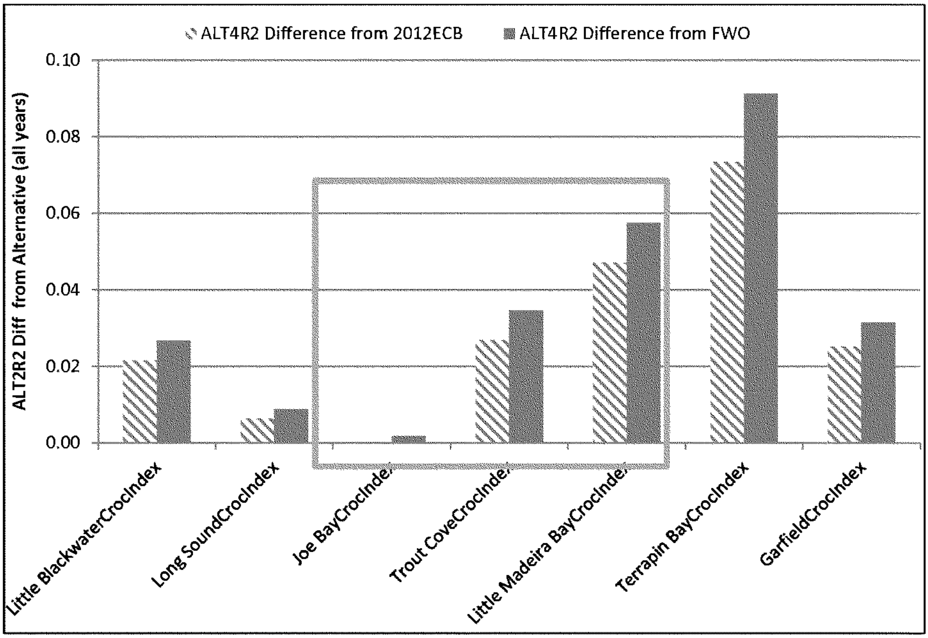


Figure 6-4. Histogram showing the results of the juvenile crocodile HSI for 7 locations of known crocodile occurrence areas across all years within Period of Record (1965-2005). Index values show lift provided by Alt 4R2 as compared with the existing conditions and FWO (Brandt 2013).

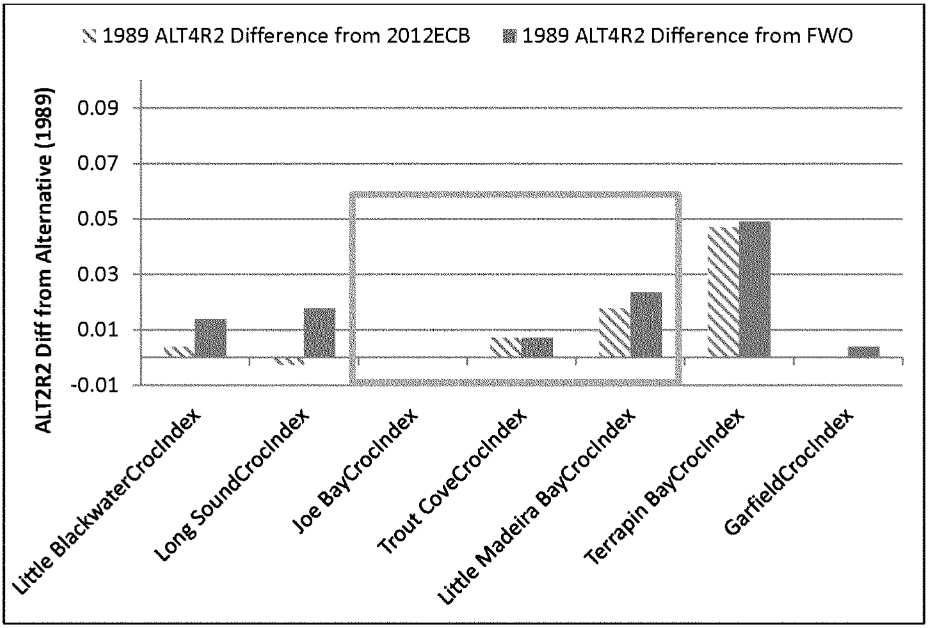


Figure 6-5. Histogram showing the results of the juvenile crocodile HSI for 7 locations of known crocodile occurrence areas for a very dry year (1989). Index values show lift provided by Alt 4R2 as compared with the existing conditions and FWO (Brandt 2013).

6.2.2.1 American Crocodile Effects Determination

Increased freshwater deliveries to ENP, Florida Bay, and Biscayne Bay are predicted to increase suitable habitat for juvenile crocodiles. Due to anticipated benefits with CEPP implementation, the Corps has determined that the project may affect American crocodile.

6.2.2.2 American Crocodile Critical Habitat

As defined in the 50 CFR 17.95 (50 parts 1 to 199, 1 October 2000), the American crocodile's 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. All designated American crocodile critical habitat lies within CEPP study area (**Figure 6-6**).

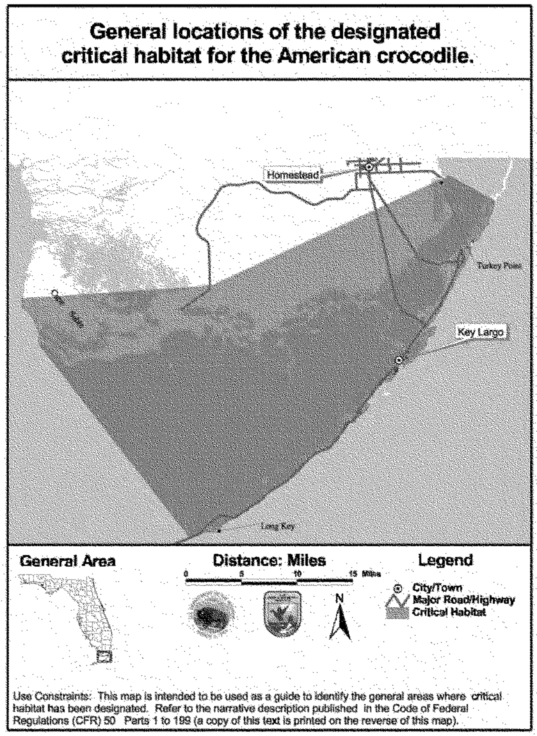


Figure 6-6. Critical habitat for American crocodile

According to 50 CFR 17.95, the easternmost tip of Turkey Point defines the northern boundary of designated critical habitat for the American crocodile and that boundary extends southwest throughout Florida Bay. Anticipated benefits of the proposed project would include improving the quality, quantity, timing, and distribution of freshwater delivered to ENP and the southern estuaries. This could potentially aid in restoring more natural salinities in estuarine habitats where critical habitat has been designated for the American crocodile. It is possible that the effects of distributing overland flow through the wetlands into Florida Bay could have positive effects on tidal wetlands and nearshore salinities that lie within American crocodile critical habitat, but these effects are expected to be minimal. Since the ideal salinity range for American crocodiles is 0 to 20 psu, project implementation has the possibility of enhancing American crocodile habitat within the project area, however, the degree to which this may occur is uncertain. Due to the expected beneficial effects from CEPP implementation, it determined that this project may affect the critical habitat for the American crocodile.

6.2.3 Eastern Indigo Snake and "May Affect" Determination

Eastern indigo snakes were listed as threatened in 1978 due primarily to 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). Declines in Eastern indigo snake populations was also due to over-collection by the pet trade and mortality caused by rattlesnake collectors who gas gopher tortoise burrows to collect snakes (FWS 2013).

The Eastern indigo snake is the largest native non-venomous snake in North America, reaching lengths of up to 8.5 feet (Moler 1992). 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 including pine flatwoods, scrubby flatwoods, floodplain edges, sand ridges, dry glades, tropical hammocks, edges of freshwater marshes, muckland fields, coastal dunes, cabbage palm hammocks, and xeric sandhill communities (Schaefer and Junkin 1990, FWS 1999). Eastern indigo snakes also use agricultural lands and various types of wetlands. Observations over the last 50 years made by maintenance workers in citrus groves in east-central Florida indicate that eastern indigo snakes are most frequently observed near the canals, roads, and wet ditches (FWS 2005). It is anticipated that eastern indigo snakes would be present in sugarcane fields since one of their prey species, the King snake (*Lampropeltis getula floridanus*) has been previously documented in sugarcane fields (Krysko 2002, FWS 2005). Eastern indigo snakes need relatively large areas of undeveloped land to maintain their population. In general, adult males have larger home ranges than females or juveniles. In Florida, Smith (2003) indicated that female and male home ranges extend from 5 to 371 acres and 4 to 805 acres, respectively.

In south Florida, the Eastern indigo snake is thought to be widely distributed. Given their preference for upland habitats (Steiner et al. 1983), Eastern indigo snakes are not commonly found in great numbers in the wetland complexes of the Everglades region, even though they are found in pinelands, tropical hardwood hammocks, and mangrove forests in extreme south Florida (Duellman and Schwartz 1958, Steiner et al. 1983). They prefer dry, well drained sandy soils, and commonly use burrows and other natural holes as dens. Steiner et al. (1983) also reported that Eastern indigo snakes inhabit abandoned agricultural land and human-altered habitats in south Florida which would include levees within the Water Conservation Areas.

One of the CEPP project features to be constructed in the EAA is the A-2 FEB. This would convert approximately 14,000 acres of former agricultural land to a wetland functioning area. The proposed A-2 FEB consists almost exclusively of drained marsh that has been converted to agriculture. Only two soil types occur in the project area: Pahokee Muck and Lauderhill Muck (NRCS 2013). Both types consist of very poorly drained organic materials that commonly occur in broad freshwater marshes, which the A-2 FEB used to be and will likely be converted back to a similar habitat. Currently, the main crop is sugar cane, although rice has also been observed in some fields. A few areas have become overgrown with exotic Brazilian pepper, willow, dog fennel, and grasses including invasive exotic Napier grass.

No natural standing water features are present in the A-2 FEB project area. Natural sloughs and channels are evident in aerial photographs from the 1940s as well as those taken as recently as 2012. These natural sloughs and channels are much drier due to drainage changes, but are the first areas to be inundated during rains. Man-made drainage features such as ditches and narrow canals traverse the A-2 FEB and are continually being modified and created in response to agricultural needs.

Since Eastern indigo snakes occur primarily in upland areas, their presence within the Greater Everglades portion of the project area is somewhat limited, except within the A-2 FEB and levees throughout the project area. The hydrologic effects of the proposed project are expected to benefit existing or historic wetlands. The levees along the Miami Canal will be degraded and used to fill in the

Miami Canal. Once the Miami Canal is backfilled, created tree islands will be constructed, which would potentially provide habitat for the indigo snakes, perhaps offsetting the loss of approximately 500 acres of levee habitat. In addition, improvements to mangrove communities adjacent to Florida Bay may also benefit Eastern indigo snakes within those areas. However, eastern indigo snakes have a high probability of occurrence within the proposed A-2 FEB site and as a result of construction of the A-2 FEB are likely to be displaced, thereby removing approximately 14,500 acres of potential habitat. Therefore, the Corps' determination is that the project may affect the Eastern indigo snake.

6.2.4 Florida Manatee and "May Affect" Determination

The Florida manatee is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers, and springs of Florida. The 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 ESA in 1973. Because the Florida 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. 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. 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. 1982, 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 July 2013, the FWC reported 672 Florida manatee deaths. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. In general, 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 (Florida Power and Light 1989). However, in 2013, most mortality was related to natural or undetermined causes (FWC 2013).

Florida manatees have been observed in conveyance canals within the project area, specifically in the lower C-111 Canal just downstream of S-197, and adjacent nearshore seagrass beds throughout Florida Bay including all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee and Buttonwood sounds. The extensive acreages of seagrass beds in the bay provide important feeding areas for Florida manatees. Florida manatees also depend upon canals as a source of freshwater and resting sites. 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 6-7** illustrates canals that Florida manatees have access to within the CEPP project area.

Under Alt 4R2, increased freshwater flows to Florida Bay and the southwestern coastal estuaries would improve salinity, therefore reducing stress on sea grasses that are important to foraging manatees. Damaging flows to the Northern Estuaries related to pulse releases would also be reduced, resulting in decreased sedimentation and silt, and increased light penetration, therefore providing better sea grass survival. Alt 4R2 includes backfilling portions of the Miami Canal north of Interstate 75, which manatees do access, however, backfilling could benefit them with less likelihood of becoming stranded in the WCAs. The Corps' determination is that CEPP may affect Florida manatee.

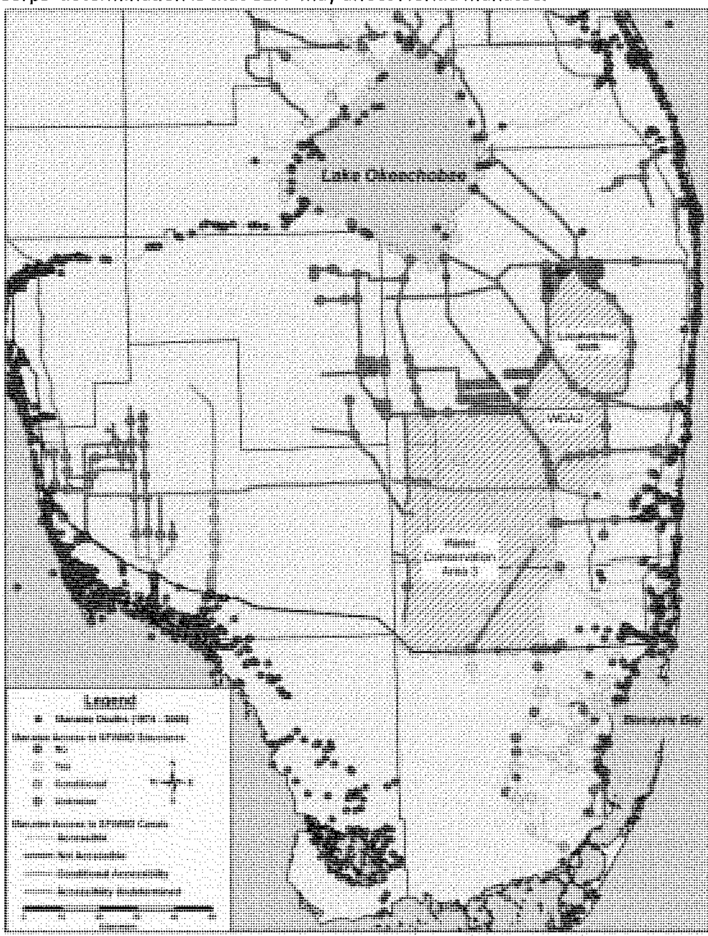


Figure 6-7. Canals that Florida manatees have access to within the Central Everglades Planning Project area

6.2.4.1 Florida Manatee Critical Habitat

Critical habitat for the Florida manatee was designated in 1976 (50 CFR 17.95). The Florida manatee's critical habitat includes all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood sounds between Key Largo, Monroe County, and the mainland of Miami-Dade County (**Figure 6-8**). Another component of designated critical habitat is defined as Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County (CFR 50 Parts 1 to 199; 10-01-00). This was one of the first designations of critical habitat for an endangered species and the first for an endangered marine mammal. Critical habitat for any species is described as the specific area within the geographic area occupied by the species (at the time it is listed under the provisions of section 4 of the Act) on which are found those physical or biological features (i.e. constituent elements) essential to the conservation of the species and which may require special management considerations or protection. No specific primary or secondary constituent elements were included in the critical habitat designation. However, researchers agree that essential habitat features for the Florida manatee include 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 (FWS 2001).

Seagrasses within Florida Bay have long suffered from high salinities due to long-term reductions of freshwater flow. Seagrasses have an optimum salinity range of 24 to 35 psu, but can tolerate considerable short-term salinity fluctuations. Reductions in the number and severity of high volume freshwater discharges to the Northern Estuaries and improvements in seasonal inflow deliveries to Florida Bay and Biscayne Bay under Alt 4R2 has the potential to improve conditions suitable for seagrass survival. In conclusion, the Corps' determination is that CEPP may affect designated critical habitat for the Florida manatee.

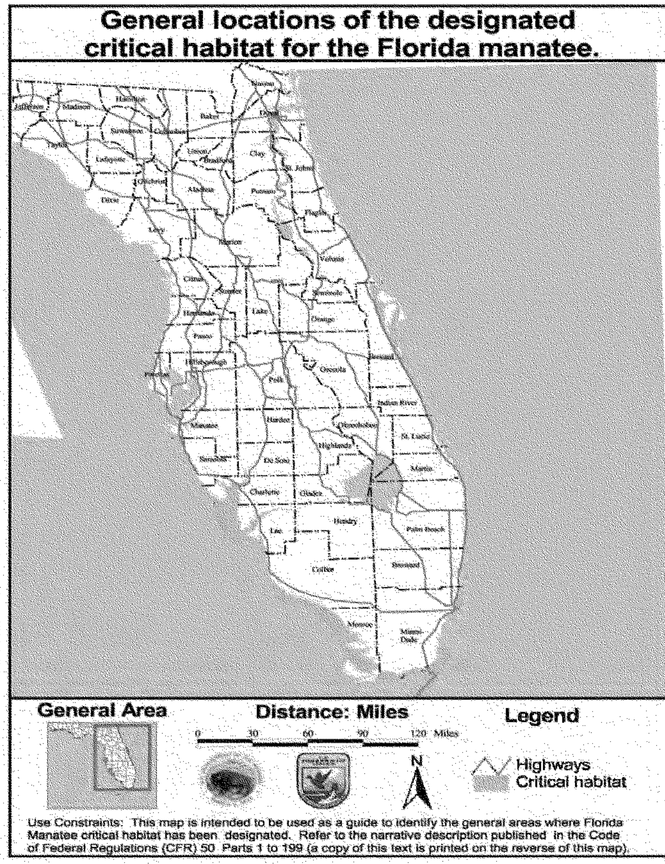


Figure 6-8. Critical habitat for Florida manatee

6.2.5 Florida Panther and "May Affect" Determination

The 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 has driven the subspecies known as the Florida panther into a small area, where the few remaining animals are highly inbred, causing such genetic flaws as heart defects and sterility. Recently, closely-related panthers from Texas were released in Florida and are successfully breeding with the Florida panthers. Increased genetic variation and protection of habitat may save the subspecies.

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. 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.

Florida panthers presently inhabit lands in the EAA and ENP adjacent to the Southern Glades, and radio tracking studies have shown that they venture into the Southern Glades on occasion during post-breeding dispersion (**Figure 6-9).** Reference is made to the revised Panther Key and Panther Focus Area Map for use in determining effects to the Florida panther (**Figure 6-10**). CEPP has the potential to affect both the Primary and Secondary Zones for Florida panther habitat (**Figure 6-10**). Construction of the 14,000 acre FEB within the A-2 parcel in EAA would result in conversion of upland habitat that could be potentially used by Florida panther to transverse the area to wetland habitat, thereby eliminating potential habitat within the panther secondary zone in this region. Today, the A-2 FEB contains agricultural fields planted in sugar cane and rice. Some areas are overgrown with Brazillian pepper, willow, and dog fennel; however, most fields are regularly tilled and disked to a standard depth. In addition, increased water deliveries to ENP could affect Florida panther habitat. However, as lands within the CEPP project area become restored to their more historic natural values, the improved forage base would result in greater use by the Florida panther utilizing these areas.

Based on this information, and that the Florida panther is a wide-ranging species with the majority of sightings west of the project area, the Corp' determination is that CEPP may affect Florida panther.

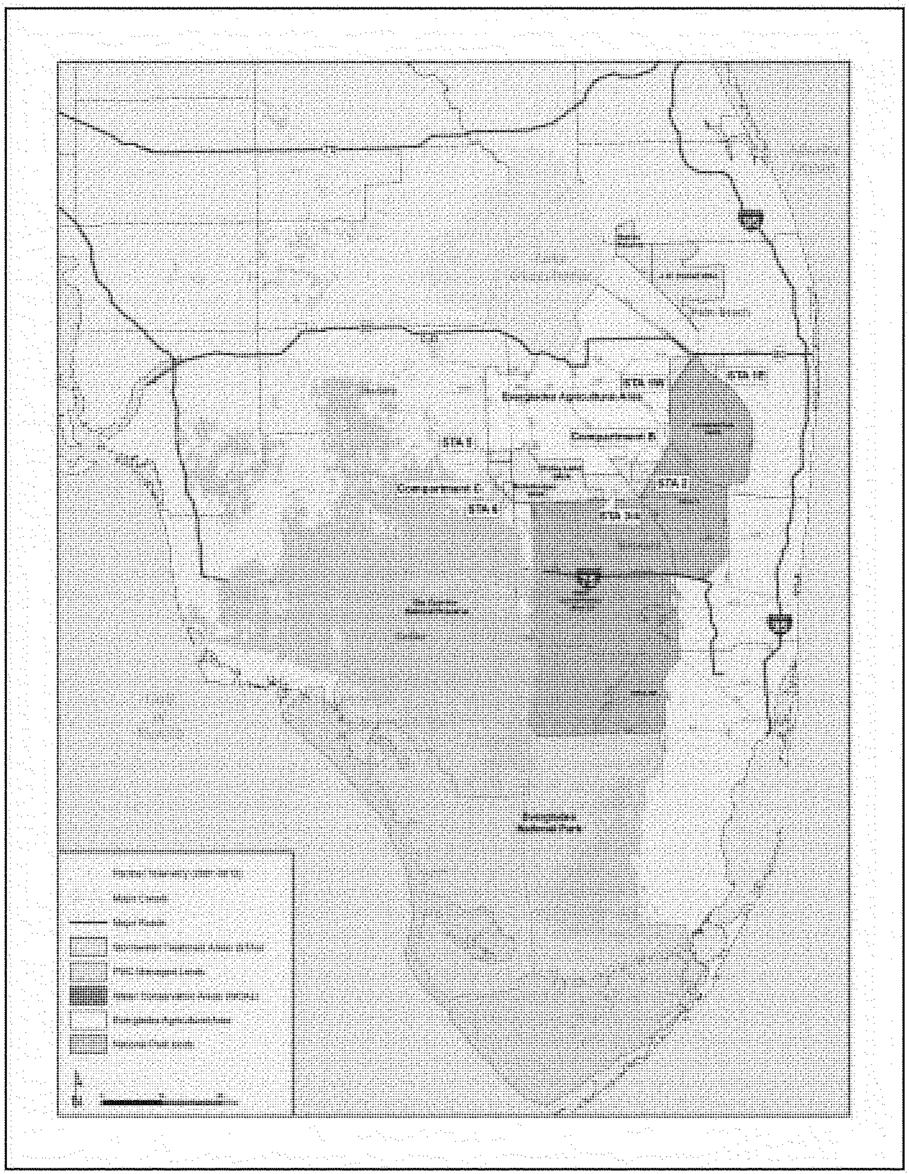


Figure 6-9. Florida panther telemetry information from 2002 – 2012

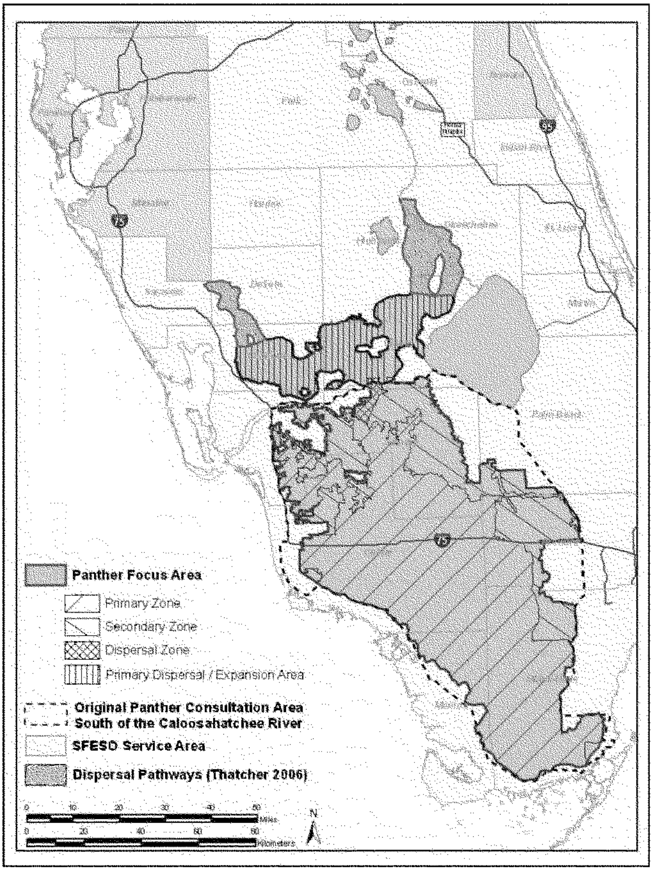


Figure 6-10. Florida panther zones in south Florida (source: Kautz et al. 2006)

6.2.6 Everglade Snail Kite and "May Affect" Determination

Background Information on Everglade Snail Kite

A wide-ranging, New World raptor, the snail kite is found primarily in lowland freshwater marshes in tropical and subtropical America from Florida, Cuba, and Mexico, and south to Argentina and Peru (FWS 1999). The Florida and Cuban subspecies of the Everglade snail kite, *R. sociabilis plumbeus,* was initially listed as endangered in 1967 due to its restricted range and highly specific diet (FWS 1999). Its survival is directly tied to the hydrology, water quality, vegetation composition and structure within the freshwater marshes that it inhabits (Martin et al. 2008, Cattau et al. 2008).

Everglade snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lakes where the apple snail (*Pomacea paludosa*), the Everglade snail kite's main food source, can be found. Snail kite populations in Florida are highly nomadic and mobile; tracking favorable hydrologic conditions and food supplies, and thus avoiding local droughts. Snail kites move widely throughout the primary wetlands of the central and southern portions of the State of Florida. Snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once Everglade snail kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth, which inhibits the Everglade snail kite's ability to see its prey.

The Everglade snail kite has a highly specialized diet typically composed of apple snails, which are found in palustrine, emergent, long-hydroperiod wetlands. As a result, the Everglade snail kite's survival is directly dependent on the hydrology and water quality of its habitat (FWS 1999). Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Suitable foraging habitat for the Everglade snail kite is typically a combination of low profile marsh and a mix of shallow open water. Shallow wetlands with emergent vegetation such as spike rush (*Eleocharis* spp.), maidencane, sawgrass, and other native emergent wetland plant species provide good Everglade snail kite foraging habitat as long as the vegetation is not too dense to locate apple snails. Dense growth of plants reduces the ability of the Everglade snail kite to locate apple snails and their use of these areas is limited even when snails are in relatively high abundance (Bennetts et al. 2006). Areas of sparse emergent vegetation enable apple snails to climb near the surface to feed, breathe, and lay eggs and thus they are easily seen from the air by foraging Everglade snail kites. Suitable foraging habitats are often interspersed with tree islands or small groups of scattered shrubs and trees which serve as perching and nesting sites.

Snail kite nesting primarily occurs from December to July, with a peak in February-June, but can occur year-round. Nesting substrates include small trees such as willow, cypress (*Taxodium* spp.), and pond apple, and herbaceous vegetation such as sawgrass, cattail, bulrush (*Scirpus validus*), and reed (*Phragmites australis*). Snail kites appear to prefer woody vegetation for nesting when water levels are adequate to inundate the site (FWS 1999). Nests are more frequently placed in herbaceous vegetation during periods of low water when dry conditions beneath willow stands (which tend to grow to at higher elevations) prevent Everglade snail kites from nesting in woody vegetation (FWS 1999). Nest collapse is rare in woody vegetation but common in non-woody vegetation, especially on lake margins (FWS 1999). In order to deter predators, nesting almost always occurs over water (Sykes et al. 1995).

Snail kites construct nests using dry plant material and dry sticks, primarily from willow and wax myrtle (Sykes 1987), with a lining of green plant material that aids in incubation (FWS 1999). Courtship includes male displays to attract mates and pair bonds form from late November through early June (FWS 1999). Snail kites will lay between one and five eggs with an average of about three eggs per nest (Sykes 1995, Beissinger 1988). Each egg is laid at about a two-day interval with incubation generally commencing after the second egg is laid (Sykes 1987). Both parents incubate the eggs for a period of 24 to 30 days (Beissenger 1983). Hatching success is variable between years and between watersheds, but averages 2.3 chicks/nest (FWS 1999, Cattau et al. 2008). February, March, and April have been identified as the most successful months for hatching (Sykes 1987). Snail kites may nest more than once within a breeding season and have been documented to renest after both failed and successful nesting attempts (Sykes 1987, Beissinger 1988). Chicks are fed by both parents through the nestling period although ambisexual mate desertion has been documented (FWS 1999). Young fledge at approximately 9 to 11 weeks of age (Beissenger 1988). Adults forage no more than 6 kilometers from the nest, and generally less than a few hundred meters (Beissenger 1988, FWS 1999). When food is scarce or ecological and hydrologic conditions are unfavorable, adults may abandon the nest altogether (Sykes et al. 1995).

The Everglade snail kite occupies the watersheds of the Everglades, Kissimmee River, Caloosahatchee River, the upper St. Johns River, and Lake Okeechobee. According to the FWS (1999), "Each of these watersheds has experienced, and continues to experience, pervasive degradation due to urban development and agricultural activities." The Everglade snail kite's dependence upon each of these watersheds has shifted significantly over the last decade. Lake Okeechobee and WCA 3A, once important Everglade snail kite foraging and nesting areas, no longer support high densities of Everglade snail kites. Lake Okeechobee is of particular importance since it serves as a critical stopover point as Everglade snail kites traverse the network of wetlands within their range. This loss of suitable habitat and refugium, especially during droughts, may have significant demographic consequences (Martin et al. 2006). Once a productive breeding site, Lake Okeechobee has only made minor contributions to the Everglade snail kite population in terms of reproduction since 1996 (Cattau et al. 2008). The loss of suitable Everglade snail kite foraging and nesting areas within Lake Okeechobee have been attributed to shifts in water management regimes (Bennetts et al. 1998), along with habitat degradation due to hurricanes (Cattau et al. 2008).

Historically, WCA 3A has been a critical component within the Everglade snail kites' wetland network for foraging and reproduction. Changes in water management regimes have contributed to the lack of reproduction within this critical habitat area (Mooij et al. 2002, Zweig and Kitchens 2008, Cattau et al. 2008, 2009).

Between 2001 and 2012, Everglade snail kites were predominantly nesting in southern WCA 3A and the southeast corner of WCA 3B (**Figure 6-11**). The high dependence on one area is of concern due to stochastic events, droughts, water management regimes within the Kissimmee Chain of Lakes (KCOL), and the presence of the exotic apple snail (*Pomacea insularum*). Juvenile Everglade snail kites are not efficient at handling the exotic snail, which is larger in size than the native, and thus, their survival may be suppressed (Cattau et al. 2012).

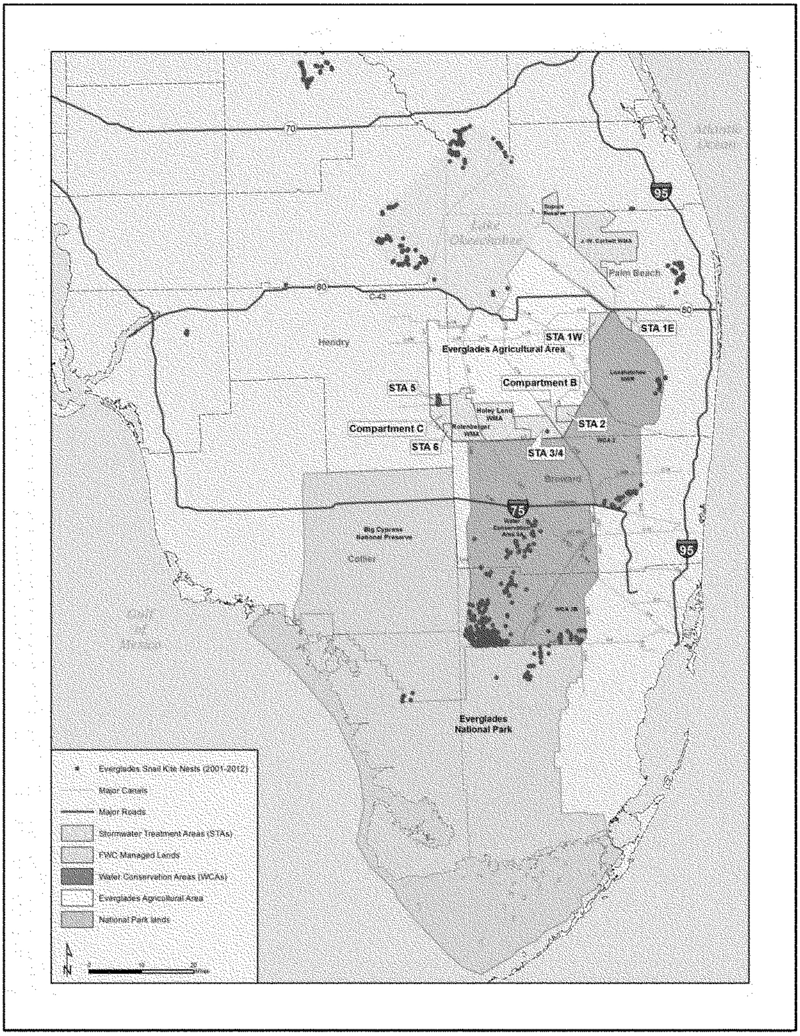


Figure 6-11. Snail kite nesting locations between 2001-2012

Recent population viability analyses predict a high probability of extinction in the next 50 years, or sooner, if current reproduction, survival, and drought frequency rates remain the same as those of the last ten years (Martin et al. 2007, Cattau et al. 2008, 2009, 2012). It is imperative to manage WCA 3A and Lake Okeechobee so that they once again become functioning components of the Everglade snail kite's network of wetlands within Florida to ensure survival of the Everglade snail kite within Florida.

The persistence of the Everglade snail kite in Florida depends upon maintaining hydrologic conditions that support the specific vegetative communities that compose their habitat along with sufficient apple snail availability across their range each year (Martin et al. 2008). WCA 3A has been previously identified as the most critical component of Everglade snail kite habitat in Florida in terms of its influence on demography (Mooij et al. 2002, Martin 2007, Martin et al. 2007). A principal concern is the lack of reproduction within this area in recent years. The Corps has funded a program to monitor nesting effort and success of the Everglade snail kite in WCA 3 since 1995 with Wiley Kitchens, Ph.D., of USGS, and the University of Florida as principal researcher. The study objectives are to track the numbers and success of Everglade snail kite nesting activities in WCA 3A as part of an on-going demographic study of the kite over its range and to identify the environmental variables related to successful breeding. The Corps is also funding Dr. Kitchens to monitor vegetation responses to altered hydrologic regimes in WCA 3A in areas of traditional Everglade snail kite nesting and foraging habitat, in accordance with recommendations in the 2006 IOP BO.

The Everglade snail kite population in Florida has progressively and dramatically decreased since 1999 (Martin et al. 2006, Cattau et al. 2008, 2009). The population essentially halved between 2000 and 2002 from approximately 3,400 to 1,700 birds; and halved again between 2006 and 2008 from approximately 1,500-1,600 birds in 2006 to approximately 685 birds in 2008. The estimated 2009 population size of 662 birds indicates that there is no sign of recovery (Cattau et al. 2009). Each decline has coincided, in part, with a severe regional drought throughout the southern portion of the Everglade snail kite's range (Martin et al. 2008, Cattau et al. 2008). Survival of both juveniles and adults rebounded shortly after the 2001 drought, but the number of young produced has not recovered from a sharp decrease that preceded the 2001 drought. Historically, the WCAs, and WCA 3A in particular, have fledged, proportionally, the large majority of young in the region. However, no young were fledged out of WCA 3A in 2001, 2005, 2007, or 2008, and only two young successfully fledged in 2009. Nesting activity is summarized in **Table 6-1** for the years 1998-2011, since the Emergency Deviations to the WCA 3A Regulation Schedule for the protection of the CSSS began in 1998. This trend of lowered regional reproduction is a cause of concern regarding the sustainability of the population. Given the 2011 population estimate (i.e. 925 birds), the extinction risk may be even greater than the previous estimate (Cattau et al. 2009). In 2010 and 2011, nesting was observed on Okeechobee for the first time since 2006, which may reflect a slight increase in habitat conditions.

Table 6-1. Successful Snail Kite Nests and the Number of Young Successfully Fledged within WCA 3A since 1998

Year	Number of Successful Nests	Number of Young Successfully Fledged
1998	84	176
1999	14	19
2000	33	56
2001	0	0
2002	22	32
2003	28	32
2004	19	29
2005	0	0
2006	13	13
2007	0	0
2008	0	0

Year	Number of Successful Nests	Number of Young Successfully Fledged
2009	1	2
2010	0	0
2011	11	11
2012	1	1

*Note: Numbers in Table 6-1 are as reported by annual surveys conducted by Wiley Kitchens, Ph.D. and his research team.

Both short-term natural disturbances (i.e. drought) and long-term habitat degradation limit the Everglade snail kite's reproductive ability. To date, most concern and interest regarding potential impacts to Everglade snail kites have focused on the higher water levels and hydroperiods, resulting in the conversion of wet prairies to sloughs within WCA 3A (Zweig 2008). The current WCA 3A Regulation Schedule does not mimic the seasonal patterns driven by the natural hydrologic cycle, resulting in water depths in WCA 3A that are too high for the period of September through January (Cattau et al. 2008). In addition, Dr. Kitchens and his research team feel that management activities associated with attempting to mitigate potential high water level impacts may well have potentially amplified those detrimental impacts to Everglade snail kite nesting and foraging activities. For example, in addition to the negative effect on reproduction, the rapid water level recession rates from the elevated stage schedule between February and July, intended to mitigate the extended hydroperiods and excessive depths between September and December, present extreme foraging difficulties to both juvenile and adult Everglade snail kites. In fact, Cattau et al. (2008) demonstrated that the recession rate had significant effects on nest success. Recession rate was defined as the stage difference between that on January 1 and the annual minimum stage divided by the number of days from January 1 to the annual minimum stage (Cattau et al. 2008).

As a result of the on-going research, Dr. Kitchens and his research team have identified three major potentially adverse effects associated with the current WCA 3A Regulation Schedule as: 1) prolonged high water levels in WCA 3A during September through January, 2) prolonged low water levels in WCA 3A during the early spring and summer, and 3) rapid recession rates.

6.2.6.1 Prolonged High Water Levels

Extreme high and low water level stressors can adversely affect snail kites throughout the species' range. Due to the legacy water management infrastructure in the highly managed C&SF system, climatic extremes cannot be entirely controlled to avoid these impacts. However, water management decisions under the current system and with the changes proposed under CEPP, have and will affect the severity and duration of these extremes. From approximately 1993 to present, which coincides with Test 7 of the MWD Experimental Program and subsequent IOP and ERTP operations, WCA 3A stages have shown relatively little annual variation compared to the previous decades, with an annual average stage of approximately 9.5 feet (2.9 meters). In addition, stages in WCA 3A have exceeded 10.5 feet (3.2 meters) in 12 of the past 17 years, while there were only approximately four occurrences of stages exceeding 10.5 feet (3.2 meters) during the 40-year period from 1953 to 1993. Stages in 1994, 1995, 1999, and 2008 also exceeded 11.5 feet (3.5 meters), and are the four highest stages within the period of record (FWS 2006).

Hydrologic modeling of IOP Alternative 7R in 2002 indicated that implementation of IOP would not relieve high water levels within WCA 3A, and in fact, would result in excessive ponding and extended hydroperiods, further contributing to declines in the condition of nesting and foraging habitat in WCA-3A (IOP FSEIS 2006). However, in their 2002 and 2006 IOP BOs, FWS determined that IOP would adversely affect Everglade snail kites and designated Everglade snail kite critical habitat in WCA 3A, but would not likely jeopardize the species. As stated in the 2006 Final IOP BO, FWS anticipated that IOP would result in incidental take in the form of "harm" resulting from reduced ability to forage successfully due to habitat changes that affect prey availability.

High water levels during the wet season are important in maintaining quality wet prairie and emergent slough habitat (FWS 2010). However, high water levels and extended hydroperiods have resulted in vegetation shifts within WCA 3A, degrading Everglade snail kite critical habitat. The extended flooding from September to January resulting either from weather conditions, IOP, or both, appears to be shifting plant communities from wet prairies to open water sloughs (Zweig 2008, Zweig and Kitchens 2008). These shifts from one vegetation type to another may occur in a relatively short time frame (1 to 4 years) following hydrologic alteration (Armentano et al. 2006, Zweig 2008, Zweig and Kitchens 2008, Sah et al. 2008).

This vegetation transition directly affects Everglade snail kites in several ways, most importantly by reducing the amount of suitable foraging and nesting habitat, and reducing prey abundance and availability. Wetter conditions reduce the amount of woody vegetation within the area upon which Everglade snail kites rely for nesting and perch hunting. In addition, prolonged hydroperiods reduce habitat structure in the form of emergent vegetation, which is critical for apple snail aerial respiration and egg deposition (Turner 1996, Darby et al. 1999). Drying events are essential in maintaining the mosaic of vegetation types needed by a variety of wetland fauna (Sklar et al. 2002), including the Everglade snail kite (FWS 2010) and its primary food source, the apple snail (Karunaratne et al. 2006, Darby et al. 2008). However, little annual variation in water depths has occurred within WCA 3A since 1993, virtually eliminating the drying events necessary to maintain this mosaic. This is particularly apparent in southwestern WCA 3A, which has experienced excessive ponding in recent years.

A revised WCA 3A Regulation Schedule was implemented under ERTP in October 2012 to further aid in the reduction of high water levels within WCA-3A, and specifically to address the protracted flooding that occurred between September and January under IOP. The intent of expanding Zones D and E1 is to achieve the ERTP objective of managing water levels within WCA 3A for the protection of multiple species and their habitats (ERTP PM B-l). Through this modification, the Corps will have additional flexibility as compared with IOP in making water releases from WCA 3A in order to better manage recession and ascension rates, as well as to alleviate high water conditions in southern WCA 3A.

As previously discussed, water levels within portions of WCA 3A (i.e. southwestern 3A) have been too high for too long resulting in detrimental effects to vegetation, apple snails and Everglade snail kites. Under ERTP, the WCA 3A Interim Regulation Schedule Zone A has been lowered by 0.25 feet (i.e. 9.75 to 10.75 feet NGVD under IOP versus 9.50 to 10.50 feet NGVD under ERTP), thereby lowering the trigger stage for water releases from WCA 3A. By providing an additional mechanism to reduce high water levels within WCA 3A, modifications to the WCA 3A Regulation Schedule under ERTP have the potential to provide beneficial effects to the Everglade snail kite and its critical habitat within WCA 3A.

Two detrimental impacts associated with the creation of Zone E-1 observed under IOP include rapid recession rates and low water levels during the Everglade snail kite's breeding season. In order to correct these detrimental impacts under ERTP, both a recession rate and a low water level criterion have been developed. ERTP includes a recession rate criterion of 0.05 feet per week between January 1 and

June 1 (ERTP PM D) to avoid recession rates that are too rapid and thus detrimental to Everglade snail kites and apple snails. In addition, to avoid water levels that are too low at the end of the dry season, specific water depth criteria have been developed based on the stage at the WCA-3AVG. The criteria include depths favorable for Everglade snail kites, apple snails and wet prairie vegetation and were created in conjunction with the species experts (Dr. Kitchens, Dr. Darby, and Dr. Zweig) and FWS.

6.2.6.2 Prolonged Low Water Levels

Under the IOP WCA 3A Regulation Schedule, there was a high likelihood that the water levels in WCA 3A would fall below a critical threshold (below which Everglade snail kite foraging success and apple snail reproduction is severely reduced) for an extended period of time. Zone E1 was first incorporated into the WCA 3A deviation schedule under the 2000 Interim Structural and Operational Plan (ISOP) and subsequently included in IOP. The 0.5 feet (15 centimeters) reduction in the bottom zone (Zone E) of the WCA 3A Regulation Schedule was intended to help offset the effects of reduced outflows through the S-12 structures that resulted from IOP closures in the dry season and early wet season. This change resulted in a greater reduction in WCA 3A stages prior to the wet season. While this new zone may have helped to achieve the desired result of reducing high water impacts that could result from S-12 closures during the early wet season, it may have contributed to detrimental impacts to Everglade snail kite nesting and foraging within WCA 3A. During the years of ISOP and IOP operations, the low stages (as indicated by gage 3A-28) that have occurred have reached approximately 8.4 feet (2.6 meters), with the exception of 2003, when the low reached 8.9 feet (2.7 meters). In the six years prior to IOP, the low stages at Gauge 3A-28 (Site 65) had been above approximately 8.9 feet (2.7 meters) at their lowest point. A difference of 0.5 feet (15 centimeters) is not large. However, depending on where Everglade snail kites choose to nest, this difference could have a notable impact on how hydrologic conditions change near Everglade snail kite nests during the spring recession. Snail kites' reliance on the area immediately around the nest for foraging and capturing sufficient prey to feed nestlings during the two months of the nestling period make them vulnerable to rapidly changing hydrologic conditions.

Low water levels have an effect on Everglade snail kite nest success in WCA 3A (Cattau et al. 2008). If water levels become too low and food resources become too scarce, adults will abandon their nest sites and young (Sykes et al. 1995). Predation on nests is also higher when water levels are low. A strong relationship exists between annual minimum stage and juvenile Everglade snail kite survival rate (Martin et al. 2007, Cattau et al. 2008). Estimated juvenile Everglade snail kite survival rates for years when water levels fell below 10 cm was substantially lower compared to years where estimated water depths stayed above 10 cm (Cattau et al. 2008). Due to their inability to move large distances, juvenile Everglade snail kites rely upon the marshes surrounding their nests for foraging. If water levels within these marshes become too low to support foraging (due to low apple snail availability), juvenile survival will be diminished.

Recent scientific information has indicated that apple snail egg production is maximized when dry season low water levels are less than 50 cm (was previously 40 centimeters) but greater than 10 cm (Darby et al. 2002, FWS 2010). Water depths outside this range can significantly affect apple snail recruitment and survival. If water levels are less than 10 cm, apple snails cease movement and may become stranded, hence they are not only unavailable to foraging Everglade snail kites, they are also unable to successfully reproduce. Depending upon the timing and duration of the dry down, apple snail recruitment can be significantly affected by the truncation of annual egg production and stranding of juveniles (Darby et al. 2008). Since apple snails have a 1.0 to 1.5-year life span (Hanning 1979, Ferrer et al. 1990, Darby et al. 2008), they only have one opportunity (i.e. one dry season) for successful reproduction. Egg cluster production may occur from February to November (Odum 1957, Hanning

1979, Darby et al. 1999); however, approximately 77% of all apple snail egg cluster production occurs between April and June (Darby et al. 2008). Dry downs during peak apple snail egg cluster production substantially reduce recruitment (Darby et al. 2008). If possible, dry downs during this critical time frame should be avoided. The length of the dry down, age, and size of the apple snail are all important factors in apple snail recruitment and survival. Larger apple snails can survive dry downs better than smaller apple snails (Kushlan 1975, Darby et al. 2006, 2008). In fact, Darby et al. (2008) found that 70% of pre-reproductive adult-sized apple snails survived a 12-week dry down; while smaller apple snails exhibited significantly lower survival rates (less than 50% after 8 weeks dry).

There is a delicate trade-off between low and high water, and timing seems to be critical. Drying events following managed recessions have the potential to induce mortality of juvenile and adult Everglade snail kites and apple snails, whereas repeated and extended flooding tends to result in long-term degradation of the habitat, which also reduces reproduction and hinders kite recovery.

6.2.6.3 Rapid Recession Rates

Given the high water levels early in the nesting season, birds are initiating nests in upslope shallower sites. Often water managers initiate rapid recession rates to meet the target regulation schedule and avoid impacts of sustained higher water levels. These rapid recession rates have serious implications for Everglade snail kite nesting success. Breeding adults may not be able to raise their young before the water levels reach a critical low, below which apple snail availability to Everglade snail kites is drastically reduced. In addition, when water levels recede below an active Everglade snail kite nest, predation risk increases due to nest exposure to terrestrial predators (Sykes et al. 1995). As a result, nesting success is further reduced in these areas.

Rapid recession rates also result in reduced apple snail productivity. Apple snails may become stranded if water levels fall too rapidly, effectively preventing apple snails from reaching areas of deeper water. Stranded apple snails cease movement and as a result, apple snail reproduction is essentially terminated.

6.2.6.4 Potential Effects of CEPP to Snail Kite

Evaluation of potential effects to Everglade snail kites within the CEPP project area included adaptations of ERTP PMs, including depth and recession rate requirements for Everglade snail kites and apple snails, along with the Apple Snail Population Model (SFNRC 2013d) throughout a 41-year period of record (POR) from 1965 - 2005. Evaluation of critical habitat within Lake Okeechobee was not performed due to CEPP itself remaining within the Lake Okeechobee Regulation Schedule (LORS) 2008. The CEPP PIR will not be the mechanism to propose or conduct the required NEPA or biological evaluation of modifications to the LORS. However, it is expected that a revision to the current LORS 2008 schedule for Lake Okeechobee will be required prior to full utilization of the CEPP A-2 FEB feature and re-direction of the full 210,000 ac-ft/yr south to the Everglades.

ERTP PMs (PM-B, PM-C) were adapted for use in this analysis to determine potential effects on Everglade snail kite and their primary food source, Florida apple snail, due to CEPP implementation. The following methodology was used to assess depths within WCA 3A and WCA 3B:

- Analysis included Regional Simulation Model (RSM) output for ECB 2012, FWO, and Alt 4R2 for gages: 3A-NE, 3A-NW, 3A-3, 3A-4, 3A-28, 3A-SW, 3B-71, and 3B1W1 (**Figure 6-12**).
- The 2010 FWS MSTS recommended stage ranges for Everglade snail kites and apple snails were translated into recommended depth ranges.

- The RSM stage was translated to depth for each of the gages listed in step 1 using ground surface elevations provided in RSM model output (i.e. RSM stage- RSM ground surface elevation = water depth at gage).
- The RSM gage depths were then compared with 2010 FWS MSTS Everglade snail kite and apple snail recommended depth ranges for pre-breeding (December 31) and dry season low (May 1-June 1 stages) (**Table 6-2**).
- The number of times throughout the 41-year POR in which the depth were within recommended depth ranges were summed. These graphs can be found in **Table 6-3**.

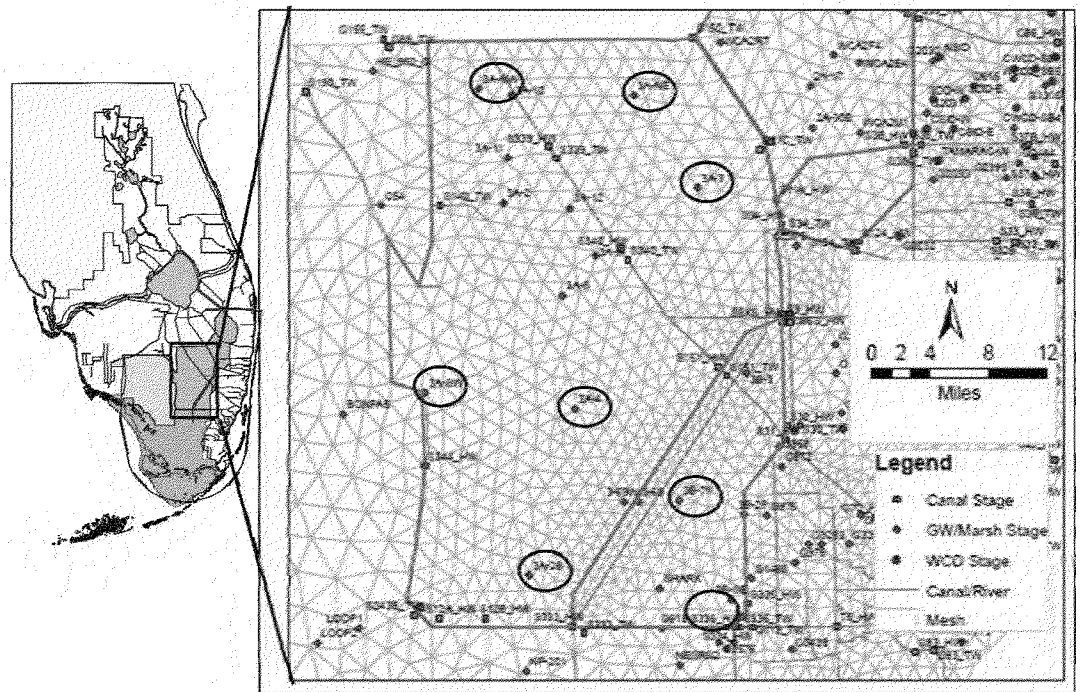


Figure 6-12. WCA 3 Gauge Locations for Snail Kite and Apple Snail Performance Measures

The number of years in which depths fell within 2010 FWS MSTS recommended ranges for Everglade snail kites and apple snails under existing conditions, FWO, and Alt 4R2 are detailed within **Table 6-2** and **Table 6-3**, respectively. As noted in **Table 6-2**, significant improvements over the existing conditions occur during the May 1 to June 1 timeframe within northern WCA 3A (3A-NW and 3A-3) as well as within WCA 3B at Gage 3B-71, while moderate increases were viewed within southwestern WCA 3A at 3A-SW, 3A-28, and in WCA 3B at 3BS1W1. Northern WCA 3A had a slight increase over the existing conditions for Gage 3A-NE. Slight declines for recommended Everglade snail kite depths were viewed within central WCA 3A at Gage 3A-4. However, it is important to note that for apple snail depth ranges a slight increase was visible at Gage 3A-4 in central WCA-3A. Significant improvements to apple snail depth ranges occurred in northern WCA 3A (3A-NE, 3A-NW, 3A-3), with a slight improvement in central WCA 3A (3A-4) and WCA 3B (3B-71 and 3BS1W1). Slight declines from existing conditions occurred in southwestern WCA 3A (3A-28 and 3A-SW) (**Table 6-3**). As noted in **Table 6-3**, there were a greater number of years across the 41-year POR in which Alt 4R2 provided depths within the 2010 FWS MSTS recommended depth range for apple snails (i.e. 1 May to 1 June: 173 across all regions for apple snails versus 84 for Everglade snail kites). This difference is largely due to the broader depth range ascribed to apple snails within the 2010 FWS MSTS as compared with that for Everglade snail kites. The apple snail depth ranges are based upon published literature from several wetland areas throughout Florida. In comparison, the depth ranges for Everglade snail kites are based on past occurrences of Everglade snail kite nesting within WCA-3A. The depth ranges for Everglade snail kite may be more narrow than the species is likely able to tolerate and thus the analysis performed likely underestimates improvements within WCA 3 for Everglade snail kites. Alt 4R2 also increased the number of times that the depth range was within recommended ranges for Everglade snail kites and apple snails within pre-breeding season except at 3A-4 for apple snails where it performed one year differently from existing conditions but the same as FWO (December 31). These pre-breeding water depths are important for a steady recession rate throughout the dry season in order to maintain within suitable depths during the dry season low (refer to 2010 FWS MSTS).

Table 6-2. Number of years in which depths fell within 2010 FWS MSTS recommended depth ranges for Everglade snail kite (ERTP PM-B)

	December 31			May 1 - June 1		
	ECB2012	ALT 4R2	FWO	ECB2012	ALT 4R2	FWO
Gage	3A-NE					
# years met	0	0	0	1	2	1
Gage	3A-NW					
# years met	0	11	0	3	9	3
Gage	3A-3					
# years met	8	8	9	1	17	4
Gage	3A-4					
# years met	14	14	14	13	11	11
Gage	3A-28					
# years met	3	35	2	7	9	10
Gage	3A-SW					
# years met	1	0	1	3	5	3
Gage	3B-71					

	December 31			May 1 - June 1		
	ECB2012	ALT 4R2	FWO	ECB2012	ALT 4R2	FWO
# years met	2	3	2	10	20	7
Gage	3BS1W1					
# years met	18	17	16	8	11	14
Total	46	88	44	46	84	53

Table 6-3. Number of years in which depths fell within 2010 FWS MSTS recommended depth ranges for apple snails (ERTP PM-C)

	Dec 31			May 1 – June 1		
	ECB 2012	ALT 4R2	FWO	ECB 2012	ALT 4R2	FWO
Gage	3A-NE					
# years met	0	0	0	2	20	2
Gage	3A-NW					
# years met	1	16	0	7	19	4
Gage	3A-3					
# years met	10	10	11	3	20	7
Gage	3A-4					
# years met	23	22	22	21	23	18
Gage	3A-28					
# years met	4	4	2	18	15	19
Gage	3A-SW					
# years met	2	0	2	37	31	37
Gage	3B-71					
# years met	6	6	5	25	28	5
Gage	3BS1W1					
# years met	19	21	18	13	17	13
Total	65	79	63	126	173	105

An apple snail population model was developed by Phil Darby (University of West Florida), Don DeAngelis (USGS), and Stephanie Romañach (USGS) and is being used as an Ecological Planning Tool for the CEPP. The purpose of the model is to describe the dynamics of the apple snail population a function of hydrology and temperature. The numbers and size distribution of the snails are simulated and can be calculated for any day of a year with input data. Here we present some results from the size-structured population model to simulate the response of apple snails for existing conditions and Alt 4R2 and FWO versus Alt 4R2 (**Figure 6-13 and Figure 6-14**). Conditions are presented for a dry year for each model run (Alt 4R2 and ECB 2012, and Alt 4R2 and FWO), as dry years are when restoration projects are likely to have the biggest impact, given that the system is largely rainfall driven in the wet season. Results are also shown for adult snails (> 20 mm) during the spring of a dry year, before that years' reproductive period. Adult snails during a given year are a product of egg production, and thus environmental conditions, from the previous year. End of spring results are shown as the population of snails of the size class consumed by the endangered Everglades snail kites. Based upon the results of this analysis, implementation of Alt 4R2 provides better conditions for apple snail populations as compared to existing conditions and FWO, particularly in WCA 3A, WCA 3B, and ENP.

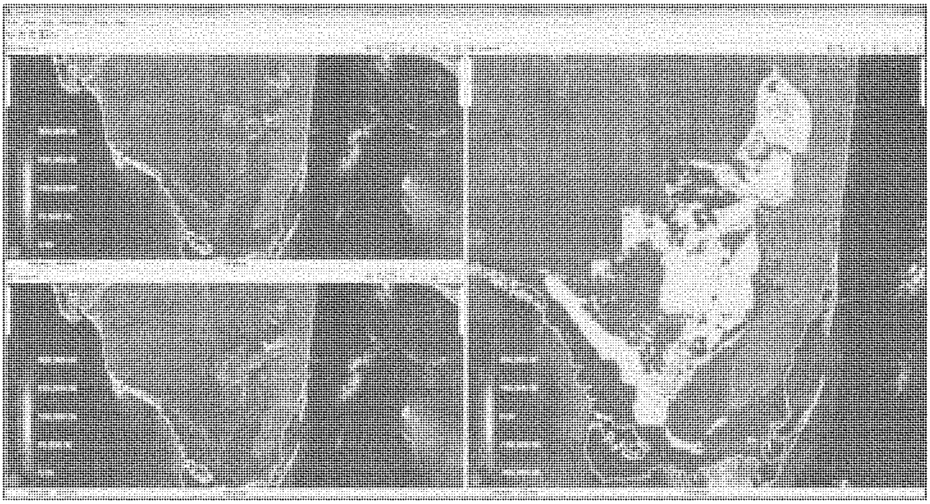


Figure 6-13. Adult snail (> 20 mm) population size as a result of Alt 4R2 (top left) vs. ECB 2012 (bottom left), and a difference map (right map panel) of Alt 4R2 minus ECB 2012.

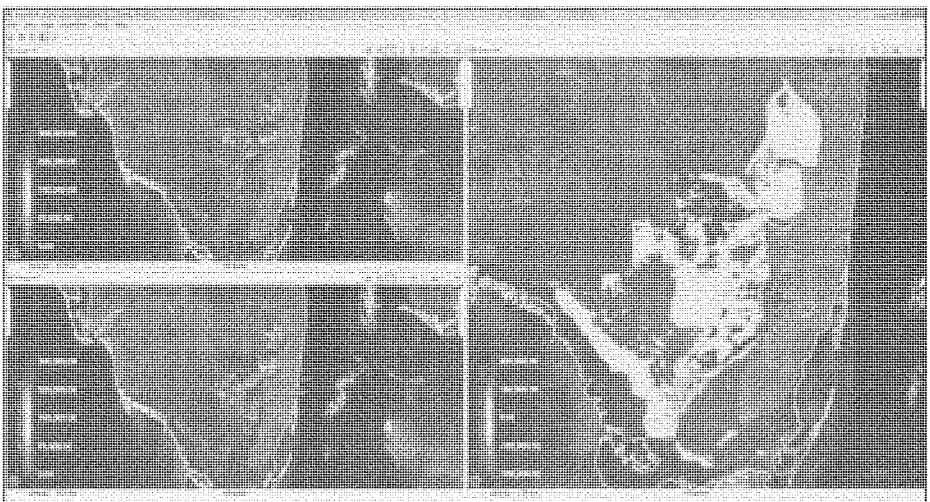


Figure 6-14. Adult snail (> 20 mm) population size as a result of Alt 4R2 (top left) vs. FWO (bottom left), and a difference map (right map panel) of Alt4R2 minus FWO.

Periphyton is a primary component of invertebrate diets, including apple snails. In addition to the potential for increased foraging opportunities, changes in vegetation resulting in expansion of wet prairie and increases in emergent vegetation would also provide habitat structure critical for apple snail aerial respiration and egg deposition (Turner 1996, Darby et al. 1999). Apple snails tend to avoid areas where water depths are greater than 50 cm (Darby et al. 2002). Avoidance of deeper depths may be related to the type and density of vegetation in deeper water areas, food availability, or energy requirements for aerial respiration (van der Walk et al. 1994, Turner 1996, Darby 1998, Darby et al. 2002). Water-lily sloughs support lower apple snail densities as compared with wet prairies (Karunaratne et al. 2006). Limited food quality and lack of emergent vegetation in sloughs may account for the lower densities. Research indicates that apple snails depend upon periphyton for food (Rich 1990, Browder et al. 1994, Sharfstein and Steinman 2001), which may be limited within deeper water environments. Karunaratne et al. (2006) observed little or no submerged macrophytes and epiphytic periphyton in the sloughs they studied in WCA 3A. In contrast, species commonly encountered within wet prairie habitat (i.e. *Eleocharis spp., Rhynchospora tracyi, Sagittaria spp.*), along with sawgrass that grows within the ecotones between the two vegetative communities, support abundant populations of epiphytic periphyton (Wetzel 1983, Browder et al. 1994, Karunaratne et al. 2006). A reduction in the number of available emergent stems for egg deposition would also contribute to the observed lower snail densities within sloughs. Drying events are needed to maintain the emergent plant species characteristic of typical apple snail habitat (Wood and Tanner 1990, Davis et al. 1994). As shown by Darby et al. (2008), apple snails can survive these events and it is the timing and duration of the dry down event that are critical determinants of apple snail survival and recruitment. CEPP would provide increased opportunities for apple snails within northern WCA 3A, and appropriate conditions for increased apple snail populations in ENP. As compared to the existing conditions and FWO, rehydration and vegetation shifts within northern WCA 3A and increased hydroperiods within WCA 3B and ENP would increase suitable habitat for apple snails, thereby increasing the spatial extent of suitable foraging opportunities for Everglade snail kites (**Table 6-3**).

6.2.6.5 Snail Kite Species Effect Determination

To improve the likelihood of successful snail kite nesting in WCA 3A, ERTP incorporated the FWS MSTS recession rate recommendation of 0.05 feet/week from January 1 until June 1 (or the onset of the wet season). CEPP used these recommendations during the planning process and ERTP PM-D was used within the analysis of CEPP alternatives. As shown in the ecological planning tool evaluations throughout this Section, Alt 4R2 performs better than both existing conditions and FWO (**Figure 6-13 and Figure 6-14**). Recession rates less than 0.05 feet/week or more than 0.05 feet but less than 0.10 foot/week are considered acceptable under certain environmental conditions. However, since rapid recession rates were identified as adversely affecting snail kite nesting in WCA 3A, recession rates that are slower than 0.05 feet/week would not have as great of a negative effect as would recession rates more than 0.05 feet but less than 0.10 feet/week. Recession rates for any given week or period of time could be determined based upon recommendations made during the WCA 3A Periodic Scientists Call. The RSMGL did not contain the ability to model flexibility and adaptive management and thus simply provides a baseline indicator of recession rates. The Corps could utilize the operational flexibility inherent within operations to achieve the recommendation.

In conclusion, with the evaluation of ERTP PMs, increased hydroperiods within northern WCA 3A, WCA 3B, and ENP as a result of CEPP implementation would have a beneficial effect on Everglade snail kite and apple snail habitat (**Table 6-1, Table 6-2, Table 6-3**). Changes in the quality, quantity, timing, and distribution of water under CEPP provides opportunities for improved vegetation in northern WCA 3A, 3B, and ENP, including expansion of sloughs and wet prairies, and contraction of sawgrass prairies. CEPP would remain below the recommended range ascension rates for apple snails, meet FWS MSTS depth recommendations throughout much of WCA 3 and would therefore support successful apple snail oviposition. Increased periphyton would provide for an increased foraging base for the apple snails, in turn providing more foraging opportunities for the Everglade snail kite. Incorporating real-time ground monitoring and using the Periodic Scientist calls could minimize any potential negative effects to the species. The Corps has determined the project may affect Everglade snail kite.

6.2.6.6 Snail Kite Critical Habitat

Critical habitat for the Everglade snail kite was designated September 22, 1977 (42 FR 47840 47845) and includes areas of land, water, and airspace within portions of the St. Johns Reservoir, Indian River County; Cloud Lake Reservoir, St. Lucie, County; Strazzulla Reservoir, St. Lucie County; western portions of Lake Okeechobee, Glades and Hendry counties; Loxahatchee National Wildlife Refuge (WCA 1), Palm Beach County; WCA 2A, Palm Beach and Broward counties; WCA 2B, Broward County; WCA 3A, Broward and Miami-Dade counties; and ENP to the Miami-Dade/Monroe County line (**Figure 6-15**). Because this was one of the first critical habitat designations under the ESA, there were no primary constituent elements defined. The designated area encompasses approximately 841,635 acres (340,598 hectares).

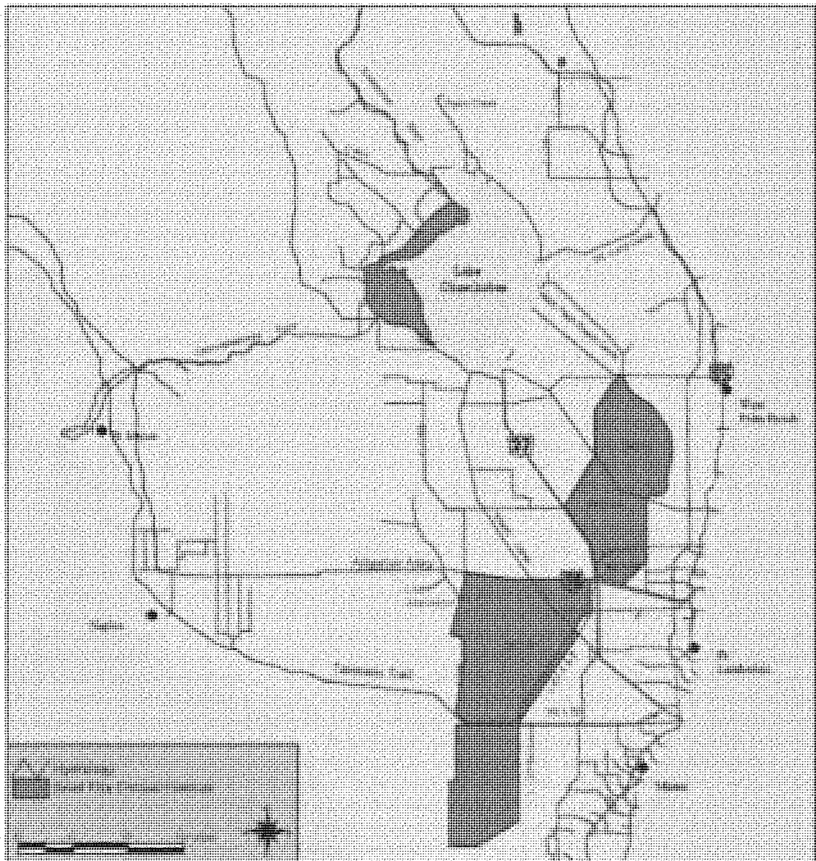


Figure 6-15. Critical habitat for Everglade snail kite

Since the designation in 1977, FWS has consulted on the loss of 18.66 acres (7.55 hectares) of critical habitat in a construction project. Construction of C&SF infrastructure resulted in impacts to less than 20 acres (8.1 hectares) of critical habitat. A FWS BO addressed the effects of construction of the Miccosukee Tribe's Government Complex Center on critical habitat, which resulted in the loss of 16.88 acres (6.83 hectares) of critical habitat. In addition, the FWS has consulted on impacts to 88,000 acres (35,612 hectares) of critical habitat resulting from prolonged flooding and temporary degradation of critical habitat because of prescribed fire. In addition to these projects, degradation of Everglade snail kite habitat has occurred because of the effects of long-term hydrologic management and eutrophication. While it is not possible to accurately estimate the changes that have occurred within each unit, approximately 40% of the original designation is estimated to be in degraded condition for Everglade snail kite nesting and foraging relative to when it was designated in 1977.

Although previously located in freshwater marshes over considerable areas of peninsular Florida, the range of the Everglade snail kite is currently more limited. This bird is now restricted to peripheral wetlands and several impoundments on the headwaters of the St. John's River, the southwest side of Lake Okeechobee, the eastern and southern portions of WCA 1, 2A, and 3, the southern portion of WCA 2B, the western edge of WCA 3B, and the northern portion of ENP.

Based upon annual surveys from 1970 to 1994, WCA 3A represents the largest and most consistently utilized portion of Everglade snail kite designated critical habitat. Over the past two decades, Everglade snail kites have shifted nesting activities to areas of higher elevation within WCA 3A in response to habitat degradation in traditional nesting areas resulting from prolonged high water levels (Bennetts et al. 1998). Nesting activity has shifted up the elevation gradient to the west, and has also moved south in response to recent increased drying rates, restricting current nesting to the southwest corner of WCA 3A (Zweig and Kitchens 2008).

Sustained high water levels have resulted in the conversion of wet prairies (preferred foraging habitat for Everglade snail kites) to aquatic sloughs in selected sites within WCA 3A, along with losses of interspersed herbaceous and woody species essential for nesting and perch hunting. Concern arose regarding sustained high water levels and their effect on the structure and function of vegetation communities in WCA 3A, portions of which are designated critical habitat for the Everglade snail kite. The principal concern is that the habitat quality, and thus the carrying capacity, of WCA 3A is already seriously degraded. Studies by Zweig (2008) and Zweig and Kitchens (2008) tend to confirm these concerns. Since 1998 and the start of water management regimes for the protection of the CSSS, Everglade snail kite production in WCA 3A has dropped (**Table 6-1**), having produced no Everglade snail kites in 2005, 2007, 2008, 2010, and only two birds in 2009 (Martin 2007, Martin et al. 2007, Cattau et al. 2009, Cattau et al. 2012). In 2011, 11 birds were reported, and in 2012 only 1 was reported. This coincides with successive annual shifts (2002, 2003, 2004, and 2005) in community types within the slough/prairies at sites reported in 2002 to be prime areas of apple snail abundance, and thus Everglade snail kite foraging, in WCA 3A. The conversion trend from emergent prairies/sloughs to deep water sloughs is certainly degradation in habitat quality for the Everglade snail kites. Habitat quality in WCA 3A is changing progressively and dramatically to less desirable habitat in this critical area, and this conversion is rapid, with changes evident in just one year (Zweig and Kitchens 2008). Potential improvements to habitat are expected with CEPP implementation due to rehydration of wetlands within northern WCA 3A and ENP. Slight improvements would be made to vegetation within southern WCA 3A and central WCA 3A is expected to remain under current conditions. The improvements would provide increased foraging and nesting habitat for the Everglade snail kite and apple snail. Water depths are not expected to change in WCA 2 or WCA 1 with implementation of CEPP.

6.2.6.7 Snail Kite Critical Habitat Effect Determination

Implementation of CEPP Alt 4R2 would have no effect on Everglade snail kite designated critical habitat within Lake Okeechobee, WCA 1, or WCA 2 because CEPP is redirecting approximately 210,000 acre feet of additional water that currently flows into the St. Lucie and Caloosahatchee Estuaries to the historical southerly flow path south through FEBs and existing STAs. The goal of CEPP is to increase hydroperiods within WCA 3 and ENP, which coincides with habitat requirements of apple snail and Everglade snail kite within WCA 3 and NESRS. In addition, implementation of Alt 4R2 substantially increased the number of years in which PM-B and PM-C were met at most gages throughout WCA 3. Based upon this information, the Corps has determined that implementation of CEPP may affect Everglade snail kite critical habitat.

6.2.7 Wood Stork and "May Affect" Determination

Background Information on the 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; therefore, none will be affected.

The wood stork is found from northern Argentina, eastern Peru and western Ecuador north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (AOU 1983). Only the population segment that breeds in the southeastern United States is listed as endangered. 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, Cone and Hall 1970, 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 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. Breeding colonies of wood storks are currently documented in all southern Florida counties except for Okeechobee County.

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 decline in the United States population of the wood stork is thought to be related to one or more of the following factors: 1) reduction in the number of available nesting sites, 2) lack of protection at nesting sites, and 3) loss of an adequate food base during the nesting season (Ogden and Nesbitt 1979). Ogden and Nesbitt (1979) indicate a reduction in nesting sites is not the cause in the population decline, because the number of nesting sites used from year to year is relatively stable. Ogden and Nesbitt suggest loss of an adequate food base is a cause of wood stork declines.

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) 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, Coulter 1987, Gawlik and Crozier 2004, Herring and Gawlik 2007). Calm water, about 5 to 25 cm 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.

Wood storks feed almost entirely on fish between 2 and 25 cm (1 to 10 inches) in length (Kahl 1964, Ogden et al. 1976, Coulter 1987) but may occasionally consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions (Kushlan 1979). Wood storks typically wade through the water with their beaks immersed and open about 7 to 8 centimeters (2.5 to 3.5 inches). When the wood stork encounters prey within its bill, the mandibles snap shut, the head is raised, and the food swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956, Kahl 1964, Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

Studies on fish consumed by wood storks have shown that wood storks are highly selective in their feeding habits with sunfish and four other species of fish comprising the majority of their diet (Ogden et al. 1976). Ogden et al. (1976, 1978) noted that the key species consumed by wood storks included sunfishes (Centrarchidae), yellow bullhead (*Italurus natalis*), marsh killifish (*Fundulus confluentus*), flagfish (*Jordenella floridae*) and sailfin molly (*Poecilia latipinna*).

These species were also observed to be consumed in much greater proportions than they occur at feeding sites, and abundant smaller species (i.e., mosquitofish (*Gambusia* spp.), least killifish (*Heterandria formosa*), bluefin killifish (*Lucania goodei*) are under-represented, which the researchers believed was probably because their small size does not elicit a bill-snapping reflex in these tactile feeders (Coulter et al. 1999). Their studies also showed that in addition to selecting larger species of fish, wood storks consumed individuals that are significantly larger (greater than 3.5 cm) than the mean size available (2.5 centimeters), and many were greater than one-year old (Ogden et al. 1976, Coulter et al. 1999).

Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida. Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over three feet during the wet season (June-September), and then receding gradually during the dry season (October-May). Wood storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the wood stork nesting period, any one site may only be suitable for wood stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for storks to access the wetlands (Gawlik 2002, Gawlik et al. 2004). Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging, and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964, Gawlik 2002).

In addition to the concentration of fish due to normal drying, several other factors affect fish abundance in potential foraging habitats. Longer hydroperiod areas generally support more fish and larger fish (Trexler et al. 2000, Turner et al. 1999). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential wood stork foraging sites (Rehage and Trexler 2006), and distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites also affect fish density and biomass. Within the highly modified environments of southern Florida, fish availability varies with respect to hydrologic gradients, nutrient availability gradients, and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a wide variety of hydroperiod classes, nutrient conditions, and spatial variability.

Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high, the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Wood stork prey availability is dependent on a composite variable consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too great (greater than 30 cm) for storks or the tree canopy at the site is too dense for wood storks to land.

Dense submerged and emergent vegetation may reduce foraging suitability by preventing wood storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Some submerged and emergent vegetation does not detrimentally affect wood stork foraging, and may be important to maintaining fish populations. Wood storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993, Coulter et al. 1999). Foraging sites with open canopies are more easily detected from overhead as wood storks are searching for food.

Gawlik (2002) characterized wood storks as "searchers" that employ a foraging strategy of seeking out areas of high density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, but while prey was still sufficiently available that other wading bird species were still foraging in large numbers (Gawlik 2002). Wood stork choice of foraging sites was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Wood storks generally forage in wetlands between 0.5 kilometer and 74.5 kilometer away from the colony site (Bryan and Coulter 1987, Herring and Gawlik 2007), but forage most frequently within 10-20 kilometer (12 miles) of the colony (Coulter and Bryan 1993, Herring and Gawlik 2007). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available, during shifts in seasonal and annual rainfall and surface water patterns, to support wood storks. Adults feed farthest from the nesting site prior to laying eggs, forage in wetlands closer to the colony site during incubation and early stages of raising the young, and then farther away again when the young are able to fly. Wood storks generally use wet prairie ponds early in the dry season then shift to slough ponds later in the dry season thus following water levels as they recede into the ground (Browder 1984).

Wood stork nesting habitat consists of mangroves as low as 1 meter (3 feet), cypress as tall as 30.5 meters (100 feet), and various other live or dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Rodgers et al. 1997, Coulter et al. 1999). Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (Rodgers et al. 1995). **Figure 6-16** shows the locations of wood stork colonies throughout Florida. The same colony site will be used for many years as long as the colony is undisturbed and sufficient foraging habitat remains in the surrounding wetlands. However, not all wood storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1995). In response to this type of change to nest site hydrology, wood storks may abandon that site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrologic conditions may re-nest in other nearby areas (Borkhataria et al. 2004, Crozier and Cook 2004).

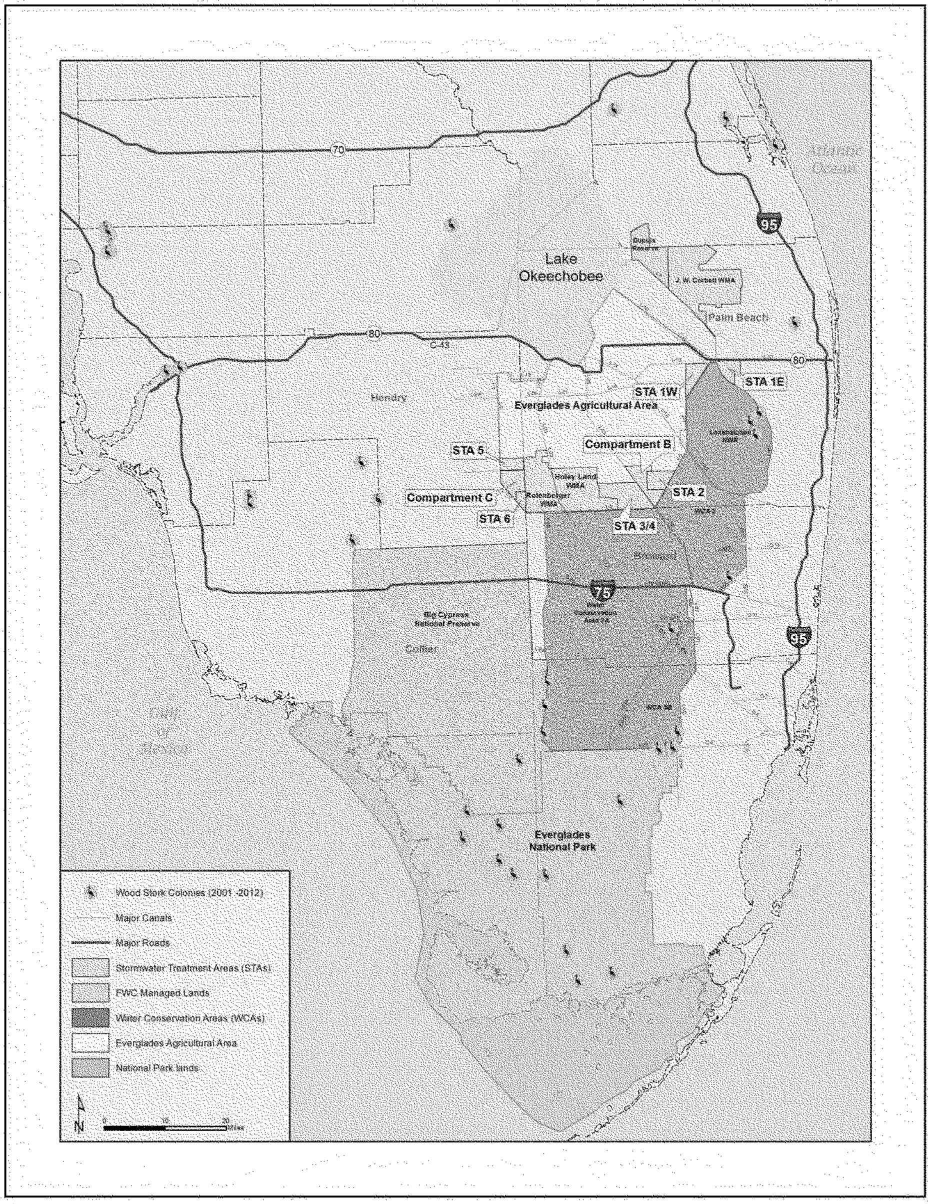


Figure 6-16. Location of wood stork colonies in Florida between 2001-2012

The wood stork life history strategy has been characterized as a "bet-hedging" strategy (Hylton et al. 2006) in which high adult survival rates and the capability of relatively high reproductive output under favorable conditions allow the species to persist during poor conditions and capitalize on favorable environmental conditions. This life-history strategy may be adapted to variable environments (Hylton et al. 2006) such as the wetland systems of southern Florida. Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony vary from year to year based on availability of suitable wetland foraging areas, which can be affected by local rainfall patterns, regional weather patterns, and anthropogenic hydrologic management (Frederick and Ogden 2001). While the majority of wood stork nesting occurs within traditional wood stork rookeries, a handful of new wood stork nesting colonies are discovered each year (Meyer and Frederick 2004, SFWMD 2004, 2009). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Breeding wood storks are believed to form new pair bonds every season. First age of breeding has been documented in 3- to 4-year-old birds but the average first age of breeding is unknown. Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990, FWS 1999). A single clutch of two to five (average three) eggs is laid per breeding season but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation among years in the clutch sizes, and clutch size does not appear to be related to longitude, nest data, nesting density, or nesting numbers, and may be related to habitat conditions at the time of laying (Frederick 2009, Frederick et al. 2009). Egg laying is staggered and incubation, which lasts approximately 30 days, begins after the first egg is laid. Therefore, the eggs hatch at different times and the nestlings vary in size (Coulter et al. 1999). In the event of diminished foraging conditions, the youngest birds generally do not survive.

The young fledge in approximately eight weeks but will stay at the nest for three to four more weeks to be fed. Adults feed the young by regurgitating whole fish into the bottom of the nest about three to ten times per day. Feedings are more frequent when the birds are young (Coulter et al. 1999). When wood storks are forced to fly great distances to locate food, feedings are less frequent (Bryan et al. 1995). The total nesting period from courtship and nest-building through independence of young, lasts approximately 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous, and consequently, a colony may contain active breeding wood storks for a period significantly longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site for a relatively short period following the completion of breeding. Appropriate water depths for successful foraging are particularly important for newly fledged juveniles (Borkhataria et al. 2008).

Wood storks produce an average of 1.29 fledglings per nest and 0.42 fledglings per egg which is a probability of survivorship from egg laying to fledgling of 42 percent (Rodgers and Schwikert 1997). However, in 2009, which was a banner year for nesting, over 2.6 young fledged from successful nests (Frederick et al. 2009). The greatest losses occur from egg laying to hatching with a 30 percent loss of the nest productivity. From hatching to nestlings of two weeks of age, nest productivity loss is an additional 8%. Corresponding losses for the remainder of the nesting cycles are on the average of a 6% per two week increase in age of the nestling (Rodgers and Schwikert 1997).

Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964, Kushlan et al. 1975) to sustain successful wood stork nesting. During the period when a nesting colony is active, wood storks are dependent on consistent foraging opportunities in wetlands within their core foraging area (30 kilometer radius, FWS 2010) surrounding a nest site. The greatest energy demands occur during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 201 kilograms (443 pounds) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for wood storks during colony establishment, courtship and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.* 30 percent and 8%, respectively from egg laying to hatching and from hatching to nestling survival to two weeks) (Rodgers and Schwikert 1997).

The annual climatological pattern that appears to stimulate the heaviest nesting efforts by wood storks is a combination of the average or above-average rainfall during the summer rainy season prior to colony formation and an absence of unusually rainy or cold weather during the following winter-spring nesting season. This pattern produces widespread and prolonged flooding of summer marshes that maximizes production of freshwater fishes, followed by steady drying that concentrates fish during the dry season when storks nest (Kahl 1964, Frederick et al. 2009). However, frequent heavy rains during nesting can cause water levels to increase rapidly. The abrupt increases in water levels during nesting, termed reversals (Crozier and Gawlik 2004), may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success was reported to have affected most wading bird colonies in southern Florida during 2004, 2005 and 2008 (Crozier and Cook 2004, Cook and Call 2005, SFWMD 2008).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first six months following fledging, most likely as a result of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006, Borkhataria et al. 2008). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects wood storks and their ability to forage (Hylton et al. 2006, Borkhataria et al. 2008).

In southern Florida, both adult and juvenile wood storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Wood storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile wood storks from southern Florida move far beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999, Borkhataria et al. 2004, Borkhataria et al. 2006). Some flocks of juvenile wood storks have also been reported to move well beyond the breeding range of wood storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Both adult and juvenile wood storks return southward in the late fall and early winter months. In a study using satellite telemetry, Borkhataria et al. (2006) reported that nearly all wood storks that had been tagged in the southeastern United States moved into Florida near the beginning of the dry season, including all sub-adult storks that fledged from Florida and Georgia colonies. Adult wood storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during the annual Christmas bird surveys, suggest that the vast majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of wood storks in this region was 10 to 100 times higher than in northern Florida and Georgia (FWS, unpublished data). As a result of these general population-level movement patterns, during the earlier period of the wood stork breeding season in southern Florida, the wetlands upon which nesting wood storks depend are also being heavily used by a large portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and sub-adult storks from throughout the wood stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

The original Everglades ecosystem, including the WCAs, provided abundant primary and secondary wading bird production during the summer and fall months (Holling et al. 1994). This productivity was concentrated during the dry season when water levels receded. The concentrations of food provided ideal foraging habitat for numerous wetlands species, especially large flocks of wading birds (Bancroft 1989, Ogden 1994). However, the hydrology of the Everglades ecosystem and WCA-3A has been severely altered by extensive drainage and the construction of canals and levees (Abbott and Nath 1996). The resulting system is not only spatially smaller, but also drier than historical levels (Walters et al. 1992). Breeding populations of wading birds have responded negatively to the altered hydrology (Ogden 1994, Kushlan and Fohring 1986, Bancroft 1989).

In most years within the vicinity of NESRS, IOP resulted in reduced stages during the dry season because of constraints on inflows. This may have caused increased recession rates in this area resulting in a reduction in the amount of suitable foraging habitat available near the end of wood stork nesting in the late dry season when stages in that area reached their lowest levels. In addition, reduced flows had the potential to result in the risk of drying below the Tamiami West wood stork colony potentially increasing nest depredation rates and risk of nest abandonment, particularly in drier-than-average years. The close proximity of the colony to the L-29 Canal helped to reduce the risk of drying below the colony because canal stages were maintained at a relatively stable level throughout the dry season. Modeling also indicated that IOP would occasionally result in increased water levels in NESRS during the spring dry season (2006 IOP FSEIS). These conditions presumably occurred when stages were sufficiently low that the G-3273 constraint did not restrict inflows, and water from WCA 3A was diverted into NESRS through the S-333 structure. In these cases, water levels within NESRS, in the immediate vicinity of the Tamiami West wood stork colony, would rise by up to one foot during the period when wood storks were nesting and when water levels were generally receding throughout the system. This results in an artificial reversal and would cause a reduction in wood stork foraging conditions in areas near the colony, and may be significant enough to cause colony abandonment. Because the foraging radius of the Tamiami West colony includes parts of WCA 3A and WCA 3B, ENP, the Pennsuco Wetlands, and urban areas, sufficient foraging opportunities remained in other areas to offset the poor foraging conditions that result from IOP in NESRS, but some reduction in foraging opportunities was expected.

Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964, Kushlan et al. 1975) to sustain successful wood stork nesting. During the period when a nesting colony is active, wood storks are dependent on consistent foraging opportunities in wetlands within their core foraging area (30 kilometer radius, FWS 2010) surrounding a nest site. The greatest energy demands occur during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for wood storks during colony establishment, courtship and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (i.e. 30 percent and 8%, respectively from egg laying to hatching and from hatching to nestling survival to two weeks) (Rodgers and Schwikert 1997).

Both adult and juvenile wood storks return southward in the late fall and early winter months. In a study using satellite telemetry, Borkhataria et al. (2006) reported that nearly all wood storks that had been tagged in the southeastern United States moved into Florida near the beginning of the dry season, including all sub-adult storks that fledged from Florida and Georgia colonies. Adult wood storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during the annual Christmas bird surveys, suggest that the vast majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of wood storks in this region was 10 to 100 times higher than in northern Florida and Georgia (FWS, unpublished data). As a result of these general population-level movement patterns, during the earlier period of the wood stork breeding season in southern Florida, the wetlands upon which nesting wood storks depend are also being heavily used by a large portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and sub-adult storks from throughout the wood stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

Historically, the short hydroperiod wetlands within ENP have been important for wood stork foraging during the pre-breeding season with the storks shifting to longer hydroperiod wetlands as the dry season progresses. ERTP ET-2 provides for a hydroperiod requirement between 90-210 days within CSSS habitat and thus would help to produce a mosaic of wetlands of varying hydroperiods within ENP. Hydrologic patterns that produce a maximum number of patches with high prey availability (i.e. high water levels at the end of the wet season and low water levels at the end of the dry season) are necessary for high reproductive outputs (Gawlik 2002, Gawlik et al. 2004). Depending upon the elevation and microtopography throughout the WCAs and ENP, implementation of CEPP will produce a variety of wetland habitats that would support prey densities conducive to successful wood stork foraging and nesting.

6.2.7.1 Potential Effects to the Wood Stork

Wood storks rely upon short hydroperiod wetlands (i.e. marl prairies) for pre-breeding foraging. Short hydroperiod wetlands would help increase body condition and would allow for wood storks and other wading birds to initiate nesting earlier than they do now (November versus February). This will improve nesting success by reducing potential for nest abandonment, increasing juvenile survival by ensuring prey are available within CFA and allowing juveniles to fledge prior to end of dry season/start of wet season when food availability decreases around nests.

Several models of wading birds were used to assess potential affects to wading birds within the Greater Everglades as a result of implementation of CEPP Alt 4R2 including: 1) Wood Stork Foraging Probability Index model (ENP 2012, 2013) 2) wading bird species distribution (Beerens 2013), and 3) wading bird nesting success (Beerens 2013). ERTP PMs are captured within the Beerens models.

A Wood Stork Foraging Probability Index model (ENP 2013) was used to assess potential affects to wading birds within the Greater Everglades as a result of CEPP implementation. An analysis of wood stork foraging potential was performed to predict how foraging habitat with CEPP implementation would be affected (ENP 2013). The Wood Stork Foraging Probability Index (STORKI v. 1.0) was developed to provide rapid simulations of wood stork foraging conditions in response to modeled CERP scenarios (LoGalbo et al. 2012).

Figure 6-17 and **Figure 6-18** indicate that Alt 4R2 provides the greatest benefit within northeastern WCA 3, areas adjacent to the Miami Canal, and throughout southern ENP relative to the existing conditions. Not many wood stork colonies are currently found in northeastern WCA 3 or adjacent to the Miami Canal, however, if foraging conditions improve in these areas, wood storks could colonize there. As compared to benefits gained in northern WCA 3A, less benefits occur within northwest WCA 3A (CEPP zone 3A-NW), and southeast Everglades National Park (CEPP zone ENP-S), however, 4R2 is still an improvement over the existing conditions and FWO. Benefits generally result from the increased water deliveries to these regions which result in more suitable water depths for wood stork foraging as compared to existing conditions and the FWO.

Declines in stork foraging suitability occur within northern ENP (CEPP Zone ENP-N) with Alt4R2 relative to existing conditions or FWO. The effects of increasing flow deliveries to Everglades National Park through the Blue Shanty flowway results in downstream water depths in ENP-N substantially less suitable for wood stork foraging. As compared to Zone ENP-N, less negative effects to foraging occur in central and southern WCA 3A central (CEPP Zones 3A-C and 3A-S) with Alt4R2 as compared to existing conditions or FWO.

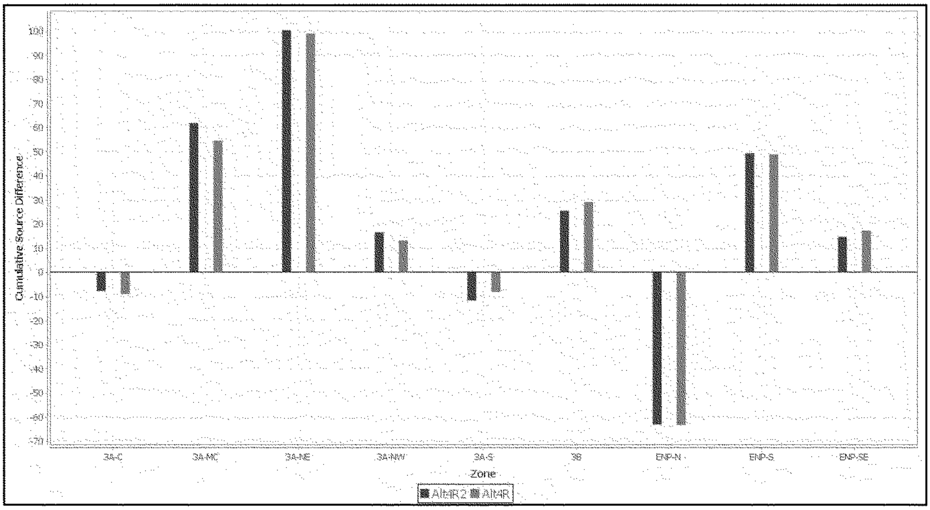


Figure 6-17. Suitable wood stork habitat cumulative (1965-2005) lift above existing conditions for Alt 4R2 within each CEPP zone. A maximum score of 1327 is possible if ECB 2012 has a suitability score of 0.0 every week and the alternative has a suitability score of 1.0 every week of the 41 year hydrologic model runs (SFNRC 2013c)

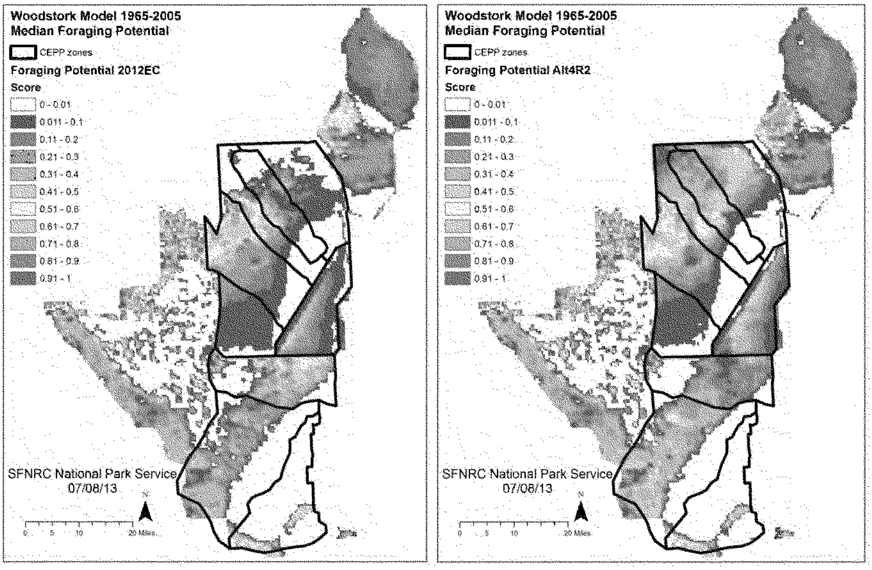


Figure 6-18. Median wood stork foraging potential suitability scores for 1965-2005. Scores vary from 0.0 (not suitable) to 1.0 (optimal foraging). Existing conditions is shown in the left panel and Alt 4R2 in the right panel (SFNRC 2013a)

Wood stork species distribution was modeled by Beerens 2013 in support of the RECOVER Greater Everglades ecological evaluation. The objectives of the spatial foraging conditions model (SFC) are to determine the average hydrological and spatial characteristics of a cell that predict the species-specific *frequency* of cell use over the study period. Wood storks generally showed increased numbers in northern WCA 3A, WCA 3B, and southern ENP under Alt 4R2 compared to the FWO (**Figure 6-19**). The existing conditions showed a similar trend in percent differences to the FWO, indicating that Alt 4R2 also performs better than existing conditions (**Figure 6-20**).

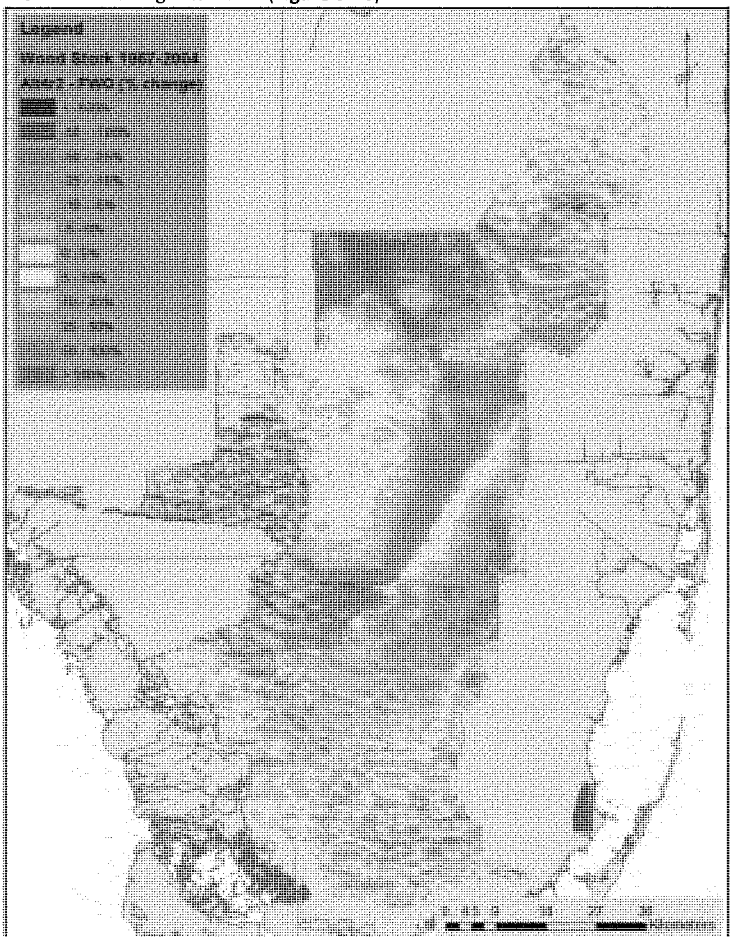


Figure 6-19. The coloration in this map represents the mean percent change in wading bird cell use (Jan – May, 1967-2004) for Alt4R2 relative to Future Without (FWO).

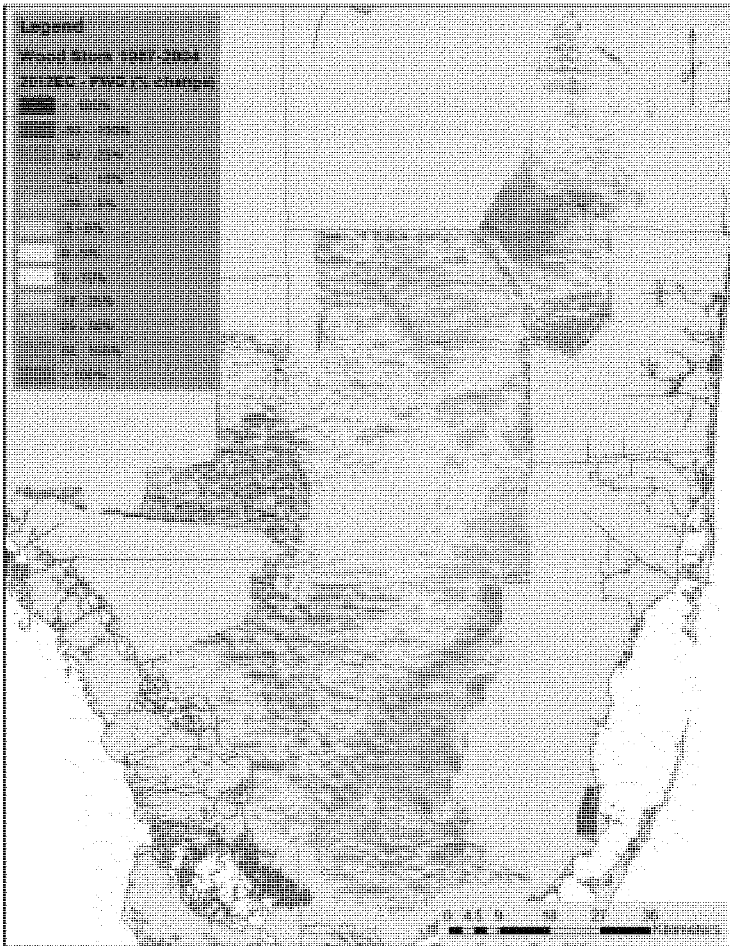
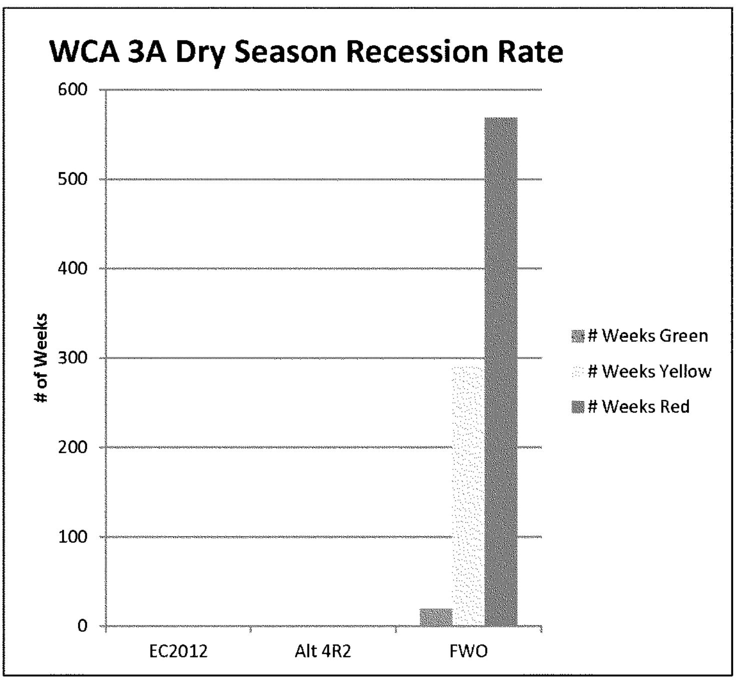


Figure 6-20. The coloration in this map represents the mean percent change in wading bird cell use (Jan – May, 1967-2004) for existing conditions relative to Future Without (FWO).

Historically, the short hydroperiod wetlands within ENP have been important for wood stork foraging during the pre-breeding season with the storks shifting to longer hydroperiod wetlands as the dry season progresses. Hydrologic patterns that produce a maximum number of patches with high prey availability (i.e. high water levels at the end of the wet season and low water levels at the end of the dry season) are necessary for high reproductive outputs (Gawlik 2002, Gawlik et al. 2004). Depending upon the elevation and microtopography throughout the WCAs and ENP, implementation of CEPP would produce a variety of wetland habitats that would support prey densities conducive to successful wading bird foraging and nesting.

Water depth and recession rate are the two most important hydrologic variables for wood storks (Gawlik et al. 2004) and wading birds. In their analysis of habitat suitability, Gawlik et al. (2004) identified feeding sites where the weekly average water depths from November to April (pre-breeding and breeding season) were between 0.0 and 0.5 feet as the most suitable. Suitability drops to 0.0 when water depths are -0.3 feet below marsh surface or greater than 0.8 feet. Wood storks and other wading birds require recession to condense their prey items into shallow pools for more effective foraging. The ERTP PM F (Strive to maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1) was moderated more often in Alt 4R2 as compared to existing conditions and FWO (**Figure 6-21**). Recession rates for any given week or period of time could be determined based upon recommendations made during the WCA 3A Periodic Scientists Call. The RSMGL did not contain the ability to model flexibility and adaptive management and thus simply provides a baseline indicator of recession rates. The Corps could utilize the operational flexibility inherent within operations to achieve the recommendation. It is recognized that areas of suitable foraging habitat will vary both within and between years due to microtopography, antecedent conditions, hydrologic and meteorological conditions, and water management actions. It is anticipated that these provisions within CEPP will help to improve foraging conditions within WCA 3A and ENP to provide a direct benefit to the wood stork and other wading bird species.



PM-F Criteria (feet/ week)
> 0.17
> 0.07 but ≤ 0.17
0.06 to 0.07
≥ -0.05 but < 0.06
< -0.05

Figure 6-21. WCA 3A Dry Season Recession Rates (PM-F).

6.2.7.2 Wood Stork Species Effect Determination

Restoration of hydroperiods and hydropatterns closer to a pre-drainage condition (Pre-drainage conditions are defined as those conditions that occurred in the late 1800s, prior to the wide-scale drainage, urbanization, and compartmentalization of the Everglades) is a focal Everglades restoration objective for CERP. A related CERP restoration goal is to restore historic wading bird foraging and colonial nesting habitats in the mainland estuary zones of ENP. Therefore, the general transitioning of wood stork foraging habitat (under most climatic conditions) from Shark River Slough, which historically was a deep water white-water lily-dominated slough habitat, back into southern ENP, is considered a progressive step toward ecosystem restoration. It should be noted, however, that with Alt 4R2, a levee will be constructed within WCA 3B that will result in permanent loss of wood stork foraging habitat as well as habitat connectivity. This impact is not assessed in the wood stork foraging probability index (SFNRC 2013a).

Hydrologic changes associated with implementation of the project are expected to alter and provide an overall net benefit for wood stork foraging suitability throughout WCA 3 and ENP. Although wood stork colonies are not currently in all of the areas where foraging and habitat suitability are increasing, the potential for wood storks to colonize these areas highly increases due to the increase in foraging and habitat suitability. However, declines in foraging suitability occur in northern ENP due to increased flow deliveries through the Blue Shanty flowway. Metrics would need to be developed prior to CEPP implementation to account for any changes in the system due to construction and operation of other features, such as Modified Water Deliveries to Everglades National Park. Based upon the current information, the Corps' determination is that CEPP may affect wood stork.

6.2.8 Cape Sable Seaside Sparrow and "May affect" Determination

Background Information on the Cape Sable Seaside Sparrow

Measuring 13-14 centimeters in length, the CSSS is one of nine subspecies of seaside sparrows (Werner 1975). CSSS are non-migratory residents of freshwater to brackish marshes and their range is restricted to the lower Florida peninsula. They were originally listed as endangered in 1969 due to their restricted range (FWS 1999). Subsequent changes in their habitat have further reduced their range and continue to threaten this subspecies with extinction.

CSSS prefer mixed marl prairie communities that include muhly grass (*Muhlenbergia filipes*) for nesting (Stevenson and Anderson 1994). Marl prairie communities have short-hydroperiods (the period of time during which a wetland is covered by water) and contain a mosaic of moderately dense, clumped grasses, interspersed with open space that permit ground movements by the sparrows (FWS 1999). CSSS are generally not found in communities dominated by dense sawgrass, cattail (*Typha* spp.) monocultures, long-hydroperiod wetlands with tall, dense vegetative cover, spike rush marshes, and sites supporting woody vegetation (Werner 1975, Kushlan and Bass 1983). CSSS also avoid sites with permanent water cover (Curnutt and Pimm 1993). The combination of hydroperiod and periodic fire events are critical in the maintenance of suitable mixed marl prairie communities for the CSSS (Kushlan and Bass 1983).

CSSS nest in the spring when the marl prairies are dry. While the majority of nesting activities have been observed between March 1 and July 15 when Everglades marl prairies are dry, (Lockwood et al. 1997, 2001), nesting has been reported as early as late February (Werner 1975), and as late as early August (Dean and Morrison 2001). Males will establish breeding territories in early February (Balent et al. 1998) and defend these territories throughout the breeding season (FWS 1999). Male sparrows vocalize to attract females and this particular breeding activity has been shown to decrease with increased surface water conditions (Nott et al. 1998, Curnutt and Pimm 1993).

Successful CSSS breeding requires that breeding season water levels remain at or below ground level in the breeding habitat. Nott et al. (1998) cited a "10-centimeter (cm)" rule for maximum water depth over which the CSSS will initiate nesting. This conclusion was based upon observations within the ENP range-wide survey in which no singing males were heard when water depths exceeded that level. However, Dean and Morrison (1998) demonstrated that nesting may occur when average water depths exceed this rule. CSSS construct their nests relatively close to the ground in clumps of grasses composed primarily of muhly, beakrushes (*Rhynchospora* spp.), and Florida little bluestem (*Schizachyrium rhizomatum)* (Pimm et al. 2002). The average early season nest height is 17 cm (6.7 inches) above ground, while the average late season nest height is 21 cm (8.3inches) above ground (Lockwood et al. 2001). The shift in average nest height after the onset of the wet season rainfall pattern, which typically begins in early June (Lockwood et al. 2001), appears to be an adaptive response to rising surface water conditions. In general, the CSSS will raise one or two broods within a season; however, if weather conditions permit, a third brood is possible (Kushlan et al. 1982, FWS 1983). A new nest is constructed for each successive brood. The end of the breeding season is triggered by the onset of the rainy season when ground water levels rise above the height of the nest off the ground (Lockwood et al. 1997).

CSSS will lay three to four eggs per clutch (Werner 1978, Pimm et al. 2002) with a hatching rate ranging between 0.66 and 1.00 (Boulton et al. 2009b). The nest cycle lasts between 34 and 44 days in length and includes a 12-13 day incubation period, 9-11 day nestling period and 10-20 days of post-fledgling care by both parents (Sprunt 1968, Trost 1968, Woolfenden 1968, Lockwood et al. 1997, Pimm et al. 2002). Nest success rate varies between 21 and 60 percent, depending upon timing of nest initiation within the breeding season (Baiser et al. 2008, Boulton et al. 2009a). Substantially higher nest success rates occur within the early portion of the breeding season (approximately 60 percent prior to June 1) followed by a decline in success as the breeding season progresses to a low of approximately 21% after June 1 (Baiser et al. 2008, Boulton et al. 2009a, Virzi et al. 2009). In most years, June 1 is a good division between the early high success period and the later, lower success period (Dr. Julie Lockwood email correspondence to FWS, October 15, 2009). Nearly all nests that fail appear to fail due to predation, and predation rates appear to increase as water level increases (Lockwood et al. 1997, 2001, Baiser et al. 2008). A complete array of nest predators has not been determined. However, raccoons *(Procyon lotor*), rice rats *(Oryzomys palustris*), and snakes may be the chief predators (Lockwood et al. 1997, Dean and Morrison 1998, Post 2007).

A dietary generalist, CSSS feed by gleaning food items from low-lying vegetation (Ehrlich et al. 1992, Pimm et al. 2002). Common components of their diet include soft-bodied insects such as grasshoppers, spiders, moths, caterpillars, beetles, dragonflies, wasps, marine worms, shrimp, grass, and sedge seeds (Stevenson and Anderson 1994). The importance of individual food items appear to shift in response to their availability (Pimm et al. 1996, 2002).

CSSS are non-migratory with males displaying high site fidelity, defending the same territory for two to three years (Werner 1975). CSSS are capable of both short-distance and longer-range movements, but appear to be restricted to short hydroperiod prairie habitat (Dean and Morrison 1998). Large expanses of deep water or wooded habitat act as barriers to long-range movements (Dean and Morrison 1998). Recent research by Julie Lockwood, Ph.D. of Rutgers University and her students have revealed substantial movements between subpopulations east of Shark River Slough (Lockwood et al. 2008, Virzi et al. 2009), suggesting that the CSSS has considerable capacity to colonize unoccupied suitable habitat (Sustainable Ecosystems Institute 2007).

In the 1930s, Cape Sable was the only known breeding range for the CSSS (Nicholson 1928). Areas on Cape Sable that were occupied by the CSSS in the 1930s have experienced a shift in vegetative communities from freshwater vegetation to mangroves, bare mud flats, and salt-tolerant plants, such as turtleweed (*Batis maritima*) and bushy seaside tansy (*Borrichia frutescens*) (Kushlan and Bass 1983). As a result, CSSS no longer use this area. More recently, continued alterations of CSSS habitat have occurred as a result of changes in the distribution, timing, and quantity of water flows in south Florida. Water flow changes and associated shifts in vegetation appear to be the leading contributor to the decline in CSSS population, which subsequently threaten the subspecies with extinction. Competition and predation also threatens the CSSS.

Presently, the known distribution of the CSSS is restricted to two areas of marl prairies east and west of Shark River Slough in the Everglades region (within ENP and BCNP) and the edge of Taylor Slough in the Southern Glades Wildlife and Environmental Area in Miami-Dade County. ENP staff first undertook a comprehensive survey of the CSSS in 1981 to identify all areas where sparrows were present. This survey, hereafter referred to as the range-wide survey, resulted in the first complete range map for the CSSS (Bass and Kushlan 1982, Kushlan and Bass 1983). The survey design consisted of a one-kilometer survey grid over any suspected CSSS habitat. As much of CSSS habitat is inaccessible, a helicopter was used and landed at the intersection of each grid line (i.e. every 1 kilometer). At each site, the researchers would record every CSSS seen or heard (singing males) within an approximate 200 meter radius of their landing location (Curnutt et al. 1998). From the resulting range map, Curnutt et al. (1998) divided the CSSS into six separate subpopulations, labeled as A through F (**Figure 6-22**) with subpopulation A (CSSS-A) as the only subpopulation west of Shark River Slough (SRS).

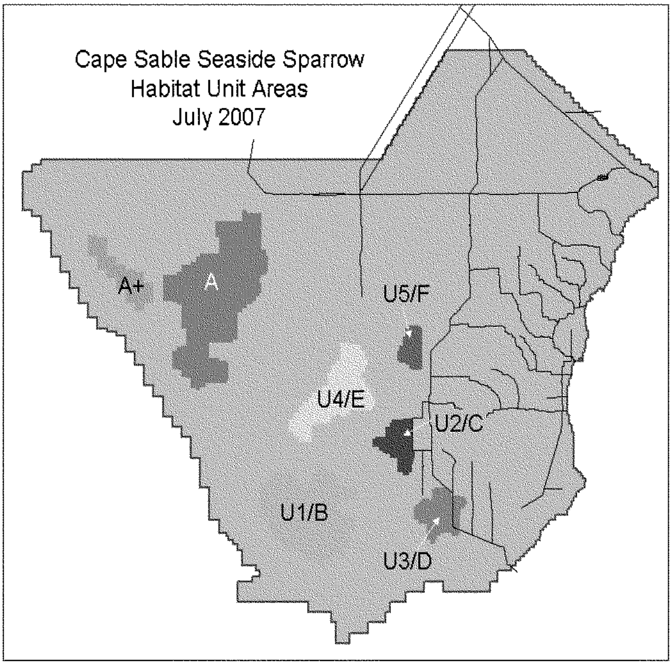


Figure 6-22. Cape Sable Seaside Sparrow Subpopulations (A-F) and Designated Critical Habitat Units (U1-U5).

After the 1981 survey, the population was not surveyed again until 1992. The range-wide survey has been performed annually since 1992, although the number of survey locations has changed from a high of over 850 sites in 1992 to a low of 250 sites in 1995 (Cassey et al. 2007).

Bass and Kushlan (1982) also devised a methodology of translating the range-wide survey results into an estimate of population size. To account for females (only males sing) and CSSS outside the audio detection range, the number of birds counted is multiplied by a factor of sixteen (15.87 rounded to 16). In order to confirm the validity of this estimation factor, Curnutt et al. (1998) compared the bird counts from the range-wide survey with actual mapped territories on intensive study plots and found it to be adequate given normal population fluctuations. More recent research indicates that this estimation factor may be overestimating population abundance within the smaller CSSS subpopulations (*i.e.* CSSS-A, C, D, F) due to the presence of floater males and a male-biased sex ratio (Boulton et al. 2009a).

Based on the range-wide surveys, total CSSS populations have declined from approximately 6,600 individuals during the period from 1981-1992, to approximately 1,456 in 2012 (**Table 6-4**). Although populations decreased significantly during the early part of that time period, they have remained relatively constant since 1993 **(Table 6-4, Figure 6-23).** Recognizing the limitations of the range-wide survey in detecting fine-scale changes in population abundance related to management actions (Walters et al. 2000, Lockwood et al. 2006), Cassey et al. (2007) translated the results of the range-wide survey into presence/absence data and then converted it into a measure of occupancy. In their study, occupancy was defined as the fraction of the area occupied by the species in any one year as used by MacKenzie et al. (2002). Their results show that the proportion of CSSS range occupied decreased between 1981 and 1992, particularly in CSSS-C, D and F, with a second period of decline between 1992 and 1996, most notably within CSSS-A. After 1996, overall occupancy has remained relatively constant (Cassey et al. 2007).

Table 6-4. Cape Sable Seaside Sparrow Bird Count and Population Estimates by Year as Recorded by the Everglades National Park Range-Wide Survey (BC: Bird Count, EST: Estimate, NS: Not Surveyed)

Population/ Year	CSSS-A		CSSS-B		CSSS-C		CSSS-D		CSSS-E		CSSS-F		Total	
	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST
1981	168	2,688	147	2,352	27	432	25	400	42	672	7	112	416	6,656
1992	163	2,608	199	3,184	3	48	7	112	37	592	2	32	411	6,576
1993	27	432	154	2,464	0	0	6	96	20	320	0	0	207	3,312
1994	5	80	139	2,224	NS	NS	NS	NS	7	112	NS	NS	151	2,416
1995	15	240	133	2,128	0	0	0	0	22	352	0	0	170	2,720
1996	24	384	118	1,888	3	48	5	80	13	208	1	16	164	2,624
1997	17	272	177	2,832	3	48	3	48	52	832	1	16	253	4,048
1998	12	192	113	1,808	5	80	3	48	57	912	1	16	191	3,056
1999a	25	400	128	2,048	9	144	11	176	48	768	1	16	222	3,552
1999b	12	192	171	2,736	4	64	NS	NS	60	960	0	0	247	3,952
2000a	28	448	114	1,824	7	112	4	64	65	1,040	0	0	218	3,488
2000b	25	400	153	2,448	4	64	1	16	44	704	7	112	234	3,744
2001	8	128	133	2,128	6	96	2	32	53	848	2	32	204	3,264
2002	6	96	119	1,904	7	112	0	0	36	576	1	16	169	2,704
2003	8	128	148	2,368	6	96	0	0	37	592	2	32	201	3,216
2004	1	16	174	2,784	8	128	0	0	40	640	1	16	224	3,584
2005	5	80	142	2,272	5	80	3	48	36	576	2	32	193	3,088
2006	7	112	130	2,080	10	160	0	0	44	704	2	32	193	3,088
2007	4	64	157	2,512	3	48	0	0	35	560	0	0	199	3,184
2008	7	112	NS	NS	3	48	1	16	23	368	0	0	34	544*
2009	6	96	NS	NS	3	48	2	32	27	432	0	0	38	608*
2010	8	128	119	1904	2	32	4	64	57	912	1	16	191	3,056
2011	11	176	NS	NS	11	176	1	16	37	592	2	32	62	992*
2012	21	336	NS	NS	6	96	14	224	46	736	4	64	91**	1456**

Note: These numbers do not reflect a significant decline in CSSS population. CSSS-B, the largest and most stable subpopulation, was not surveyed in 2008, 2009, or 2011. Adding the 2007 CSSS-B population estimate of 2,512 birds to those of the other subpopulations, the estimated total CSSS population size is 3,056 and 3,120 birds for 2008 and 2009, respectively. Adding the 2010 CSSS-B population estimate of 1,904 birds to those of the other subpopulations, the estimated total 2011 CSSS population size is 2,896 birds.

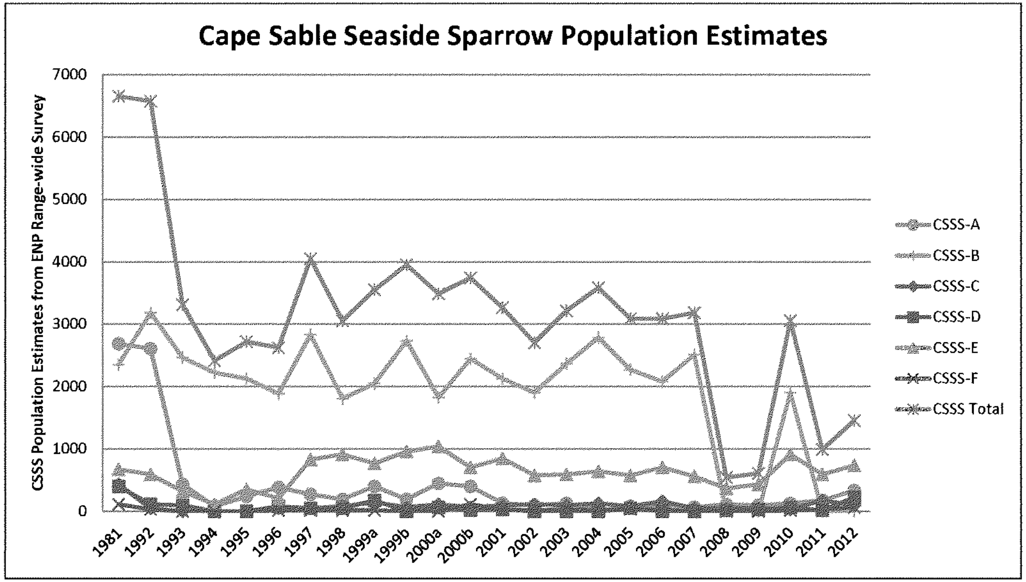


Figure 6-23. Cape Sable Seaside Sparrow Population Estimates within Each Subpopulation as Reported from the Everglades National Park Range-Wide Surveys

CSSS-A is located in western SRS immediately in the path of water discharges out of WCA 3A through the S-12 structures. Unusually intense and unseasonable rainy periods during the winter of 1992/93, along with Hurricane Andrew, and again in 1993/94 and 1994/95 caused prolonged flooding in CSSS-A, sufficient enough that the high water levels may have nearly precluded breeding in 1993 and 1995 (Walters et al. 2000). In addition, little or no breeding was possible during the 1994 and 1996 breeding seasons, due to the limited availability of suitable dry habitat. The flooding of the habitat by direct rainfall was compounded by discharges of water through the S-12 structures needed to meet the regulation schedule for WCA 3A. With an average life-span of two to three years, several consecutive years with little or no reproduction, could significantly affect population size. This is reflected in the dramatic reduction of sparrows detected in subsequent surveys in CSSS-A, in addition to the reduction in occupancy reported by Cassey et al. (2007) for the time period between 1992 and 1996. As a consequence, the FWS issued a BO in 1999 providing recommendations to the Corps on how water levels should be controlled within CSSS-A nesting habitat so that the existence of the CSSS would not be jeopardized. The Corps responded by developing changes in water management operations through emergency deviations in 1998 and 1999, two iterations of the Interim Structural and Operational Plan (ISOP) for Protection of the Cape Sable Seaside Sparrow in 2000 and 2001, culminating in the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow in 2002, which has been in effect until December of 2012 when the Everglades Restoration Transition Plan went into effect. The ISOP/IOP goals were to keep subpopulations (particularly CSSS-A) dry during the breeding season and to also keep the habitat for sub-populations B, C, D, E, and F (CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F) from excessive drying in order to prevent adverse habitat change from unseasonable fire frequencies.

The primary objective in implementing IOP was to reduce damaging high water levels within CSSS habitat west of SRS (i.e. CSSS-A). IOP was designed to protect the CSSS to the maximum extent possible through water management operations. The purpose of IOP was to provide an improved opportunity for nesting by maintaining water levels below ground level for a minimum of 60 consecutive days between March 1 and July 15, corresponding to the CSSS breeding season. In addition, a secondary purpose of IOP was to allow CSSS habitat to recover from prolonged flooding during the mid-1990s. It is recognized in the 1999 FWS BO that there could be times when unseasonable rainfall events could overwhelm the ability of the water management system to provide the necessary dry conditions. Since implementation of IOP, the FWS recommendations for protection of the CSSS in CSSS-A were met in 2002, 2004, 2006, 2008 and 2009. Direct rainfall on CSSS-A prevented meeting the RPA requirements for 2003, 2005 and 2007, contributing to the lack of recovery of CSSS-A. As reported from the range-wide survey (**Table 6-4**), the estimated total CSSS population during IOP has remained between 2,704 bird (2002) and 3,584 birds (2004). CSSS-A population estimates during IOP ranged from a low of 16 (1 bird counted) in 2004 to a high of 128 (8 birds counted) in 2003. The population estimates for CSSS-A may be inflated due to the potential inaccuracy of the estimation factor in smaller subpopulations as suggested by recent research (Boulton et al. 2009a). In addition, it should also be noted that the estimates for a particular year have relevance for potential breeding that year, but this would not be reflected in the population estimates until the following year. Under the 2006 IOP, the S12A-C, S343A-B and S344 structures were closed during portions of the year in order to meet the FWS RPA of 60 consecutive dry days at gauge NP-205 between March 1 and July 15. Under ERTP, the S-12A-B, S343A-B and S344 closure dates remain as identified under IOP. However, under ERTP, S-12C would not have any associated closure dates designed to meet the FWS RPA for the CSSS. Due to its more eastern location, S-12C is farther removed from CSSS-A as compared with the S12A-B structures and thus has less of an impact on hydrological conditions within CSSS-A (refer to 2006 IOP FSEIS). In addition, Department of the Interior will maintain sandbags within the culverts along the Tram Road within ENP to prevent westward flow of water from S-12C into the western marl prairies and CSSS-A. These stoppers will help to prevent S-12C flows west of the Tram Road and maintain shorter hydroperiods within the western marl prairies. Also, S-346 will be open when S-12D is open to further facilitate the movement of water into central Shark River Slough. As ERTP was implemented in October 2012, sufficient data is not available to understand if ERTP operations are having the intended effect within CSSS habitat.

Another factor in lack of recovery is change in vegetative structure resulting from physical damage during the high water events of 1993 through 1995 and a shift in the vegetative community dominants away from previous species. This phenomenon was studied by Michael Ross, Ph.D. and Jay Sah, Ph.D. of Florida International University, along with James Synder of the United States Geological Survey (USGS) in a 2003-2009 monitoring study funded by the Corps (Ross et al. 2003, 2004, 2006, Sah et al. 2007, 2008, 2009). Based upon several years of vegetation studies within CSSS habitat, the researchers concluded that the direction and magnitude of short-term vegetation change within marl prairie is dependent upon the position of the habitat within the landscape. Efforts to regulate the S-12 structures under ISOP/IOP to protect CSSS-A and its habitat west of SRS, as well as drought, have resulted in lower water depths during the sparrow breeding season as measured at gage NP-205. However, the persistence of wetter vegetation within the vicinity of gage P-34 may have limited the recovery of CSSS-A within this part of its habitat. This suggests water flow from the northwest resulting in deeper water levels and longer hydroperiods within this portion of CSSS-A habitat. As shown in **Table 6-4**, CSSS-A has not recovered under IOP operations, but has remained relatively stable since its implementation. Recent research suggests that sparrow populations are slow to recover, or cannot recover, once they reach very small population sizes due to low adult and juvenile recruitment, many unmated males, biased sex ratios, lower hatch rates and other adverse effects associated with small population size (i.e. the Allee effect) (Boulton et al. 2009a, Virzi et al. 2009).

Vegetation change is mediated by the interaction of fire and hydrology. Studies by Sah et al. (2009) revealed that not only did post-fire flooding delay the vegetation recovery process, but also caused it to follow a different trajectory in terms of species composition. This in turn, could potentially impede recolonization by the CSSS (Sah et al. 2009). The transition from one vegetation type to another (i.e. prairie to marsh) in response to hydrology may take place in as little as three to four years (Armentano et al. 2006), however, the transition from marsh to prairie may take longer (Ross et al. 2006, Sah et al. 2009). Vegetation studies within CSSS habitat (Ross et al. 2004) have shown that CSSS occupy prairies with a hydroperiod ranging between 90 and 240 days. However, solely attaining this hydroperiod requirement may not be enough to promote a transition from marsh to prairie habitat, as this likely requires the process of fire (Ross et al. 2006, Sah et al. 2009).

6.2.8.1 Potential Effects on CSSS

Presently, the known distribution of the CSSS is restricted to two areas of marl prairies east and west of SRS in the Everglades region (within ENP and BCNP) and the edge of Taylor Slough in the Southern Glades Wildlife and Environmental Area in Miami-Dade County. CSSS surveys resulted in a range map that divided the CSSS into six separate subpopulations, labeled as A through F (**Figure 6-24**), with CSSS-A as the only subpopulation west of SRS (Curnutt et al. 1998). The following analysis of Alt 4R2 compared to existing conditions and FWO is arranged by ERTP PM and ET with potential effects to each subpopulation described in greater detail.

PM-A: Number of years a minimum of 60 consecutive days at NP-205 below 6.0 feet, NGVD beginning no later than March 15 is met out of the 40 year period of record.

In order to compare alternatives in relation to PM-A, the RSM-GL simulated NP-205 daily stage was used. From this data, the annual discontinuous hydroperiod (number of days inundated), was calculated and the number of consecutive dry days within the CSSS nesting window of March 1 through July 15 were counted. For CSSS-B, CSSS-C, and CSSS-F, Alt 4R2 performs similarly to existing conditions and FWO. One region (IR-A2 and one gage (TMC) in CSSS-A, and 1 gage in CSSS-E (NE of NPA) performed worse than the existing conditions by 8, 2, and 4 years respectively (**Table 6-5 and Figures 6-25 through 6-37**).

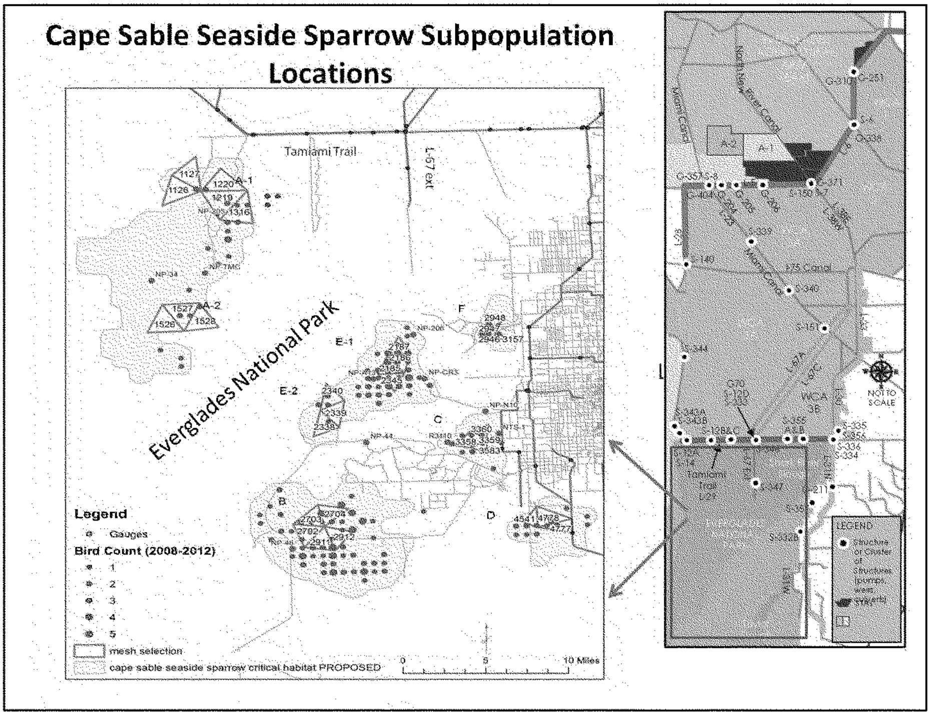


Figure 6-24. Extent of CSSS sub populations

Table 6-5. PM-A: Number of years there is a minimum of 60 consecutive days at NP-205 below 6.0 feet, NGVD beginning no later than March 15. Comparison of ECB 2012, FWO, and Alt 4R2 for each subpopulation of CSSS out of the 41 year POR.

Subpop	Gage	ECB2012	Alt 4R2	FWO
A	IR-A1 (region)	20	22	20
	IR-A2 (region)	33	25	33
	P34	29	29	29
	TMC	31	29	32
B	CY3	40	40	40
C	R3110	39	39	39
	E112	38	38	38
D	EVER4	20	20	22
E	NE of NPA13	37	33	36
F	NE of RG2	33	33	33

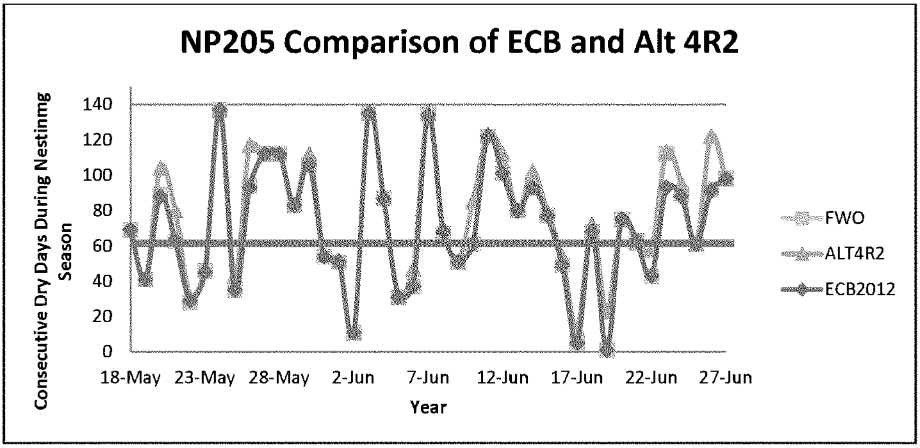


Figure 6-25. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A

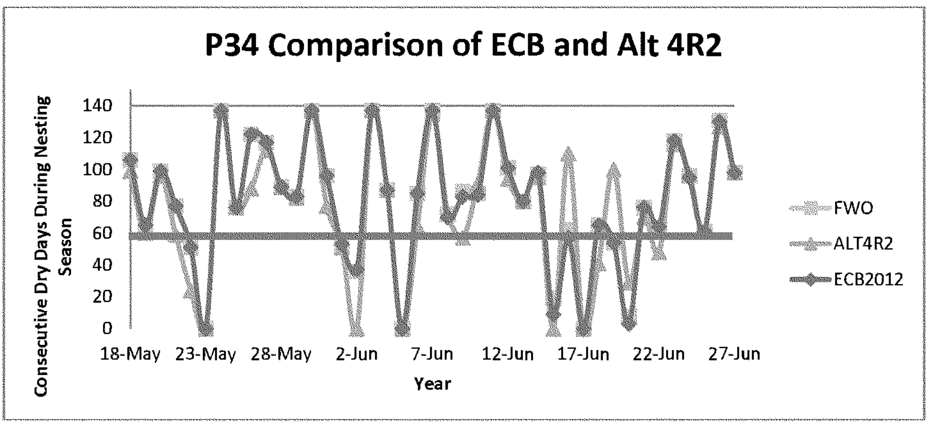


Figure 6-26. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A

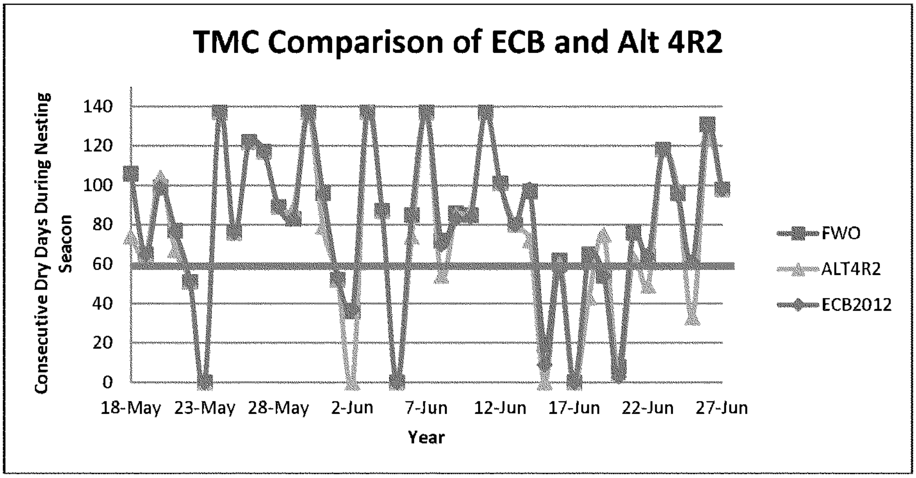


Figure 6-27. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A

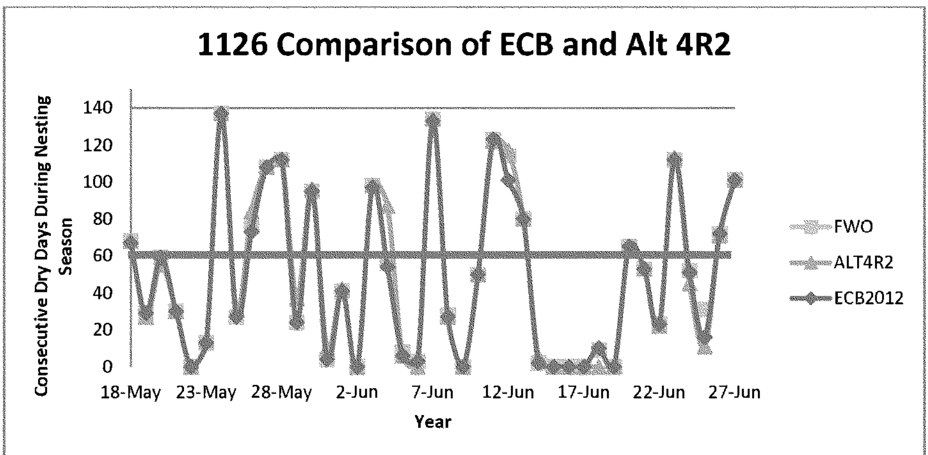


Figure 6-28. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

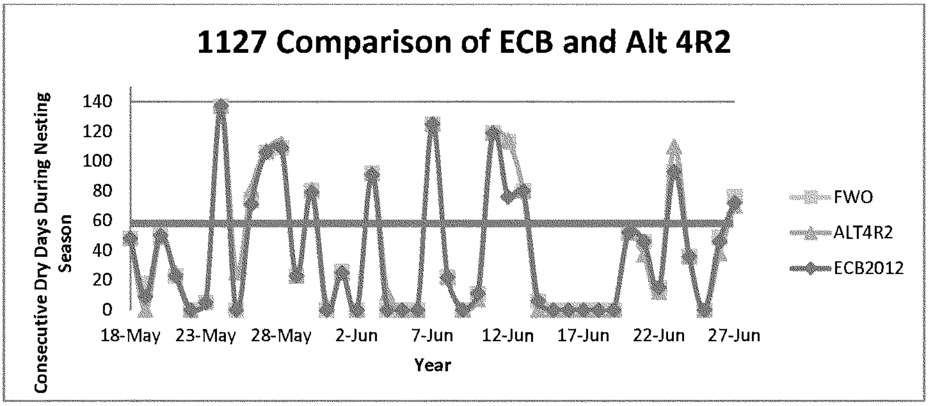


Figure 6-29. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

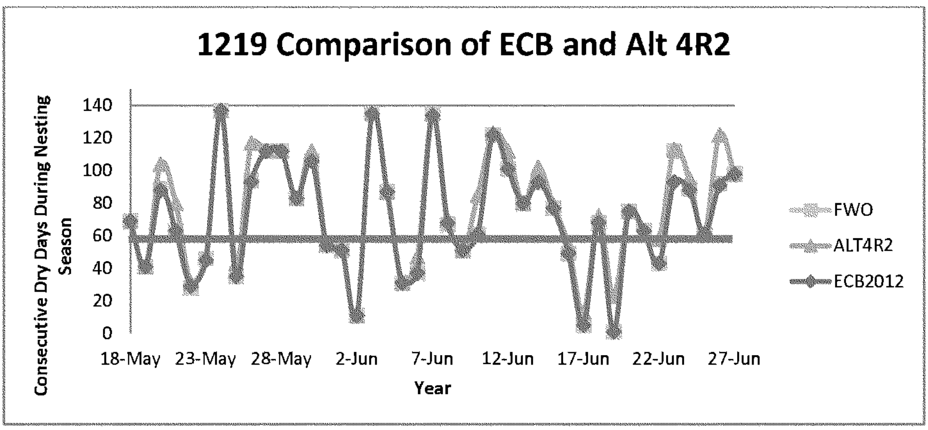


Figure 6-30. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

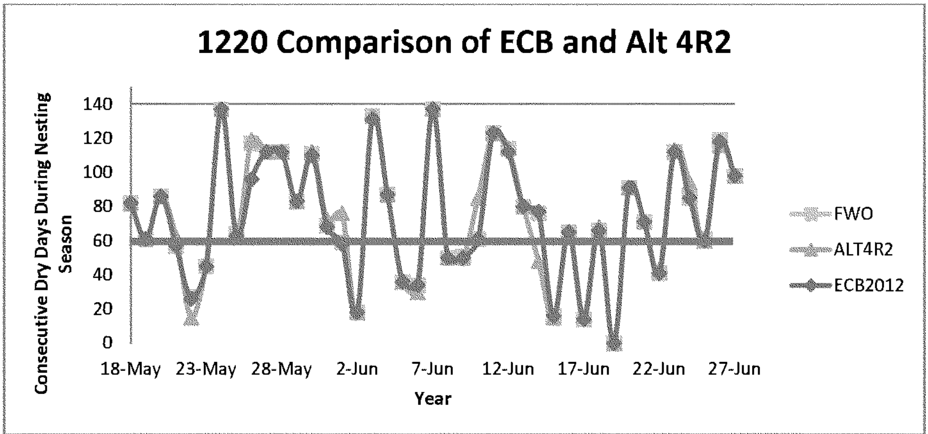


Figure 6-31. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

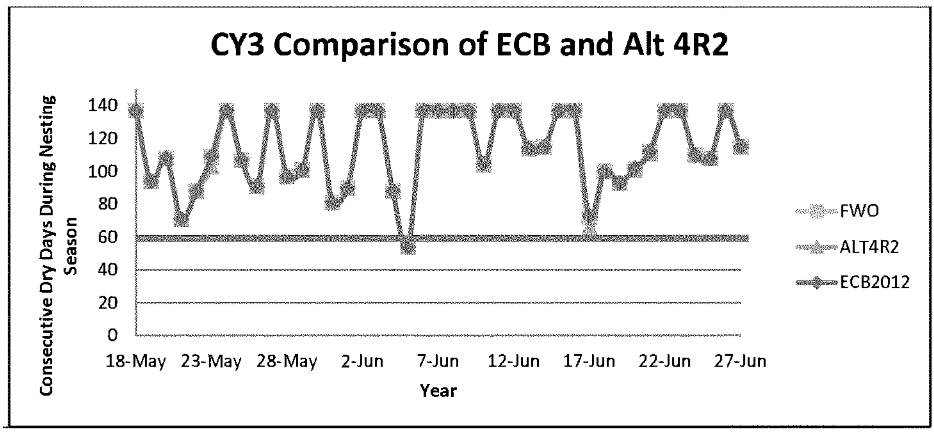


Figure 6-32. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-B

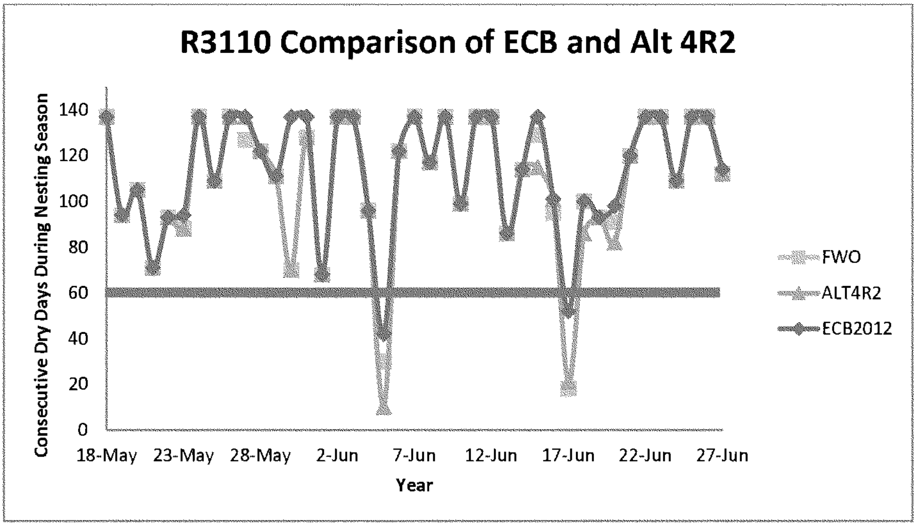


Figure 6-33. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-C

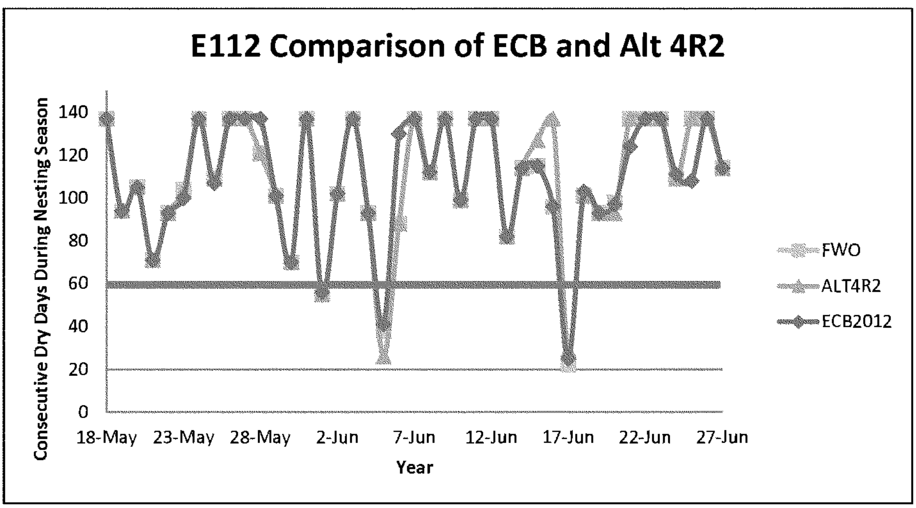


Figure 6-34. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-C

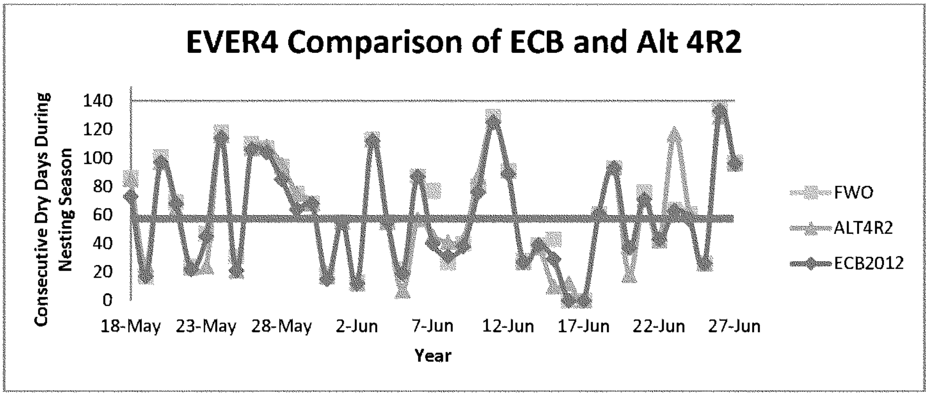


Figure 6-35. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-D

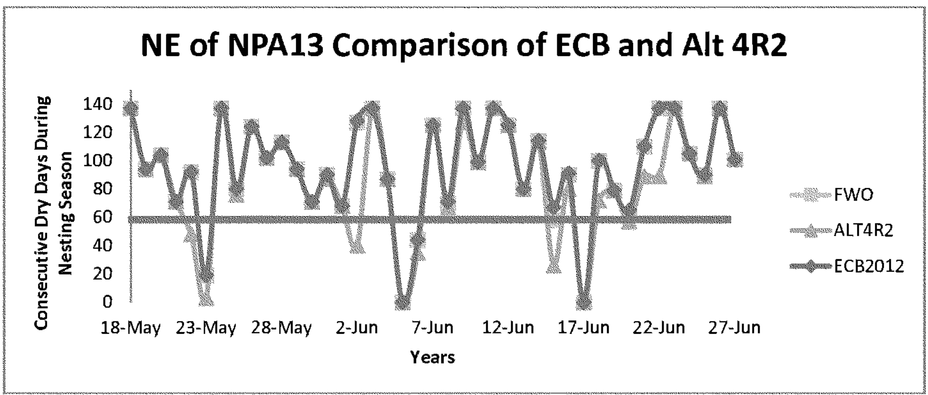


Figure 6-36. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-E

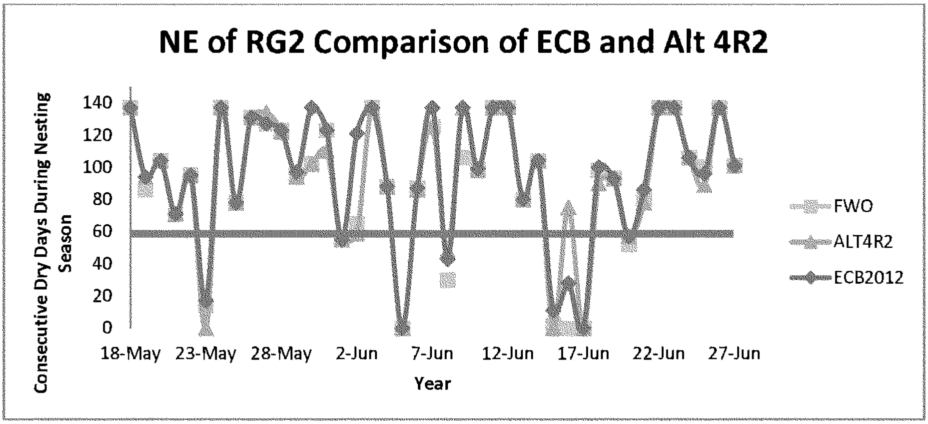


Figure 6-37. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-F

CSSS-A population has remained stable, but has not increased since the implementation of CSSS protective measures in 1999. Critical habitat for CSSS was revised in 2007 and CSSS-A is the only subpopulation that does not reside within designated critical habitat. The biggest difference in CSSS-A where existing conditions performed better than Alt 4R2 is 8 years at IR-A2 and 2 years at TMC. In the 2008-2012 survey, the IR-A1 had more birds present than in IR-A2 (**Figure 6-38**), and the IR-A1 increased meeting PM-A by 2 years over existing conditions and FWO. P34 had the same number of years met between all comparisons, however, only a few birds were found present in the area (**Figure 6-38**).

Preliminary 2013 Cape Sable Seaside Sparrow Survey Results

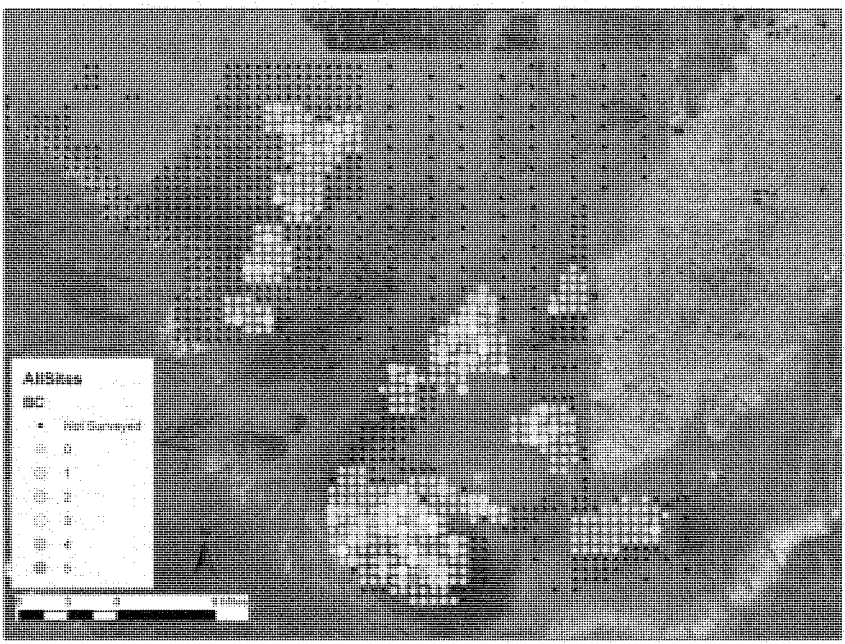


Figure 6-38. 2013 CSSS ENP survey results

CSSS-E is the second largest subpopulation, and Alt 4R2 met the criteria 4 years less than existing conditions and 3 years less than FWO. CSSS-D met the criteria the same as existing conditions but 2 years less than the FWO. Research suggests that CSSS are capable of short and long range movement (Dean and Morrison 1998), which could suggest that if the area around CSSS-E and D becomes too wet, the birds could reside in the CSSS-B area where Alt 4R2 is meeting the 60 day requirement below 6 ft of water every year. CSSS-C also meets the PM-A requirement often (38 and 39 years), as did CSSS-F (33 years), therefore potentially providing habitat for birds to move into areas of suitable habitat as others have become too wet in some years. These areas have a smaller population count than E, however, if birds from areas that are becoming too wet migrated towards B, F, and C, the populations may have a better chance of survival with increased subpopulation size.

Cape Sable seaside sparrows are largely sedentary, occupy the prairie habitats year-round and are completely dependent on the condition of the prairies. The CSSS have a short life expectancy of two to three years. This short life expectancy range identifies that for the population to sustain itself, there must not be three or more years in a row where water depths are not suitable for nesting. This means that there should not be three consecutive years in a row where the minimum of 60 consecutive dry days during the nesting season is not met.

Further analysis of gages specific to where nesting occurred in 2013 of the PM-A data looked at the durations and timing of the total number of consecutive dry days during the nesting season for each year of the POR. Tables presenting this data show that some areas exceed the greater than 60 day nesting period between March 1 and July 15, potentially allowing for multiple nests in one year. Preferable discontinuous hydroperiod durations range from 60 to 180 days, although a 40 to 80 consecutive day period is considered favorable (Pimm et al. 2002). Some of the consecutive day counts are close to 60, and may have been a day or a few days where the water level is just above the ground surface. In these cases, the cells were coded as yellow in that they may provide a suitable nesting season. Cells that are green met the 60 consecutive dry days and cells that are red did not meet the 60 consecutive dry days or even a total of 60 dry days during the nesting season. This analysis shows that for the northern CSSS sub population A (A-1), while there is still no difference between Alt 4R2, existing conditions, and FWO, 1984 was a year in which there were a total of 115 dry days for 4R2 and 57 dry days for existing conditions and FWO that has the possibility of producing a successful nest (**Table 6-6**). Table 6-6 shows that in the southern sub population A (A-2), while Alt 4R2 perform worse than existing conditions and FWO for more years and more consecutive years where there are less than 60 dry days during the nesting season, the breakdown of the days show that in 1979, there are 60 total dry days during the nesting season. **Table 6-7** shows no difference between Alt 4R2, existing conditions, and FWO in sub populations B and C, respectively. **Table 6-8** shows that while Alt 4R2 perform slightly worse than existing conditions and FWO for CSSS sub population D, there are 7 potential years where the total number of days adds up to greater than 60, therefore having the possibility of producing a successful nest. Subpopulation E-1 has 3 more potential years that have a total of greater than 60 days.

Table 6-9 shows while Alt 4R2 perform worse than FWO in the southern CSSS sub population E (E-2), there are a few years such as 1972, 2000, and 2003 where the alternatives do not meet the 60 consecutive dry day target, but they do have at least 60 dry days during the nesting season. **Table 6-9** also shows that Alt 4R2 performs better than the FWO in CSSS sub population F and that there are a few years such as 1980 and 1986 where the alternatives do not meet the 60 consecutive dry day target, but they do have at least 60 dry days during the nesting season.

Table 6-6. Total number of consecutive dry days during March 1 – July 15 for the northern CSSS sub population A-1 (left) and the southern CSSS subpopulation A-2 (right). Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

NP-205 (A-1)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	[illegible]	[illegible]	[illegible]
1966	[illegible]	[illegible]	[illegible]
1967	[illegible]	[illegible]	[illegible]
1968	[illegible]	[illegible]	[illegible]
1969	[illegible]	[illegible]	[illegible]
1970	[illegible]	[illegible]	[illegible]
1971	[illegible]	[illegible]	[illegible]
1972	[illegible]	[illegible]	[illegible]
1973	[illegible]	[illegible]	[illegible]
1974	[illegible]	[illegible]	[illegible]
1975	[illegible]	[illegible]	[illegible]
1976	[illegible]	[illegible]	[illegible]
1977	[illegible]	[illegible]	[illegible]
1978	[illegible]	[illegible]	[illegible]
1979	51, 2, 8, 8, 6, 13, 1	52, 3, 9, 29, 3	51, 2, 8, 6, 6, 13, 1
1980	[illegible]	[illegible]	[illegible]
1981	[illegible]	[illegible]	[illegible]
1982	[illegible]	[illegible]	[illegible]
1983	[illegible]	[illegible]	[illegible]
1984	[illegible]	6, 9, 1, 47, 25	[illegible]
1985	[illegible]	[illegible]	[illegible]
1986	[illegible]	[illegible]	[illegible]
1987	[illegible]	[illegible]	[illegible]
1988	[illegible]	[illegible]	[illegible]
1989	[illegible]	[illegible]	[illegible]
1990	[illegible]	[illegible]	[illegible]
1991	[illegible]	[illegible]	[illegible]
1992	[illegible]	[illegible]	[illegible]
1993	[illegible]	[illegible]	[illegible]
1994	[illegible]	[illegible]	[illegible]
1995	[illegible]	[illegible]	[illegible]
1996	[illegible]	[illegible]	[illegible]
1997	[illegible]	[illegible]	[illegible]
1998	[illegible]	[illegible]	[illegible]
1999	[illegible]	[illegible]	[illegible]
2000	37, 43, 10	44, 58	38, 43, 10
2001	[illegible]	[illegible]	[illegible]
2002	[illegible]	[illegible]	[illegible]
2003	[illegible]	[illegible]	[illegible]
2004	[illegible]	[illegible]	[illegible]
2005	[illegible]	[illegible]	[illegible]

1527 (A-2)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	[illegible]	[illegible]	[illegible]
1966	[illegible]	[illegible]	[illegible]
1967	[illegible]	[illegible]	[illegible]
1968	[illegible]	[illegible]	[illegible]
1969	[illegible]	[illegible]	[illegible]
1970	[illegible]	[illegible]	[illegible]
1971	[illegible]	[illegible]	[illegible]
1972	[illegible]	[illegible]	[illegible]
1973	[illegible]	[illegible]	[illegible]
1974	[illegible]	[illegible]	[illegible]
1975	[illegible]	[illegible]	[illegible]
1976	[illegible]	[illegible]	[illegible]
1977	[illegible]	[illegible]	[illegible]
1978	[illegible]	[illegible]	[illegible]
1979	[illegible]	46, 1, 8, 5	[illegible]
1980	[illegible]	[illegible]	15, 21, 37, 3
1981	[illegible]	[illegible]	[illegible]
1982	[illegible]	[illegible]	[illegible]
1983	[illegible]	[illegible]	[illegible]
1984	[illegible]	[illegible]	[illegible]
1985	[illegible]	[illegible]	[illegible]
1986	[illegible]	[illegible]	[illegible]
1987	[illegible]	[illegible]	[illegible]
1988	[illegible]	[illegible]	[illegible]
1989	[illegible]	[illegible]	[illegible]
1990	[illegible]	[illegible]	[illegible]
1991	[illegible]	[illegible]	[illegible]
1992	[illegible]	[illegible]	[illegible]
1993	[illegible]	[illegible]	[illegible]
1994	[illegible]	[illegible]	[illegible]
1995	[illegible]	[illegible]	[illegible]
1996	[illegible]	[illegible]	[illegible]
1997	[illegible]	[illegible]	[illegible]
1998	[illegible]	[illegible]	[illegible]
1999	[illegible]	[illegible]	[illegible]
2000	12, 48, 10, 1	22, 45, 9	12, 48, 10, 1
2001	[illegible]	[illegible]	[illegible]
2002	[illegible]	[illegible]	[illegible]
2003	[illegible]	[illegible]	[illegible]
2004	[illegible]	[illegible]	[illegible]
2005	[illegible]	[illegible]	[illegible]

Table 6-7. Total number of consecutive dry days during March 1 – July 15 for the CSSS sub population B (left) and sub population C (right). Cells that are green have 60 or greater dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

[illegible] (B)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	94
1967	107	107	107
1968	71	71	71
1969	91	91	91
1970	115, 1	111, 1	113, 1
1971	137	137	137
1972	107	107	107
1973	121	121	121
1974	137	137	137
1975	107	97, 1, 4	107
1976	101	101	101
1977	137	137	137
1978	94	94	94
1979	137	137	137
1980	137	137	137
1981	137	137	137
1982	66	66	66
1983	53	53	53
1984	134	134	134
1985	137	137	137
1986	119, 17	119, 17	137
1987	137	137	137
1988	96, 2	96, 2	96, 2
1989	137	137	137
1990	137	137	137
1991	110	110	110
1992	115	115	115
1993	135	97, 18, 17	135
1994	137	137	137
1995	73	73	73
1996	110	110	110
1997	91	91	91
1998	102	101	102
1999	112	110	112
2000	137	137	137
2001	137	137	137
2002	109	109	109
2003	101, 4, 11	101, 4, 11	101, 4, 11
2004	137	137	137
2005	114, 1, 5	116, 1, 5	114, 1, 5

[illegible] – (C)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	94
1967	105	105	105
1968	71	71	71
1969	93	93	93
1970	86, 64, 1, 1	84	86, 7, 2
1971	137	137	137
1972	104, 1	104, 1	108
1973	105, 11	125, 1, 4	125, 1, 4
1974	125, 1	125, 1	125
1975	118	118	118
1976	101	96, 5	96, 5
1977	70, 62	70, 55, 26	70, 55, 27
1978	4, 125	2, 3, 125	4, 126
1979	68, 55	68, 55	68, 55
1980	137	1, 135	137
1981	137	137	137
1982	90, 1, 1, 35	90, 34	90, 34
1983	2, 41	53, 5, 4	50
1984	137	64, 77	61, 77
1985	124, 10	124, 4, 4	124, 4
1986	112, 4	111, 1, 1, 5	112, 4
1987	137	137	137
1988	98	98	98
1989	137	137	137
1990	137	137	123, 13
1991	82	82	82
1992	114	114	114
1993	93, 28, 8, 1, 1, 1	93, 1, 17, 2	93, 1, 17, 2
1994	75, 55	1, 55, 1, 55	1, 75, 17, 13
1995	10, 1, 23	6, 22	6, 5, 20
1996	86, 1, 6	86, 6	86, 7
1997	95	92, 10	92, 10
1998	87	87	92
1999	130, 6	111, 7, 3	111, 7, 4
2000	137	137	137
2001	137	137	137
2002	107, 1	108	108
2003	106, 5, 17	105, 5, 18	109, 4, 2, 18
2004	137	137	137
2005	111, 3	101, 4	101, 4

Table 6-8. Total number of consecutive dry days during March 1 – July 15 for the CSSS sub population D (left) and southern sub population E (E-1, right). Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

4581 (D)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	3, 91, 5, 4, 4	111, 5, 14	111, 6, 16
1966	6, 55, 8	3, 25, 27, 16	8, 55, 14
1967	98	102	102
1968	68	69	69
1969	24	26, 9	3, 1, 26, 1
1970	48	34	44
1971	116	116, 4, 1, 4	119, 0, 7
1972	55, 5, 7	31, 1, 12, 16	31, 1, 12, 17
1973	107	116	114
1974	105, 1	123	110
1975	90	98, 10, 10	98, 2, 2, 10
1976	82, 12, 1	75, 4, 2	75, 5, 2
1977	66, 7, 3, 8	68, 1, 3, 8	68, 1, 3, 8
1978	16	19	23, 1
1979	55	55	55
1980	33, 13	37, 25, 1	35, 24, 5
1981	116	119	119
1982	54	58, 4	58, 6
1983	14	8	14
1984	17, 62	17, 68	86
1985	20, 50, 2, 6, 27	71, 4, 38	117
1986	6, 36, 4	20, 49	5, 46
1987	5, 28, 41	5, 6, 40, 51	4, 11, 47, 47
1988	94	91	91
1989	126	126, 7	137
1990	87, 8	87, 8, 28	87, 3, 18
1991	2, 4, 13, 28	2, 45, 29	2, 44, 29
1992	18, 70	19, 75	22, 75
1993	1, 25	32	2, 8, 31
1994	3	13, 5	1, 9
1995	8	8	8
1996	42, 22	46, 23	2, 47, 23
1997	93	93	93
1998	2, 26, 15, 1	35, 27, 8	31, 24, 5
1999	76	85	2, 103
2000	40, 47	43, 54, 1	105, 2
2001	63, 34, 13	101, 25, 1	105, 25, 2
2002	74	90	91
2003	36, 11, 2, 1	36, 18, 8, 1	38, 18, 2, 5
2004	137	135	137
2005	78	101	101

2185 (E-1)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	98	98	98
1967	104	104	104
1968	71	71	71
1969	87	15, 46, 12, 1	87
1970	35	2	35
1971	137	137	137
1972	85, 1, 5	76, 1	85, 4
1973	124	124	124
1974	102	102	102
1975	113, 2	113, 1	113, 1
1976	94	94	94
1977	71, 35, 6, 18	71, 34, 2, 5, 6	71, 35, 2, 6, 6
1978	90	87	90
1979	68, 17	66, 5	68, 13, 1, 1, 1
1980	1, 128	14, 29, 40, 4	1, 127
1981	137	137	137
1982	87	87	87
1983	6	6	6
1984	44, 39, 10, 7	32, 5, 15, 8, 2, 1	44, 38, 9, 7
1985	115	115	115
1986	26, 71	22, 67	26, 70
1987	137	5, 137	137
1988	99	99	99
1989	137	137	137
1990	125, 1, 1	125, 1, 1	125, 1, 1
1991	80	80	80
1992	114	113	114
1993	67, 1, 17	26	54, 15
1994	91, 1, 10, 1, 10	80, 1, 8	80, 1, 6
1995	9	9	9
1996	108	2, 71, 30	108
1997	75, 1	76	75, 1
1998	66	29	62
1999	101	86	110
2000	137	31, 91	137
2001	137	137	137
2002	105	104	105
2003	90, 9, 3	89, 6	90, 9, 3
2004	137	137	137
2005	101	101	101

Table 6-9. Total number of consecutive dry days during March 1 – July 15 for the southern CSSS sub population E (E-2, left) and sub population F (right). Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

2339 (E-2)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	81	1, 79	81
1967	104	104	104
1968	71	71	71
1969	3, 8, 10, 25	2, 5, 5, 25	2, 5, 5, 25
1970	[illegible]	[illegible]	[illegible]
1971	137	137	137
1972	76	24, 1, 16	55, 1, 41
1973	5, 2, 1, 79	1, 1, 75	4, 2, 79
1974	106	106	106
1975	96, 1	96	96
1976	88	88	88
1977	71, 34, 3, 14	71, 33, 3, 6, 6	71, 33, 2, 7, 6
1978	74	71	74
1979	56, 1, 8	51	55, 1, 1
1980	24, 44, 46	45	24, 41, 2, 40, 5
1981	131	1, 124	131
1982	87	87	87
1983	0	0	0
1984	27, 58	2, 8, 35	27, 58
1985	124	124	124
1986	106	35, 71	106
1987	5, 101	5, 98	5, 101
1988	98	98	98
1989	137	137	137
1990	117	117	117
1991	87	87	87
1992	97	21, 73	97
1993	64, 1, 1	17, 2	64, 1, 1
1994	48	33, 5, 17	48
1995	0	0	0
1996	9, 72, 1, 2, 1	2, 24, 36	9, 72, 1
1997	79	73	79
1998	46	35	45
1999	100	94	100
2000	44, 46, 2, 3	16, 43	44, 46, 1, 2
2001	137	102	137
2002	91, 5	90, 4	91, 5
2003	26, 21, 20	16, 8, 21, 19	26, 21, 19
2004	117	105	117
2005	98	98	98

2347 (F)	ECB 2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	95
1967	104	104	104
1968	71	71	71
1969	95	95	95
1970	15	2	15
1971	137	137	137
1972	76	76	76
1973	131	131	131
1974	121, 6, 2	133, 2	127, 5, 1
1975	123	122	123
1976	97	96	95, 1
1977	137	100, 37	100, 34
1978	124	4, 120	124
1979	95, 17	44	35, 1
1980	131	4, 99	1, 31, 1, 65
1981	137	137	137
1982	88	88	88
1983	0	0	0
1984	87	86	87
1985	137	135, 1	135, 1
1986	25, 43	25, 49	24, 35, 1
1987	137	137	35, 102
1988	99	98	99
1989	137	137	137
1990	137	137	137
1991	80	80	80
1992	104	104	104
1993	1, 31	0	2
1994	35, 1, 15, 1, 2	35, 17	0
1995	0	0	0
1996	120	90	96
1997	81, 6	83	81, 7
1998	57	57	57
1999	86, 8, 7	75, 8, 5	88, 8, 6
2000	137	137	137
2001	137	137	137
2002	106	106	106
2003	96	99	100
2004	137	137	137
2005	101	101	101

Ecological Target 1

ET-1 (NP-205, CSSS-A): Strive to reach a water level of < 7.0 feet, NGVD at NP-205 by December 31 for nesting season water levels to reach 6.0 feet, NGVD by mid-March.

Alt 4R2 performed the same as the FWO for ET-1, with both meeting the requirement 1 extra year than the existing conditions (**Table 6-10**).

Table 6-10. Comparison of ECB 2012, Alt 4R2 and FWO: Number of years ET-1 was met

ET-1	ECB 2012	Alt 4R2	FWO
# years met	38	39	39

Ecological Target 2

ET-2 (CSSS): Strive to maintain a hydroperiod between 90 and 210 days (three to seven months) per year throughout sparrow habitat to maintain marl prairie vegetation.

RSMGL results for each CSSS subpopulation are depicted in **Table 6-11** and **Figure 6-39**. Alt 4R2, existing conditions, and FWO were compared to understand how many years out of the 41 year POR the hydroperiod between 90 and 210 days (three to seven months) were met to maintain marl prairie vegetation. Alt 4R2 only performed better than the FWO in the Northern Sub population A (A-1) by meeting the ET-2 criteria 6 more years than the existing conditions and 4 more years than FWO. Alt 4R2 performed worse than the existing conditions and FWO in CSSS-A-2 and B (1 year), CSSS-C (3 and 4 years), CSSS-D (1 and 4 years), CSSS-E1 (6 years), CSSS-E2 (2 years), and CSSS-F (3 and 4 years) Line graphs are presented in **Figures 6-40 through 6-49** to show visually show the differences between existing conditions, Alt 4R2, and FWO.

Table 6-11. Number of years out of the period of record that the hydroperiod was between 90 and 210 days each year throughout sparrow habitat in order to maintain marl prairie vegetation (ET-2)

CSSS Sub Population	ECB 2012	Alt 4R2	FWO
A-1	4	10	6
A-2	9	8	9
B	25	24	25
C	18	15	19
D	11	10	16
E-1	24	18	24
E-2	12	10	12
F	17	14	18

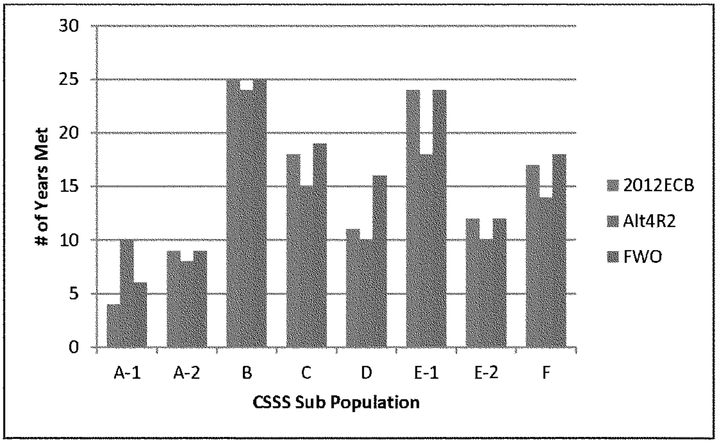


Figure 6-39. Number of years out of the period of record that the hydroperiod was between 90 and 210 days each year throughout sparrow habitat in order to maintain marl prairie vegetation

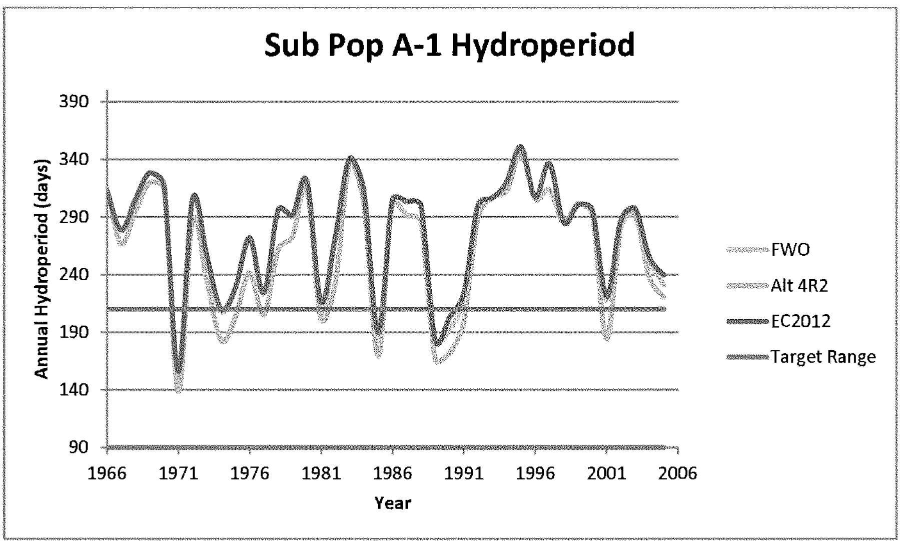


Figure 6-40. CSSS-A-1 comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

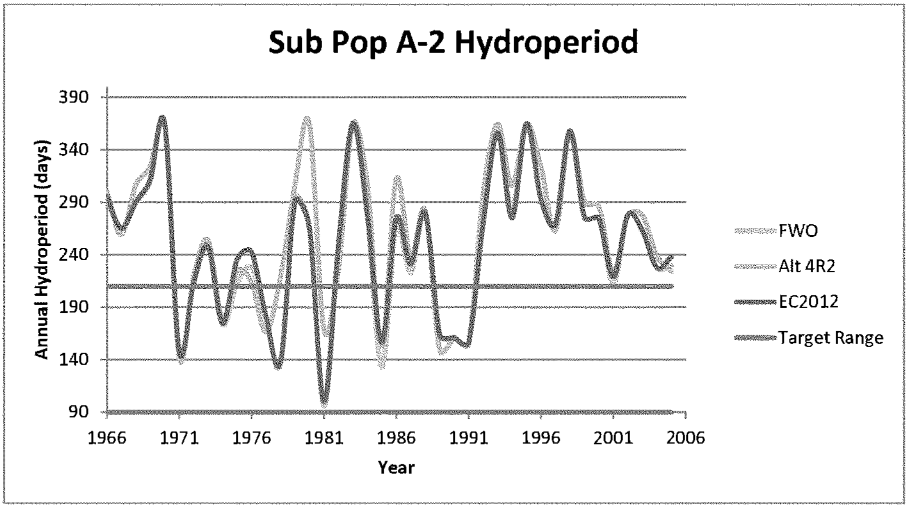


Figure 6-41. CSSS-A-2 comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

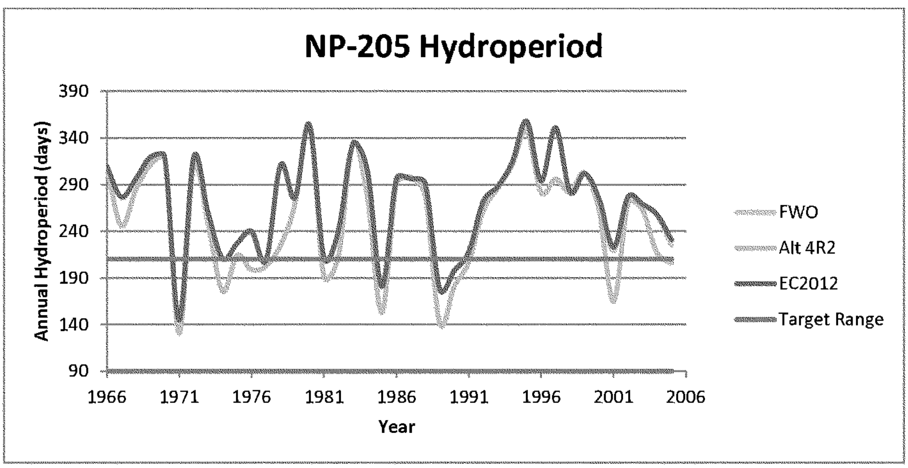


Figure 6-42. CSSS-A comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

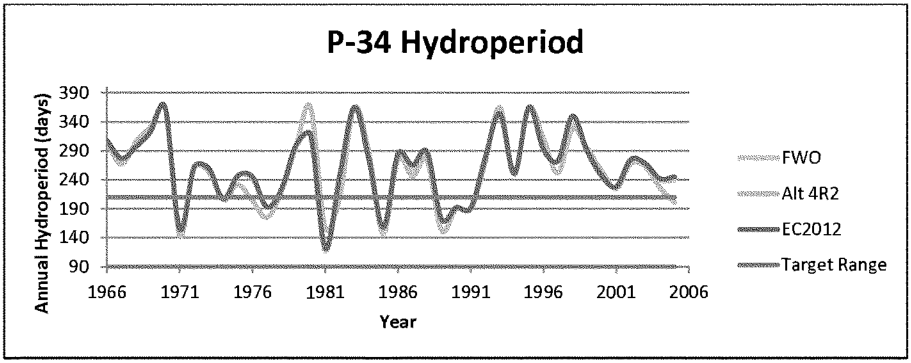


Figure 6-43. CSSS-A comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

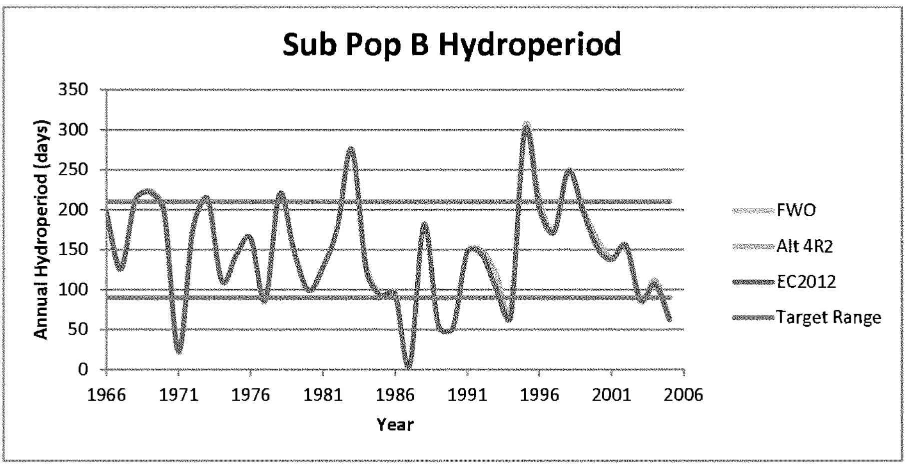


Figure 6-44. CSSS-B comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

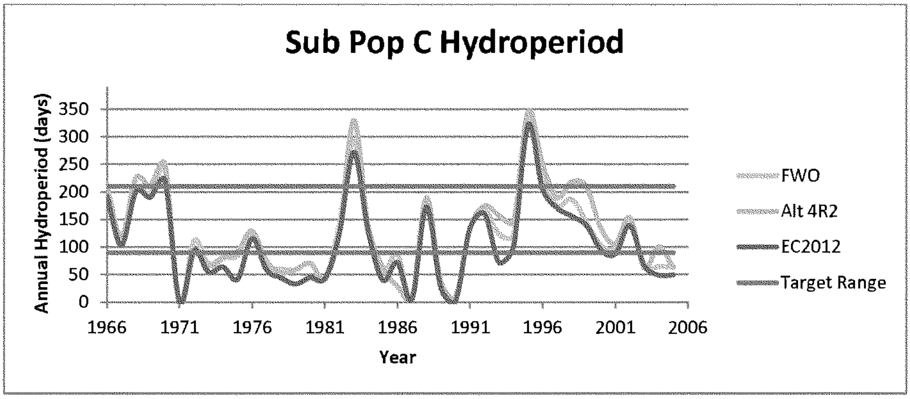


Figure 6-45. CSSS-C comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

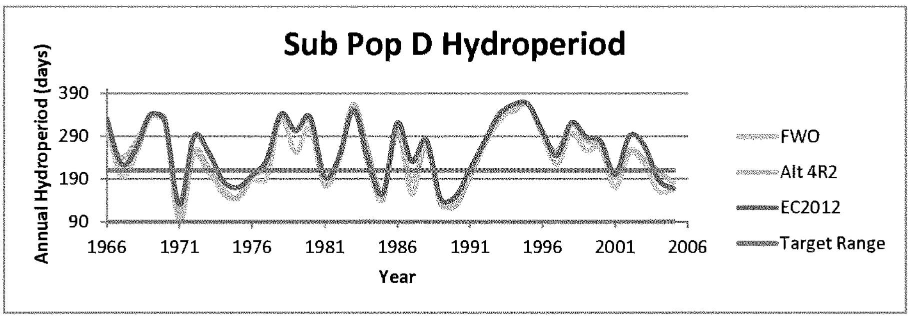


Figure 6-46. CSSS-D comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

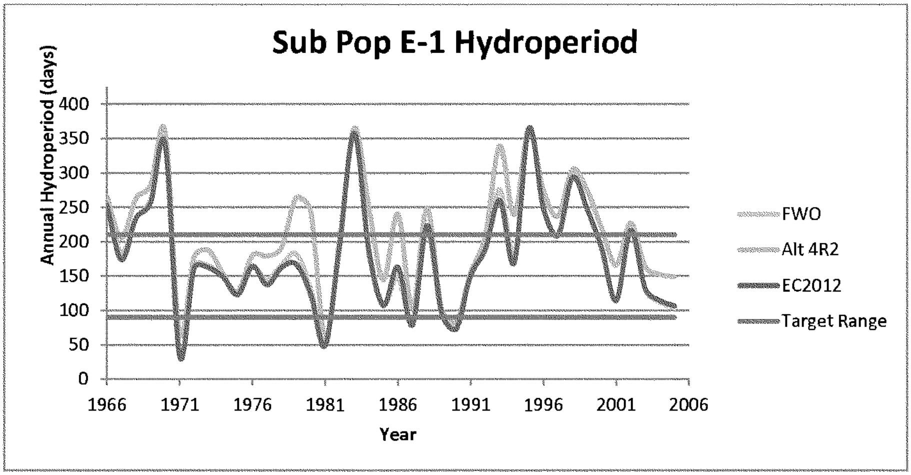


Figure 6-47. CSSS-E-1 comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

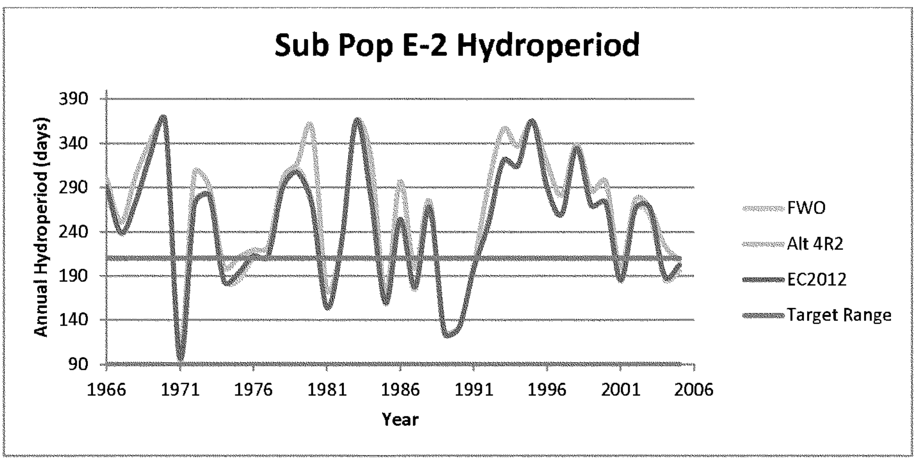


Figure 6-48. CSSS-E-2 comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

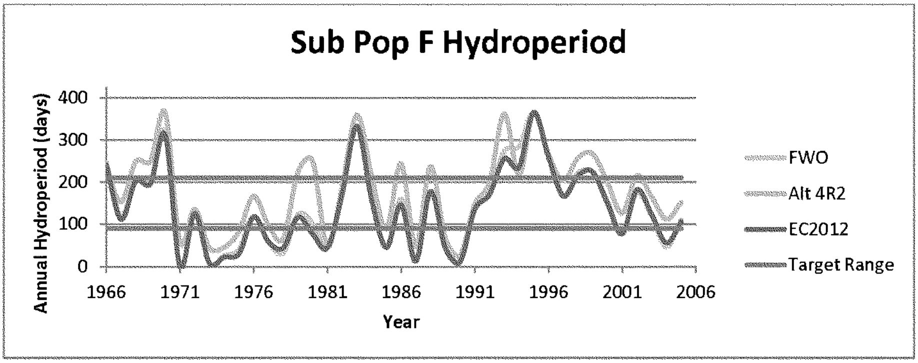


Figure 6-49. CSSS-F comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year

Marl Prairie Indicator

A HSI for marl prairie habitat was used to predict potential effects of implementation of CEPP Alt 4R2 as compared to existing conditions and FWO. The HSI predicts hydrologic suitability of marl prairies based on CSSS survey presence data and threshold ranges (Pearlstien et. al. 2011). The HSI measures marl prairie habitat suitability annually for four metrics: (1) average wet season water depths from June – October, (2) average dry season water depths from November – May, (3) discontinuous annual hydroperiods from May-April of the next year, and (4) maximum continuous dry days during the nesting season from March 1- July 1S.

Suitability for marl prairie habitat is decreased in the vicinity of CSSS-B, CSSS-D, CSSS-E, and CSSS-F for Alt 4R2 relative to the existing conditions and FWO (**Figure 6-50**). Notable changes occur within the eastern marl prairies in the vicinity of CSSS-E, along the eastern edge of SRS that decrease the marl prairie habitat suitability, shifting into wetter habitats with Alt 4R2 (**Figure 6-51**). Increased hydroperiods within the eastern marl prairies may potentially result in a shift in vegetation. Ross and Sah (2004) noted differences in species composition within wet prairies based upon hydroperiod. Shorter hydroperiod prairies were dominated by *Muhlenbergia*, *Schizachyrium* and *Paspalum*, while longer hydroperiod prairies consisted of *Cladium, Schoenus,* and *Rhynchospora*. Compared to the existing conditions and FWO, differences in marl prairie habitat suitability within CSSS-B, CSSS-D, and CSSS-F for Alt 4R2 were minor.

Analyses of marl prairie habitat suitability with the northwestern marl prairies in the vicinity of CSSS-A reveal negligible benefits for Alt 4R2 as compared with the existing conditions and FWO. Pollen data indicate that the marl prairies west of SRS are not a natural feature of the Everglades landscape but developed after twentieth century hydrologic modification of the system reduced flow to the region (Bernhardt and Willard 2006). Prior to the modifications, plant communities at the sites analyzed by Bernhardt and Willard (2006) in western SRS consisted of sawgrass marshes. The authors concluded that "the current spatial distribution and community composition of marl prairies are a response to water management and land cover changes of the twentieth century, and further sampling of modern marl prairie communities and adjacent communities is necessary to document the pre- and post-drainage distribution of marl prairie" (Bernhardt and Willard 2006). Habitat suitability within central and southern CSSS-A (and flanking regions to the east) decline while habitat suitability in northern CSSS-

A and regions northeast of CSSS-A slightly improve (**Figure 6-51**). Alt 4R2 provides negligible benefits within CSSS-C compared to the existing conditions and FWO.

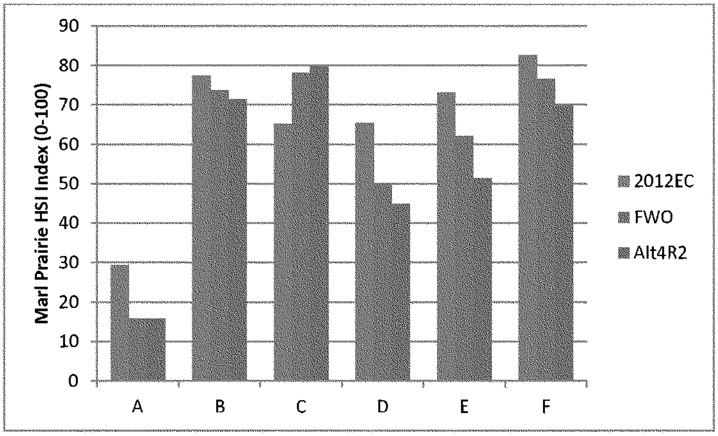


Figure 6-50. Average marl prairie suitability index scores (1965-2005) for existing conditions, Alt 4R2, and FWO.

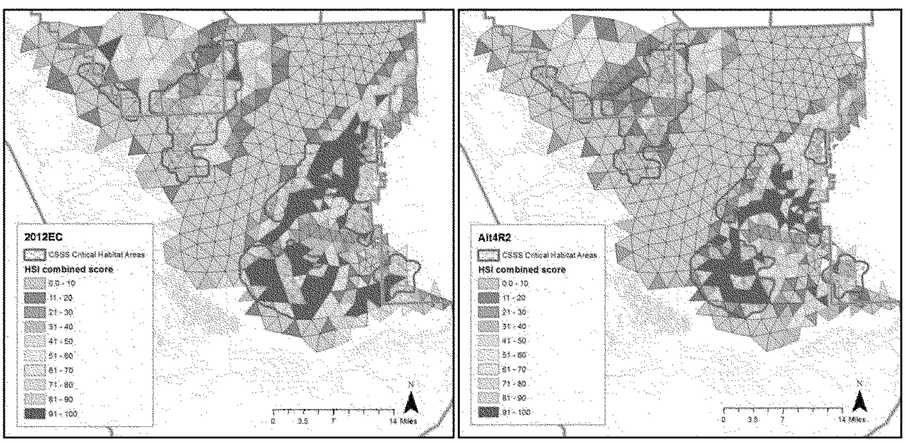


Figure 6-51. Habitat suitability of existing conditions is presented in the left panel and Alt 4R2 habitat suitability for the combined marl prairie indicator scores at each RSM cell south of Tamiami Trail. Scores vary from 0.0 (not suitable) to 100.0 (most suitable). Subpopulation areas for the Cape Sable seaside sparrow are shown as a blue outline

6.2.8.2 CSSS Species and "May Affect" Determination

The goal of CEPP and the future CERP is to rehydrate the greater Everglades and provide higher volumes of freshwater into ENP. Overall, CEPP would decrease the number of years that meet the 60-day dry nesting constraint (PM-A) in CSSS-A and E as compared to the existing conditions. While the number of years that PM-A is met is not many, Alt 4R2 remains consistent with the existing conditions and FWO for all other subpopulations for PM-A, with the exception of CSSS-D where the FWO met more years than Alt 4R2 and existing conditions (**Table 6-5**).

Additional analysis of PM-A, using 60 consecutive nesting days below 6 feet for 3 or more years in a row, revealed that potentially a few more years would have met the criteria in some of the subpopulations (**Table 6-5**). In 1979, CSSS-A-1 and CSSS-A-2 (56 and 46 days, respectively (with total days over 60) would have met the criteria in total days, which is between two years that did not meet the 60 day requirement, potentially allowing for CSSS nesting during that year to recuperate during that particular nesting season.

Areas within the eastern marl prairies along the boundary of ENP suffer from over-drainage, reduced water flow, exotic tree invasion and frequent human-induced fires (Lockwood et al. 2003, Ross et al. 2006). To alleviate the perpetual drier conditions and its associated problems, increased water flows within this area are required. Alt 4R2 provides more water to SRS and the southern marl prairies. Increased hydroperiods within the eastern marl prairies may act to alleviate some of the problems associated with drier conditions and promote a shift in species community composition. However, marl prairie habitat suitability was met less than the existing conditions and FWO for CSSS-A, CSSS-B, CSSS-D, CSSS-E, and CSSS-F (**Figure 6-50 and Figure 6-51**). Restoring conditions back to pre-drainage conditions would not be suitable for marl prairie habitats, however, CEPP does not meet targets for full pre-drainage conditions.

Since the proposed action potentially raises groundwater levels in sensitive areas for the sparrow, hydrological changes associated with implementation of the action are expected to alter some of the physical and biological features essential to the nesting success and overall conservation of the subspecies. In order to protect CSSS, structural closings implemented under 2006 IOP and preserved under 2012 ERTP were also retained under CEPP. Further changes in operations that limit flows into ENP for protection of CSSS have the potential to limit CEPP benefits to the northern estuaries, WCA 3A, ENP, Florida Bay, the southwestern coastal estuaries, and other threatened and endangered species within those areas, most notably American crocodile, smalltooth sawfish, Florida manatee, Florida panther, and wood stork. Although the action related hydrologic changes as compared to the existing conditions are expected to be minimal throughout much of CSSS habitat with improvements seen within some areas (northern CSSS-A, CSSS-F), the Corps has determined the action may affect CSSS. Metrics could be developed prior to CEPP implementation to incorporate real-time monitoring since other projects will be built and operated prior to CEPP. These projects would provide interim increased water flows to the area and provide information about the transition in the system to higher water levels. This interim process would potentially minimize effects to the subspecies as well as ensure CEPP benefits are realized in other areas of the system.

6.2.8.3 Cape Sable Seaside Sparrow Critical Habitat

Critical habitat for the CSSS was designated on August 11, 1977 (42 FR 42840) and revised on November 6, 2007 (72 FR 62735 62766). Currently, the critical habitat includes areas of land, water, and airspace in the Taylor Slough vicinity of ENP in Miami-Dade and Monroe counties, Florida. Primary constituent elements include suitable soil, vegetation, hydrologic conditions, and forage base. The designated area encompasses approximately 156,350 acres (63,273 hectares). CSSS-A is the only area occupied by sparrows that does not have associated designated critical habitat.

Designated critical habitat for the CSSS includes areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Dade, and Monroe counties, with the following components: those portions of ENP within T57S R36E, T57S R36E, T57S R37E, T58S R35E, T58S R36E, T58S R37E, T58S R35E, T58S R36E, T59S R35E, T59S R36E, T59S R37E. Areas outside of ENP within T55S R37E Sec. 36, T55S R38E Sec. 31, 32, T56S R37E Sec. 1, 2, 11-14, 23-26, T56S R38E Sec. 5-7, 18, 19, T57S R37E Sec. 5-8, T58S R38E Sec. 27, 29-32, T59S R38E Sec. 4 (CFR Vol. 72, No. 214 / 11-6-07). All of the designated CSSS critical habitat lies within CEPP study area (**Figure 6-52**).

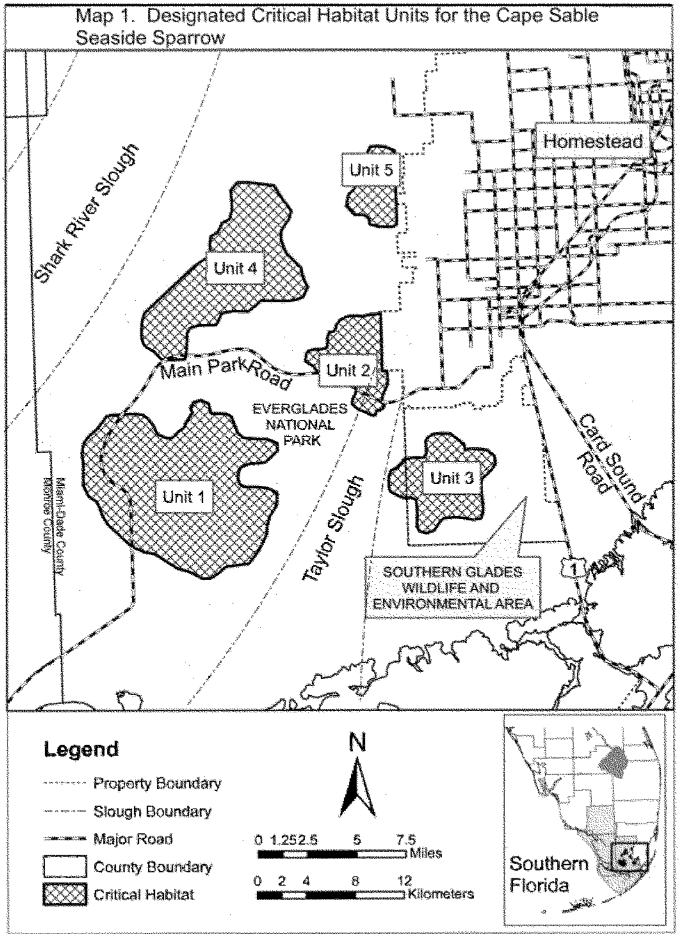


Figure 6-52. Critical habitat for the Cape Sable seaside sparrow

Because the majority of designated critical habitat lies within ENP, there have been relatively few human-related structural impacts to the land. However, about 471.5 acres (190.8 hectares) of critical habitat were altered during construction of the S-332B detention areas and a portion of the B-C connector. No other permanent alteration of critical habitat is known. Degradation of critical habitat has resulted from flooding within the area of CSSS-D, and frequent fires and woody vegetation encroachment in overdrained areas near CSSS-C and CSSS-F. Degradation of these habitats is not permanent, and they may improve through restoration efforts.

In order to predict the project related effects on the CSSS, one must consider those physical and biological features that are essential to the conservation of the species and their habitat. These include, but are not limited to space for individual and population growth and for normal behavior, food, water, air, light, minerals, or other nutritional or physiological requirements, cover or shelter, sites for breeding, reproduction, and rearing (or development) of offspring, and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. These requirements, which are based on the biological needs of this species, are described in the final critical habitat designation published in the Federal Register on 6 November 2007 (FR Vol. 72, No. 214).

Primary constituent elements are physical and biological features that have been identified as elements essential to the conservation of the species. As described in the Federal Register (FR Vol. 72, No. 214), the primary constituent elements include:

- Soils that are widespread in the Everglades' short-hydroperiod marshes and support the vegetation types that the CSSS rely on
- Plant species that are characteristic of CSSS habitat in a variety of hydrologic conditions that provide structure sufficient to support CSSS nests, and that comprise the substrate that CSSS utilize when there is standing water
- Contiguous open habitat because CSSS require large, expansive, contiguous habitat patches with sparse woody shrubs or trees
- Hydrologic conditions that would prevent flooding sparrow nests, maintain hospitable conditions for CSSS occupying these areas, and generally support the vegetation species that are essential to CSSS
- Overall the habitat features that support the invertebrate prey base the CSSS rely on and the variability and uniqueness of habitat

Evaluations of project effects to the primary constituent elements are discussed below:

6.2.8.3.1 Calcitic Marl Soils

Marl soils are characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades and support the vegetation community on which CSSS depend. Presently, soils in the marl prairie landscape within CSSS habitat vary in physical and chemical characteristics due to the variation in topography, hydrology, and vegetation (Sah et al. 2007). Alteration of soil characteristics due to project operations would be difficult to detect in the short term.

6.2.8.3.2 Herbaceous Vegetation

Greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species: muhly grass, Florida little bluestem, black sedge, and cordgrass (*Spartina bakeri*) are largely characteristic of areas where CSSS occur. They act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Although many other herbaceous plant species also occur within CSSS habitat (Ross et al. 2006), and some of these may have important roles in the life history of the CSSS, the species identified in the primary constituent relationship consistently occur in areas occupied by sparrows (Sah et al. 2007). With a trend indicating longer hydroperiods affecting the vegetative community composition in CSSS critical habitats, it may be difficult to separate project level effects from other factors (i.e. sea level rise; C-111 SC Project).

6.2.8.3.3 Contiguous Open Habitat

CSSS subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. The components of this primary constituent element are largely predicated on a combination of hydroperiod and periodic fire events. Fires prevent hardwood vegetation from invading these communities and prevent the accretion of dead plant material, both of which decrease the suitability of this habitat type for CSSS. Implementation of the proposed project could extend hydroperiods causing a minimal effect on the occurrence of natural fires in the area.

6.2.8.3.4 Hydrologic Regime-Nesting Criteria

As stated, favorable nesting habitat requires short hydroperiod vegetation characteristic of mixed marl prairie communities. A measure of the potential for CSSS nesting success is the number of consecutive days between March 1 and July 15 that water levels are below ground surface. Preferable discontinuous hydroperiod durations range from 60 to 180 days, although a 40 to 80 consecutive day period is considered favorable (Pimm et al. 2002).

In order to maintain suitable vegetative composition conducive for successful nesting, it is important that water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) more than 30 days during the period from March 15 to June 30 at a frequency of more than two out of every ten years. Water depths greater than 7.9 inches (20 centimeters) during this period will result in elevated nest failure rates (Lockwood et al. 2001, Pimm et al. 2002). If these water depths occur for short periods during nesting season, CSSS may be able to re-nest within the same season. These depths, if they occur for sustained periods (more than 30 days) within CSSS nesting season, will reduce successful nesting to a level that will be insufficient to support a population if they occur more frequently than two out of every ten years. This has occurred within portions of the CSSS range.

6.2.8.4 Potential Effects to Cape Sable Seaside Sparrow Critical Habitat

Effects to each Unit are discussed below.

6.2.8.4.1 Critical Habitat Unit 1/CSSS-B Description

Critical habitat Unit 1 represents the largest CSSS subpopulation and has remained relatively stable since implementation of IOP operations in 2002. Wet prairie vegetation dominates within this unit (Ross et al. 2006). This Unit meets the hydroperiod criteria between 90-210 days per year the most number of years out of the 41 year POR compared to all other units (24 years in Alt 4R2, 25 years in FWO). Alt 4R2 performs slightly different than the hydrologic regime from existing conditions or FWO (**Table 6-10**).

6.2.8.4.2 Critical Habitat Unit 2/ CSSS-C Description

Habitat of varying suitability occurs within Unit 2. Long-hydroperiod marshes occur south of the S-332 pump station, while areas to the north are overdrained and prone to frequent fires. The most recent fire occurred in March 2007 when the Frog Pond fire swept through this area. The habitat has yet to fully recover (Sah et al. 2008, Virzi et al. 2009). The variable habitat conditions are thought to be a consequence of the 1980 construction of the S-332 pump station, located at the boundary of ENP and Taylor Slough. Unit 2 holds relatively few CSSS. During intensive nest surveys in 2008, Virzi et al. (2009) documented four females and five males, nine nest attempts and reported nest survival as 22.8%. Previous research has indicated that habitat is unsuitable for CSSS for two to three years after it burns. This remains consistent with the range wide survey results; surveys in 2010 revealed that 2 birds were counted, giving a population estimate of 32, in 2011 11 birds were counted with a population estimate of 176, and in 2012, 6 were counted with a population estimate of 96. The bird count/population estimate has not been as high as year 2011 since before the 2007 fire. Recent research has indicated that within Unit 2, CSSS-C is suffering from the ill-effects of small population size including fewer breeding individuals, male-biased sex ratios, lower hatch rates, and lower juvenile return rates (Boulton et al. 2009a, Virzi et al. 2009). This unit meets the hydroperiod criteria of 90-210 days per year 15 out of the 41 year POR as compared to the existing conditions of 18 years, and FWO that meets the criteria 19 years **(Table 6-11)**.

6.2.8.4.3 Critical Habitat Unit 3/CSSS-D Description

Since 1981, when an estimated 400 CSSS resided within Unit 3, this subpopulation experienced a continual decline in population size (Cassey et al. 2007). CSSS-D is a small, dynamic subpopulation that fluctuates annually; occupancy within Unit 3 is low and detection probability is highly variable. Thought to be functionally extirpated in 2007 (Lockwood et al. 2007), CSSS were again encountered within this area in 2009 when Virzi et al. (2009) encountered four males and two females **(Table 6-4)**. However, in 2012, 14 birds were counted with a population estimate of 224, which is substantially higher than between the years 2007 and 2011. Prior to the 2012 survey, vegetation within this critical habitat unit was thought to be unsuitable for CSSS breeding. Since 2000, high water levels and longer hydroperiods have prevailed resulting in a sawgrass-dominated community interspersed with patches of muhly grass at higher elevations (Ross et al. 2003). This unit meets the hydroperiod criteria of 90-210 days per year 10 out of the 41 year POR as compared to the existing conditions of 11 and FWO that meets the criteria 16 years (**Table 6-11**).

6.2.8.4.4 Critical Habitat Unit 4/CSSS-E Description

Located along the eastern edge of Shark River Slough, critical habitat Unit 4 encompasses approximately 66 square kilometers. The Rocky Glades separate Unit 4 and CSSS-E from the other eastern subpopulations. Unit 4 holds the second greatest number of CSSS among all subpopulations. This unit is expected to be affected by an altered hydroperiod that is too long to support marl prairie habitat requirements. This unit meets the hydroperiod criteria of 90-210 days per year at E-1 for 18 out of the 41 year POR as compared to the existing conditions and FWO that meets the criteria 24 years. For E-2, Alt 4R2 meets the criteria 10 years versus the existing conditions and FWO at 12 years (**Table 6-11**).

6.2.8.4.5 Critical Habitat Unit 5/CSSS-F Description

The most easterly of all the CSSS critical habitat units, Unit 5 is located at the ENP boundary in proximity to agricultural and residential development. Habitat within this critical habitat unit suffers from over-drainage, reduced water flow, exotic tree invasion and frequent human-induced fires (Lockwood et al. 2003, Ross et al. 2006). To alleviate the perpetual drier conditions and its associated problems, increased water flows within this area are required. Unit 5 consists of approximately 14 square kilometers and thus is the smallest of all the units. Surveys from 2007-2009 detected no CSSS within this unit, whereas in 2010 there was one bird count and in 2011, two were detected (**Table 6-4**). This unit meets the hydroperiod criteria of 90-210 days per year 14 out of the 41 year POR as compared to the existing conditions at 17 years and FWO that meets the criteria 18 years (**Table 6-11**).

6.2.8.5 Cape Sable Seaside Sparrow Critical Habitat Effect Determination

The 1999 FWS RPA stated that in addition to the 60-day dry nesting constraint the Corps would have to ensure that 30%, 45%, and 60% of required regulatory releases crossing Tamiami Trail enter ENP east of the L-67 Extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that meet or exceed those produced by the 30%, 45%, and 60% targets. Hydroperiods and water levels in the vicinity of subpopulations C, E, and F would also have to be produced that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase II operations (Corps 1995).

The CEPP goal of increasing the hydroperiod throughout WCA 3A and ENP does not coincide with the hydroperiods needed to maintain a drier, marl prairie habitat that is necessary for the CSSS. Alt 4R2 performed the worst in CSSS-E across all ecological targets as compared to the existing conditions and FWO. Most of the CSSS habitats have hydroperiods that are too deep for too long to be conducive for the species, which mirrors the existing conditions and FWO in most cases **(Figure 6-40 through Figure 6-49)**. Subpopulations E-1 and F perform outside of the target range on the higher end more often than the existing conditions for Alt 4R2. CSSS-F and CSSS-C perform below the target range of 90 days more often than going above the 210 days (too wet). Too dry (less than 90 days) of conditions are more conducive to nesting than too wet (above 210 days) due to reasons discussed above. CSSS-B, the largest of the subpopulations, met the ET-2 hydroperiod criterion in 29 of the 41 year POR, which is similar to the existing conditions. Within other subpopulations, hydroperiod targets are only met approximately half of the POR or less under existing conditions, Alt 4R2, and/or FWO (**Table 6-11** and **Figures 6-40 through 6-49**). Therefore, the Corps concludes that CEPP may affect CSSS critical habitat.

6.2.9 Other Species Discussion – Bald Eagle

On July 9, 2007, the FWS published the final rule in the Federal Register announcing the removal of the bald eagle from the Federal list of endangered and threatened wildlife. The rule became effective on August 8, 2007. However, this species remains protected under the Migratory Bird Treaty Act and the Bald Eagle Protection Act, therefore potential impacts from project activities are discussed below.

The bald eagle occurs in various habitats near lakes, large rivers and coastlines. Most breeding eagles construct nests within several hundred yards of open water (FWS, 1999). Shorelines, such as the shorelines around Lake Okeechobee, the Okeechobee Waterway, and estuaries provide fishing and loafing perches, nest trees, and open flight paths for the bald eagle (FWS, 1999). The bald eagle primarily feeds on fish, but is known to occasionally prey on small mammals and will feed on carrion. Bald eagles are known to nest around the study area. Nesting season occurs from October through May. The bald eagle mates for life and uses the same nesting site year after year, if the territory is available. According to the FWC database, for the period of 2000-2004, two nests were reported in close proximity to Lake Okeechobee. One nest, located in Palm Beach County near Lake Harbor, was last listed as active in 2003. The second nest, located in Glades County northeast of Lake Port, was active in 2004. Bald eagle nesting locations from 2001-2011 are shown in **Figure 6-53**.

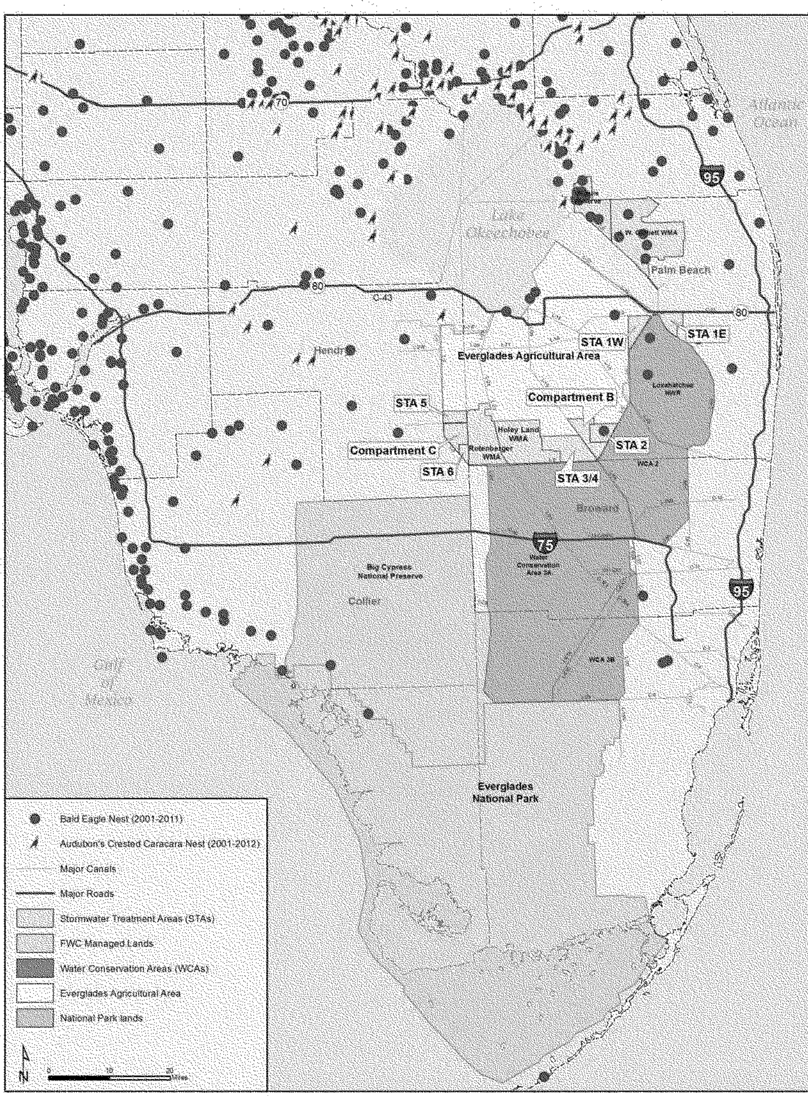


Figure 6-53. Bald eagle nest locations from 2001-2011

In south Florida, nests are often in the ecotone between forest and marsh or water, and are constructed in dominant or codominant living pines (*Pinus spp.*) or bald cypress (*Taxodium distichum*) (McKewan and Hirth, 1979). Approximately ten percent of eagle nests are located in dead pine trees, while two to three percent occur in other species, such as Australian pine (*Casuarina equisetifolia*) and live oak (*Quercus virginiana*). The stature of nest trees decreases from north to south (Wood et al., 1989) and in Florida Bay eagles nest in black (*Avicennia germinans*) and red mangroves (*Rhizophora mangle*) almost exclusively (96.9 percent), half of which are snags (Curnutt and Robertson, 1994). Suitable habitat for bald eagles is any forested area with potential nesting trees that are within 1.9 miles (3 kilometers) of large open water, such as borrow pits, lakes, rivers, and large canals. Due to the confirmation of nests in Florida Bay it can be surmised that habitat is conducive for bald eagle nesting and foraging within the study area.

7.0 CONSERVATION MEASURES

The Corps acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within the CEPP study area. Species and habitat monitoring would continue to identify population trends for the CSSS, Everglade snail kite, wood stork, and the vegetation characteristic of their habitats. CSSS mitigation measures could include preemptive measures to offset the potential adverse effects of the project including translocation of species to more suitable habitat, improvement of habitat within ENP, and/or improvement of habitat within some of the critical habitat areas that will be improved by CEPP, such as CSSS-A. Habitat restoration measures discussed with the FWS also include prescribed fire, evaluation of the role of woody vegetation in CSSS habitat, and removal of woody vegetation. Monitoring that would help determine the current CSSS population would be useful in determining actual project effects, and could include development of a spatially explicit population estimator, conducting intensive nesting monitoring, conducting helicopter surveys, population modeling, and hydrologic monitoring.

The Corps proposes to use panther credits in the Picayune Strand Restoration Project to offset the loss of habitat due to construction of the 14, 000 acre FEB site. Additional monitoring of panthers should not be necessary due to use of the approved mitigation bank. 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 the manatee, and *Draft Standard Protection Measures for the Eastern Indigo Snake* (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.

8.0 CONCLUSIONS

State-Listed Species: Effects of project activities are not likely to adversely affect state protected species (**Table 5-2**). Impacts to state-listed wading bird species will be similar to those described for the federally endangered wood stork. Modifications to the existing C&SF project are designed to improve hydrologic conditions for wading birds through increasing foraging opportunities within WCA 3 and ENP, thereby directly benefitting these species within the CEPP study area.

Federally-Listed Species: The Corps acknowledges the probable existence of 40 federally-listed threatened, endangered, and candidate species within the boundaries of the CEPP 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 reasons discussed in Section 6 include the following: Crenulate lead plant, cape sable thoroughwort, Deltoid's spurge, Garber's spurge, Small's milkpea, tiny polygala, Okeechobee gourd, Miami blue butterfly, Schaus swallowtail butterfly, stock island tree snail, piping plover, red-cockaded woodpecker, Roseate tern, and Northern crested caracara.

The Corps acknowledges the potential existence of fifteen federally listed threatened and endangered species under NMFS purview within the boundaries of the CEPP study area. Although the green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, and the loggerhead sea turtle are known to potentially exist within close proximity of the project area, any project related impacts through restoration efforts will ultimately benefit estuarine and nearshore communities and associated biota. Based on available information, it is evident that the smalltooth sawfish, resides, travels, and/or forages within the study area and could be affected by CEPP implementation. 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, the Gulf sturgeon, blue whale, fin whale, humpback whale, sei whale, sperm whale, elkhorn, and staghorn stony corals. The Corps has determined that the proposed project will have "no effect" on the above species utilizing the study area.

The conversion of agricultural land to a FEB in the EAA will result in a loss of habitat for the indigo snake and the Florida panther. However, increased water flows through the WCA 3 and ENP would indirectly increase foraging habitat for the panther as some of its prey eats fish. Constructed tree islands along the Miami Canal backfill could potentially create some deer habitat to also increase prey, as well as potentially providing some upland habitat for indigo snake. Eastern indigo snakes currently inhabit EAA agricultural fields used for sugar cane production and regularly burned. Soils in this area are hydric (wetland) soils that will support wetlands, which is not typically the type of area the snakes are found in. Eastern indigo snakes would still have relatively large areas of undeveloped and agricultural land in the EAA to maintain their population.

Within the Greater Everglades, altered hydrology has led to degradation of the native vegetation communities, such as tree islands, sawgrass marsh mosaic, and marl prairies, and the expansion of undesirable cattail monocultures. As habitats have been degraded, abundance and diversity of wildlife populations have been affected as well. Restoration of sheetflow and historic hydropatterns within WCA 3 and ENP will result in beneficial shifts toward more desirable vegetation communities, landscape patterns, and animal populations.

Wood storks would benefit from increased freshwater sheetflow due to an increased foraging base in WCA 2, 3, and ENP. Based on Beeren's frequency of use model, wood stork use and foraging would increase due to implementation of CEPP (Bereens 2013). Changes in the quality, quantity, timing, and distribution of water under CEPP provides opportunities for improved vegetation in northern WCA 3A, 3B, and ENP, including expansion of sloughs and wet prairies, and contraction of sawgrass prairies, thus benefiting the Everglades snail kite. Conversion back to sloughs and wet prairies would provide improved apple snail ascension rates and meet the FWS MSTS depth recommendations, which support successful apple snail oviposition, a key factor in snail kite survival. Designated Everglade snail kite critical habitat would also be improved with increased sheetflow to WCAs and ENP. There would be no effect on Everglade snail kite designated critical habitat within Lake Okeechobee, WCA 1, or WCA 2 because CEPP is redirecting approximately 210,000 acre feet of additional water that currently flows into the St. Lucie and Caloosahatchee Estuaries to the historical southerly flow path south through FEBs and existing STAs.

Based on the best available information, it is evident that the CSSS would likely be affected by CEPP implementation. However, neither existing nor projected future conditions provide an ideal outlook for the CSSS. Comparisons of existing conditions and the CEPP recommended plan (Section 6) show that some areas utilized by sparrows are slightly improved by CEPP implementation, while others remain the same or slightly worse than existing conditions. Slight improvements to critical habitat areas in CSSS-A, CSSS-F, and CSSS-B (some metrics) could potentially provide the interim habitat needed to keep the CSSS population as is, with potential for physical habitat improvements as well. Natural fluctuations in climate and weather are difficult to predict (e.g., Hurricane Andrew where a decline in species population happened afterwards). Actions discussed in Section 7 of this document may help improve undesirable conditions in areas formerly inhabited by the sparrow prior to CEPP implementation, potentially contributing to an increase in the CSSS population.

Changes in hydrology of the freshwater systems have led to effects on the estuarine and marine environments of Florida Bay and Biscayne Bay. Alterations in seasonal deliveries to Florida Bay have resulted in extreme salinity fluctuations. Implementation of CEPP would improve the production of bay flora and fauna by moderating unnatural shifts in salinity through improvements to freshwater delivered to coastal wetlands and downstream estuaries in ENP, Florida Bay, and Biscayne Bay. These improvements directly benefit the American crocodile and its critical habitat and Florida manatee and its critical habitat with increased freshwater flows to the estuaries. CEPP has the potential to reduce the frequency and volume of high level flows from Lake Okeechobee to the Caloosahatchee River Estuary and the St. Lucie Estuary, thus reducing the potential for adverse impacts on estuarine and nearshore biota associated with EFH. This is a significant improvement for estuarine systems compared to existing conditions.

The Corps recognizes the need for re-initiation of consultation if modifications to the project are made and/or additional information involving potential effects to listed species becomes available. The Corps commits to maintain ongoing communications with the FWS, NMFS, and FWC in the event of project modifications. This document is being submitted for formal consultation with the FWS pursuant to Section 7 of the ESA.

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Appendix A

Fish and Wildlife Service Planning Aid Letters

United States Department of the Interior

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

January 20, 2012

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

Dear Colonel Pantano:

The U.S. Fish and Wildlife Service (Service) has prepared this Planning Aid Letter (PAL) to assist in developing the Central Everglades Planning Project (CEPP), an expedited planning process to implement portions of the Comprehensive Everglades Restoration Plan (CERP) located in the central Everglades. This PAL is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), and section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This PAL does not constitute the report of the Secretary of Interior as required by section 2(b) of the FWCA, nor does it constitute a biological opinion under section 7 of the Act. The purpose of this PAL is to provide the U.S. Army Corps of Engineers (Corps) with recommendations regarding several aspects of the planning process including but not limited to the project goals and objectives, management actions that should be considered (*e.g.*, project components), ecological performance measures, and to provide a list of Threatened and Endangered species that may be encountered within the Study Area.

BACKGROUND

Project Purpose

While CERP has made considerable progress on projects on the periphery of the remaining Everglades, less has been achieved in the most critical areas of the central Everglades. Construction has begun on the first generation of CERP project modifications already authorized by Congress. These include the Picayune Strand, Indian River Lagoon South and Site 1 projects. Project Implementation Reports have been completed, or are nearing completion, for the second generation of CERP projects for Congressional authorization. These include the Biscayne Bay Coastal Wetlands, Broward County Water Preserve Area, Caloosahatchee River (C-43) West Basin Storage Reservoir, and C-111 Spreader Canal Western projects.

The next step for implementation of the Plan, and the main focus of CEPP, is to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south. This will allow for restoration of natural habitat conditions and water flow in the central Everglades and re-connect the central Everglades ecosystem with Everglades National Park (ENP) and Florida Bay. The Corps, who is leading the planning effort in partnership with the South Florida Water Management District (SFWMD), has recommended that the Everglades Agricultural Area Storage and Treatment (EAA), Decompartmentalization of Water Conservation Area 3 (Decomp PIR 1), and Everglades Seepage Management (ESM) projects form the core of CEPP. These are highly interdependent features of the Plan that must be formulated and optimized in a comprehensive and integrated manner.

Planning Process

The CEPP will be one of five nationwide pilot projects to utilize a streamlined planning process with the goal of significantly reducing the amount of time it takes to plan projects. Over the last decade it has become apparent that the current Corps planning process is perceived by sponsors, State and Federal partners, Congress and the public as taking too long, being too cumbersome, too detailed, too expensive and does not lead to a better product or decision commensurate with the added years of effort to an already long process. The Corps and senior leadership at the Office of the Assistant Secretary of the Army (Civil Works) have initiated a pilot program for candidate planning studies designed to assess the effectiveness of transforming the Civil Works Planning Program to better meet the needs of the nation's water resources challenges.

Based on the above, the proposed approach for the CEPP is to incorporate the new science and understanding of the hydrology of the ecosystem and build upon the information and tools developed by SFWMD in support of a more streamlined planning process that utilizes the concepts for transformation of the Corps planning process. A general outline of the proposed process for CEPP is shown in Figure 1.

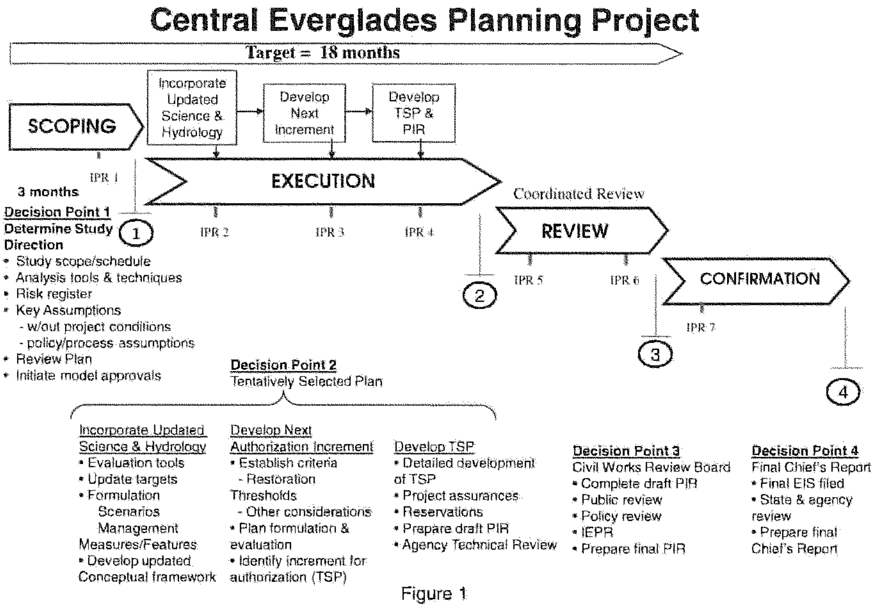

Figure 1: General outline of the proposed process for CEPP.

Project Objectives

The major goal of the project, as stated by project managers, is to redirect water that is currently discharged to the east and west coast estuaries from Lake Okeechobee and restore water flow to the south, allowing for restoration of natural habitat conditions and water flow in the central Everglades. This will re-connect the central Everglades ecosystem with ENP and Florida Bay. This portion of the Plan will include those components that provide for storage, treatment and conveyance south of Lake Okeechobee, removal of canals and levees within central Everglades and seepage management features to protect the urban and agricultural areas to the east from the increased flow of water through the central portion of the system. An integrated study effort on these components is needed to set the direction for the next decade of implementation of the Plan. The goal of the study effort would be to develop an integrated, comprehensive technical plan for delivering the right quantity, quality, timing and distribution of water needed to restore and reconnect the central Everglades ecosystem. The study area for the CEPP has been defined to include Lake Okeechobee, Caloosahatchee and St. Lucie Estuaries, EAA, Greater Everglades, ENP, and Biscayne and Florida Bays (Figure 2).

To achieve the goals stated above, the Corps and SFWMD have drafted preliminary project objectives as follows:

- Restore seasonal hydroperiods and freshwater distribution that support a natural mosaic of wetland and upland habitat in the Everglades System.

- Improve sheet flow patterns and surface water depths and durations in order to reduce soil subsidence, frequency of damaging fires, and decline of tree islands.

- 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 predicted by project modeling that will promote plant and animal diversity and habitat function.

- Increase oyster habitat and sea grass populations in the Northern Estuaries by reducing salinity fluctuations from freshwater regulatory pulse discharges.

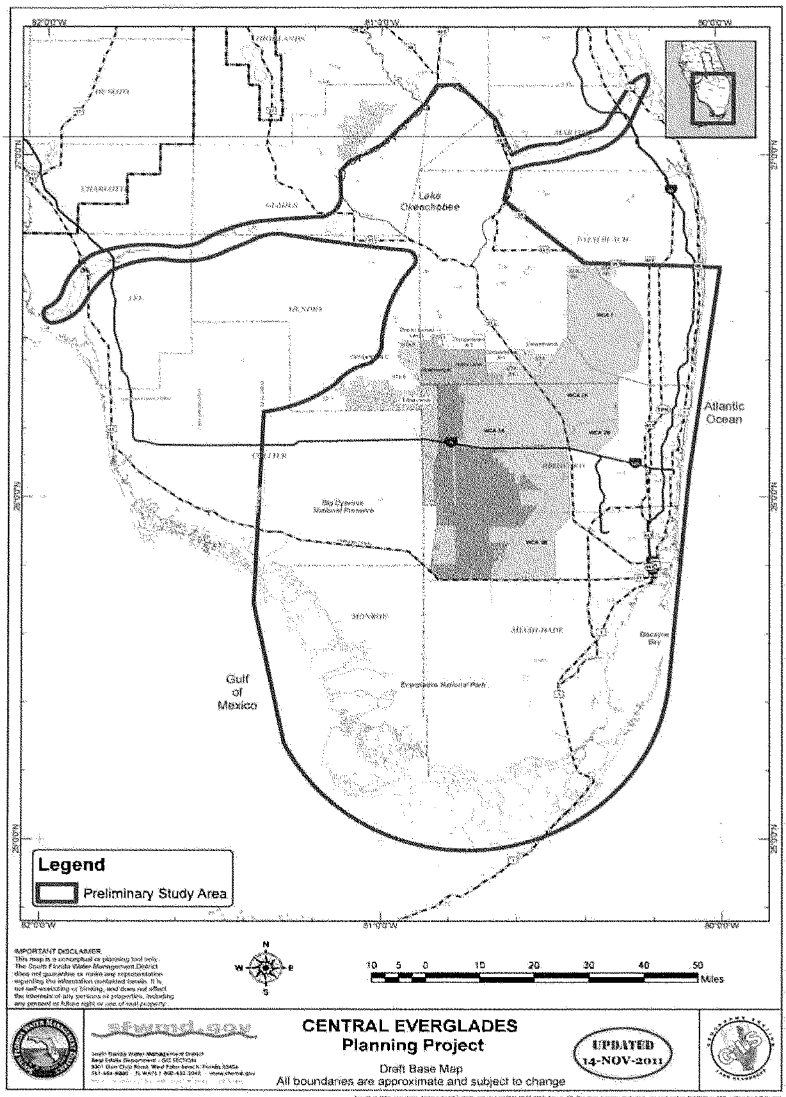

Figure 2. Central Everglades Planning Project Study Area.

Performance Measures

An interagency environmental sub-team of the Project Delivery Team (PDT), composed of scientists, engineers and planners, have drafted a list of hydrology based Performance Measures (PM) listed below. The group concentrated on Restoration Coordination and Verification (RECOVER)-approved PMs to avoid delays associated with having controversial PMs vetted. While these PMs are familiar to most and have been used in the past they will need to be adapted, in most cases, to work with the primary hydrologic model being utilized in CEPP, the Regional Simulation Model (RSM). Additionally, they are hydrologic PMs and reflect hydrologic benefits and not necessarily the desired ecological and other environmental benefits expected to result from the project. To remedy this, an interagency team led by Department of Interior scientists has drafted a list of additional environmental tools and PMs to be run separately and interjected into the planning process. A list of these tools appears below the Primary PMs. Some ecological tools that the team agreed, were not ready for use at this time, have not been included in the list (see meeting minutes available from Corps for additional information).

Preliminary List of Performance Measures

1. Lake Okeechobee Performance Measure - Lake Stage.
2. Northern Estuaries Performance Measure - Salinity Envelopes.
3. Greater Everglades Performance Measure - Inundation Duration in the Ridge and Slough Landscape.
4. Greater Everglades Performance Measure - Sheet flow in the Everglades Ridge and Slough Landscape.
5. Greater Everglades Performance Measure - Number and Duration of Dry Events in Shark River Slough.
6. Greater Everglades Performance Measure - Slough Vegetation Suitability.
7. Greater Everglades Performance Measure - Hydrologic Surrogate for Soil Oxidation.
8. Greater Everglades Aquatic Trophic Levels Small-Sized Freshwater Fish Density (RECOVER Greater Everglades #1).*
9. Everview Viewing Windows (refer to Section 2.2 of River of Grass document, page 23)*.

* Denotes Performance Measures that will be used as planning tools.

Additional Ecological

1. Everglades Landscape Vegetation Succession Model (ELVeS.)
2. Wood Stork Foraging Probability.
3. Cape Sable Seaside Sparrow Hydrologic Indicator.
4. Apple Snail Population Model.
5. Oyster Habitat Suitability Index for Northern Estuaries.

The ecological sub-team is advising the PDT to use all available ecological tools that will provide additional useful information. Two models that may be completed in time for use on this project are the amphibian community index, alligator production index and alligator population model. These indices may appear on the list above in the future.

The PMs and tools listed above are for evaluating alternative performance as it relates to environmental restoration, however there are PMs for other concerns that the Corps should include in its planning process. Examples of these would be agriculture and water supply metrics.

Models

The primary application of models in the CEPP will be in the assessment of regional-level hydrologic planning. More detailed models will also be brought to bear on specific questions related to hydraulic and water quality constraints. At this time, the modeling strategy does not consider the application of detailed flood event modeling (or hydrodynamic levee assessment) or water quality fate/succession modeling within the Everglades Protection Area given the schedule of the CEPP. Depending on the outcomes of the CEPP scoping phase and risk registry development, it is possible that key elements of this strategy may need to be revisited.

Several models will be used during the execution phase of project planning and can be categorized as screening, planning and detailed models. The Reservoir Sizing and Operations Screening (RESOPS) model is a spreadsheet application which will test alternative storage configurations that consider the interconnectivity of Lake Okeechobee, the Lake Okeechobee Service Area, the northern estuary watershed systems, and the Everglades. Models which will be used for planning include the RSM Basin, RSM Glades-LECSA, and South Florida Water Management Model (SFWMM). Detailed models include the Dynamic Model for Stormwater Treatment Areas (DMSTA) and the HEC-RAS. For more detailed information on CEPP modeling please refer to the Corps' Central Everglades Study DRAFT Modeling Strategy.

Risk Register

The risk register workshop was a good exercise for the inter-disciplinary, multi-agency PDT team. It brought the larger group into a sub-team setting to begin focusing on the risks associated with the expedited Corps planning process. Risk registers were developed by four sub-teams consisting of (1) Cultural Resources/Real Estate; (2) Environmental; (3) Engineering, Hydrology, Hydraulics, Geotech and Operations; and (4) Planning. Risks were identified and valued in a qualitative nature based on best professional judgment and agreement within each group. It is expected that a "living" document will be created by the Corps and updated on a regular basis.

SERVICE RECOMMENDATIONS

Project Purpose

While the Service fully supports this effort and approach, it is necessary to point out that there are many restoration opportunities within the Central Everglades that would not be captured by simply undertaking the three specific projects suggested: EAA storage component; Decomp PIR 1 Project; and ESM Project. Primarily, the reconnection of WCA-3B as a flow-through system connecting WCA-3A to ENP is the most critical part of Everglades restoration remaining to be planned. This component of the Modified Water Deliveries (MWD) to ENP Project was called Conveyance and Seepage and has undergone initial planning during the Combined Structural and Operational Plan. Since then, funding for MWD has been exhausted, and the Conveyance and Seepage Project set aside. The Service suggests, and will provide alternative scenarios, that this critical element be made a core component of CEPP. The initial phase of this component could be as simple as continued use of the L-67A culvert approved for the Decompartmentalization Physical Model and a new weir on the L-29 levee. The optimal approach, however, would be implementation of the original plan (1994 GDM) which consisted of 3 gates (S-349 A,B and C) in the L-67A canal, 3 weirs or culverts in the L-67 A levee, degradation of the L-67 C levee and canal, and 3 weirs on the L-29 levee to allow flow across the Tamiami Trail.

Additional opportunities that should be included in CEPP are the relaxation of the G-3273 constraint, integration of the S-356 pump station to control seepage in the L-30 and L-31N canals, and expansion of the S-333 structure to allow greater flow out of the ponded areas of WCA-3A into Northeast Shark River Slough (NESRS). Also, if the Combined Operational Plan is going to be delayed or absorbed into CEPP then an operational plan that utilizes the newly constructed 1-mile bridge should be incorporated. Other opportunities include defining environmental water regulation schedules for WCAs 2 and 3B and refining the schedule for 3A.

It is also important that the Corps and SFWMD, as quickly as possible, determine the size and type of available storage and treatment areas in the EAA to help guide the team in formulating downstream project features. There is considerable speculation as to the amount of water that the project will deliver south which is entirely predicated on the amount of storage and treatment available in the EAA. Team members and the public are initially being asked to provide comments and lay out issues for an as yet undefined project. This will hinder stakeholder and public buy-in and support. Even if tentative plans are numerous, they need to be discussed early in the process.

It may be the case that some proposed components of the project become less important (*e.g.*, seepage management) as more is learned about the quality of water delivered south. The Service does not feel that a completed seepage management project, without the delivery of additional water for the environment, constitutes a valid restoration project. The Corps should notify the Service regarding the best time to provide important information regarding the design and detailed operations of stormwater treatment areas and storage reservoirs and their effects on listed species, migratory birds, and other wildlife resources.

A project feature that should not be considered during the CEPP is further modification of the S-12 structures closure regime for protection of the Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*). Once the Everglades Restoration Transition Plan (ERTP) is authorized (Record of Decision scheduled late February 2012) the S-12 closure regime will be relaxed due to the addition of year-round operational capability at S-12 C. With the additional "untested" risk to the Cape Sable seaside sparrow subpopulation A and its habitat from ERTP operations, the Service strongly recommends that restoration become more focused on shifting flow eastward towards the original flow path of WCA 3B to NESRS. No further management changes to the S-12s should be considered until more flow has been restored into northeastern ENP.

Planning Process

The Service fully supports the use of an expedited planning process for the CEPP. The process used to plan CERP projects over the past decade is cumbersome and has not always resulted in a better plan. The proposed expedited process will identify issues early and elevate these issues through the vertical management team for timely decisions, reducing delay at the PDT level. The complexity previously required of project implementation reports will be reduced, thus allowing preparation of these documents in much shorter time periods. In an effort to identify and process the added risk of completing a rapid and possibly less detailed study, the Corps has implemented a risk registry procedure where team members and other public stakeholders were asked to identify major risks and suggest ways in which to mitigate the risk.

An area of concern regarding the expedited process is how PDT meetings are being conducted. As we approach the 3-month mark there have only been two PDT meetings. These were conducted as short (~3 hour) meetings prior to public workshops. Dialogue among PDT members and between the team and project management regarding critical project planning elements was restricted. Draft language, such as project objectives, on which the PDT members were asked to comment, was not shared prior to the meeting. The Service suggests that the Corps and SFWMD convene a PDT meeting in the style previously used during CERP to discuss critical project elements as soon as possible.

As noted above, the primary performance measures listed to date are hydrologic. There are a number of ecological planning tools that have been developed and are being linked to RSM output that could be used in the planning process. The Service encourages the Corps and SFWMD to seek out and use available ecological planning tools to help to ensure that evaluations include both hydrologic and ecologic information. Consideration should be given to ecological planning tools in Florida Bay and Biscayne Bay as well as Greater Everglades.

Adaptive management and the monitoring associated with it is a key part of the science strategy for CERP and should be for CEPP as well, yet there has been no discussion on development of an adaptive management plan for CEPP. The Service recommends that development of an adaptive management plan occur in conjunction with the CEPP planning process.

Project Objectives

The Service appreciates the challenging work completed by the Corps and SFWMD staff on the initial draft project objectives. This task is difficult because of the scope and enormity of the project study area. The Corps and SFWMD project managers should refine the scope and study area to more precisely fit the first increment of the CEPP as soon as possible. This will allow the team to refine the objectives and identify PMs and model applications that will be useful in determining project benefits.

Specific comments on the draft project objectives are as follows:

- "Reduce water loss out of the natural system…" We assume that this is referring to seepage loss since the Seepage Management project was identified as a core component of CEPP but it is not clear. It may refer to the loss of freshwater to tide. The seepage component is not primarily for wildlife benefit but for flood protection and the objective should reflect this. Please clarify this objective.

- "Restore more natural water level responses to rainfall predicted by project modeling…" This needs to be reworded or better explained. Does this imply that the model predicts rainfall? We assume the desire is to have the system respond more naturally to rainfall patterns.

- "Increase oyster habitat and sea-grass populations in the Northern Estuaries by reducing salinity fluctuations from freshwater regulatory pulse discharges." There is a misconception contained within this objective that by reducing salinity fluctuations you increase oyster and seagrass habitats. This is not the case as additional management actions are needed for this to occur. The Service also suggests this objective be reworded to include the restoration of the overall ecological function of the estuaries as measured by oyster and sea-grass populations. Detailed questions regarding this objective are as follow:

    - What is meant by seagrass population, species composition, density, acreage increase, etc?
    - Is *Vallisneria* included under seagrass since it is an important component of the Caloosahatchee River restoration?
    - Which Northern Estuaries will the CEPP improve (St. Lucie, Caloosahatchee, etc.)?
    - Will muck removal in estuaries or addition of artificial substrates (oyster cultch) be included in the Management Measures as part of the CEPP to claim maximum ecological benefits for Northern Estuaries oyster and seagrass health and abundance?

Performance Measures

The process used by the Ecological sub-team to select the project PMs is working well and the draft suite of PMs listed above is suitable to detect hydrologic benefits. Concerns we have at this point are whether the RECOVER approved and vetted PMs previously used in CERP can be modified to use RSM output. Additionally, the estuarine performance measures proposed utilize an array of models including the SFWMM; or 2x2. Will the SFWMM be used to evaluate project alternatives (perhaps solely in the estuaries)?

Also of concern is how output from the additional ecological tools will be used to formulate alternatives to optimize benefits for natural resources throughout the system. The Service recommends that conclusions and recommendations drawn from these specialized tools be considered between alternative runs to make the next iteration more beneficial for natural resources. Additionally, the information will be used to better relate hydrologic change to environmental lift predicted by the preferred alternative.

Examples of the resource-specific ecological tools currently under consideration are listed previously in this document and minutes from a recent Ecological sub-team meeting indicate that most of the models are ready for use. One issue that arose is whether the models can accept RSM hydrologic model output. Most of the ecological models were set up to work on a fixed grid so the RSM output needs to be manipulated to get it into a fixed-grid format. Modelers from the Corps, Joint Ecological Modeling group and other agencies are working on ways to eliminate this problem.

Models

Since the River of Grass modeling tools and PMs have been moderately peer-reviewed, their use during CEPP will be appropriate as long as the Corps' certification process is either completed or these PMs exempted from certification.

There are some concerns with using the RESOPS model in conjunction with the Regional Simulation Model – Glades Lower Ease Coast Service Area (RSM-Glades LECSA) model. RSM-Glades LECSA is a daily time-step model that will be using output from RESOPS which utilizes a monthly time-step. This will automatically create inherent errors in the model results.

The RSM Basin model covers the Kissimmee Basin, Lake Okeechobee, St. Lucie River, and Caloosahatchee River. Unfortunately, this model does not provide individual gauge data, which the Service has used previously to assess impacts and implement terms and conditions within its biological opinions. Rather than simulating gauge data, this model represents stage as an average water level condition across an entire water body. Also, model documentation for RSM Basin does not discuss ground water. The spatial extent of the RSM Basin model includes an intensive surface water / ground water interaction. This interaction in the Everglades headwaters needs to be defined and verified for accuracy. It is unclear whether the surficial aquifer is simulated in this model.

A similar concern exists for the RSM Glades-LECSA model which simulates hydrology within 1-square mile grid cells without providing individual gauge data. Since the Corps and SFWMD water management sections base their management actions on individual gauge data as the Service bases its nondiscretionary terms and conditions on gauge data, a cross-walk between simulated hydrology across a large area to that at specific gauges will be needed. The hydrologic effects of the proposed action at key gauge sites identified by the Service during this and previous consultations should be provided.

The modeling strategy for CEPP does not consider any detailed flood event modeling or levee assessments. L-29 levee concerns have presented a human health and safety constraint in WCA-3A, thus a levee assessment with flood event modeling will likely become necessary especially since more water is predicted to move south through the system into WCA-3A.

Recent water quality legal and scientific issues throughout the Everglades necessitate the need for water quality assessments and modeling. It has been noted that the DMSTA model does not allow for extreme events, such as droughts and hurricanes. Thus, DMSTA is expected to predict +/-23 percent of the mean phosphorus concentrations. DMSTA may be useful in the planning process, but it will likely need more refinement for project level simulations.

Climate Change Scenarios

Given the range of uncertainties in dealing with climate change and urbanization it is important that these be incorporated into the planning process in the best way feasible. The planning team should evaluate available tools and information that can be used to assess future impacts of climate change including sea level rise and changes in urbanization (which may affect water supply). One possible tool has resulted from work conducted by an MIT research team (Service, U.S. Geological Survey, and MIT) that developed a series of scenarios in collaboration with a wide range of stakeholders, including representatives from Federal, State, and local government. These scenarios have four top-level dimensions selected by the stakeholders: climate change, population, financial resources, and planning assumptions. Within these dimensions, stakeholders developed a bounded range of possible values from the best available science, including sea level rise, land use, agriculture, conservation lands, and transportation corridors. This climate change model covers the CEPP area and it is recommended that the team determine how best to incorporate this information into the planning process and/or identify other climate change information that can be used during planning.

Project Schedule

The following table (Table 1) highlights some issues identified with the current draft schedule as it pertains to Service activities.

Table 1. Comments on the draft schedule as it pertains to Service activities.

Activity ID	Activity Name	Start	End	Notes
1060	Prepare Draft PIR and EIS	1 May 2012	2 Oct 2012	What will be evaluated in this draft PIR/EIS? The TSP will be selected 4 months later (1110). Will the Corps be assessing all the potential TSPs that are under consideration (1400)?
1410	Complete Draft PIR/EIS Report	4 Feb 2013	7 Feb 2013	This occurs a week after the TSP Approval (1110). How does the Corps propose to evaluate the TSP for the EIS in less than 4 days?
1570	FWS Prepares Coordination Act Report	4 Feb 2013 *14 Dec 2012*	20 Mar 2013 *8 Feb 2013*	Is this the draft or final CAR? The draft CAR is usually completed about 45 days after the TSP (1120) and a couple weeks prior to the draft EIS (1420). If we are given the TSP when the EIS begins evaluating it we can start this activity earlier (see the italics dates for example).
1540	USACE Starts Biological Assessment	1 Feb 2013	22 Mar 2013	This activity lists 1550 as a successor. What is 1550? The FWS BO is activity 1560.
1560	FWS Prepares Biological Opinion	25 Mar 2013	2 Oct 2013 *12 Aug 2013*	The Service has 135 calendar days to prepare the BO under the Act. It appears that the current schedule has 135 work days. I think this makes the end date 12 Aug 2013 which lines up with 1240. The predecessor to the BO is listed as 1550. What is 1550?
	Final FWS Coordination Act Report	*9 Apr 2012*	*27 May 2013*	This activity is not included in the schedule. The end date for this is usually prior to the final EIS going to public review (see the italics dates for example).

Threatened and Endangered Species List

The Service has received a request from the Corps (email dated January 20, 2012) for a preliminary list of Threatened and Endangered Species that may be encountered within the project area. The following table (Table 2) is a preliminary list that will be finalized later when an official request from the Corps has been received.

Table 2: Threatened and Endangered species that may be present in the CEPP project area.

COMMON NAME	SCIENTIFIC NAME	FEDERAL STATUS	CRITICAL HABITAT
Mammals			
Florida bonneted bat	*Eumops floridanus*	Candidate	No
Florida panther	*Puma (=Felis) concolor coryi*	Endangered	No
West Indian manatee	*Trichechus manatus*	Endangered	Yes
Birds			
Northern Crested caracara	*Caracara cheriway*	Threatened	No
Bald eagle*	*Haliaeetus leucocephalus*	Delisted	No
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	Endangered	Yes
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Endangered	Yes
Piping plover	*Charadrius melodus*	Threatened	No
Red-cockaded woodpecker	*Picoides borealis*	Endangered	No
Roseate tern	*Sterna dougallii dougallii*	Threatened	No
Wood stork	*Mycteria Americana*	Endangered	No
Reptiles			
American alligator	*Alligator mississippiensis*	Threatened	No
American crocodile	*Crocodylus acutus*	Endangered	Yes
Eastern indigo snake	*Drymarchon corais couperi*	Threatened	No
Green sea turtle**	*Chelonia mydas*	Endangered	Yes
Hawksbill sea turtle**	*Eretmochelys imbricata*	Endangered	Yes
Kemp's ridley sea turtle**	*Lepidochelys kempii*	Endangered	No
Leatherback sea turtle**	*Dermochelys coriacea*	Endangered	Yes
Loggerhead sea turtle**	*Caretta caretta*	Threatened	No
Plants			
Big Pine partridge pea	*Chamaecrista lineata* var. *keyensis*	Candidate	No
Blodgett's silverbush	*Argythamnia blodgettii*	Candidate	No
Cape Sable thoroughwort	*Chromolaena frustrata*	Candidate	No
Crenulate lead-plant	*Amorpha crenulata*	Endangered	No
Deltoid spurge	*Chamaesyce deltoidea* ssp. *deltoidea*	Endangered	No
Florida brickell-bush	*Brickellia mosieri*	Candidate	No

Florida pineland crabgrass	*Digitaria pauciflora*	Candidate	No
Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	Candidate	No
Florida semaphore cactus	*Consolea corallicola*	Candidate	No
Johnson's seagrass	*Halophila johnsonii*	Threatened	No
Garber's spurge	*Chamaesyce garberi*	Threatened	No
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeensis*	Endangered	No
Pineland sandmat	*Chamaesyce deltoidea* ssp. *pinetorum*	Candidate	No
Tiny polygala	*Polygala smallii*	Endangered	No
Invertebrates			
Bartram's hairstreak butterfly	*Strymon acis bartrami*	Candidate	No
Florida leafwing butterfly	*Anaea troglodyta floridalis*	Candidate	No
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	Endangered	No
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	Endangered	No
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	Threatened	No
Fish			
Smalltooth sawfish**	*Pristis pectinata*	Endangered	No

* The bald eagle has been delisted under the Act but continues to be protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

** Species under the purview of the NMFS-NOAA Fisheries for consultation under the Act.

CONCLUSION

The guidance and recommendations that we provide in this PAL aim to assist us in our obligations to consider the effects of the project on all of the trust resources that we must address to fulfill our responsibilities under the FWCA and Act. We applaud the progress made so far by the CEPP PDT as well as the team's common vision for restoration and commitment to the expedited planning process. We look forward to continuing our working relationship with the Corps staff and other partners and stakeholders throughout the remainder of the CEPP planning process. If you have any questions regarding the contents of this PAL, please contact Kevin Palmer or Lori Miller at 772-562-3909.

Sincerely yours,

Larry Williams
Field Supervisor
South Florida Ecological Services

cc: electronic copy only
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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

March 27, 2012

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

Dear Colonel Pantano:

The U.S. Fish and Wildlife Service (Service) has prepared this second in a series of Planning Aid Letters (PAL) to assist in developing the Central Everglades Planning Project (CEPP), an expedited planning process to implement portions of the Comprehensive Everglades Restoration Plan (CERP) located in the central Everglades. This PAL is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), and section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This PAL does not constitute the report of the Secretary of Interior as required by section 2(b) of the FWCA, nor does it constitute a biological opinion under section 7 of the Act. The purpose of this PAL is to provide the U.S. Army Corps of Engineers (Corps) with recommendations regarding several aspects of the planning process including, but not limited to, management measure screening, alternative formulation, modeling strategy, and natural resource considerations.

Review of major points from previous PAL

- Reconnection of Water Conservation Area (WCA) 3B as a flow-through system connecting WCA-3A to Everglades National Park (ENP) is the most critical part of restoration remaining to be planned. All options should be analyzed regarding how and to what extent this critical reconnection should be made.
- Relaxation of the G-3273 constraint, the integration of the S-356 pump station to control seepage in the L-30 and L-31N canals, and the expansion of S-333 structure to allow greater flow out of the ponded areas of WCA-3A into Northeast Shark River Slough (NESRS) should be included in CEPP.
- Regulation schedules for WCAs 2 and 3B should be defined and the regulation schedule for WCA-3A should be refined.
- Further modification of the S-12s should not be considered as it was screened out in the recent Everglades Restoration Transition Plan (ERTP) for protection of the Cape Sable Seaside Sparrow (CSSS) (*Ammodramus maritimus mirabilis*). Once ERTP is authorized, the S-12C closure regime will be relaxed allowing for year-round operations.

Project Status

Since the last PAL was submitted on January 24, 2012, the Corps and South Florida Water Management District (SFWMD) project managers briefed their vertical management teams on the progress of the project at a Decision Point One meeting held on January 27, 2012. The purpose of this meeting was to determine study direction and receive feedback on the study scope and schedule. The team was directed to proceed to the next phase of the project, the Execution phase. This phase will last roughly 12 months and result in development of a Tentatively Selected Plan (TSP) and Project Implementation Report for the first increment of the CEPP Project. Detail regarding the team's progress during the first 2 months of the Execution phase will follow in this letter. The next milestone will be an In-Progress Review to the Corps' vertical management team on March 29, 2012. This letter will help inform that briefing.

Management Measures and Screening

Background

A draft list of coarse or general management measures was presented to the Project Delivery Team (PDT) at a meeting on January 31, 2012 (Table 1). These measures were compiled from work other teams had completed on previous CERP projects, and grouped by geographic location (*i.e.*, above and below the red line (an imaginary line used in modeling) designating the bottom of the Everglades Agricultural Area [EAA]). The team agreed to employ a first-cut screening of these measures using information generated from the other teams that considered them (*e.g.*, partitioning Lake Okeechobee was screened out during previous project deliberations and so it would be screened out of CEPP on this basis).

Table 1. List of general management measures grouped by geographic location. Quantity and quality are located above the red line in the EAA; Conveyance and distribution measures are located in the Greater Everglades downstream of the EAA; and Seepage management measures are located between the Greater Everglades and populated areas of the Miami Rock Ridge along the protective levee.

Quantity and Quality	Conveyance and Distribution	Seepage Management
Higher lake levels	Plug or backfill canal to marsh grade	Detention area
Partition Lake Okeechobee	Shallowing of canal	New pump stations
Above-ground storage reservoir	Gated structure in canal	Groundwater wells
Ecoreservoir	Pipeline	Line/pipe canals
Operational changes	Spreader canal	Recharge area
Stormwater Treatment Area	Levee removal/degradation	Flood attenuation reservoir
Flow equalization basin	Increase flow resistance in canals	Relocate existing canals
Dry/wet flow way	Culverts within existing levees	New canals
Aquifer Storage and Recovery	Spoil mound removal	Relocate existing pump stations
	Operational changes	Operational changes
	Bridging	Raise canal stages
	Cap canals	Step-down levees
	Pumping stations	In-ground seepage barriers
	Levee/berm construction	

The management measures remaining after the first round of screening (Table 2) have been added to a spreadsheet currently being called the *CEPP Component and Alternative Development and Screening Tool (CEPP Roadmap).* This spreadsheet is a central depository of all information the team will generate and use to screen and combine management measures into components, and combine components into a final array of alternatives. The next step will be to define the process the team will use to analyze available information (model output and other data) using hydrologic and ecological targets, and screen out certain measures while combining others into functional components and alternatives. As seen in Table 2, the names and numbers of management measures in each category have changed somewhat from the original list. The Service recommends that a brief write-up be included with the matrix to show the evolution of how some of the measures were screened and others were fleshed out in detail.

Table 2. Management measures as listed in the latest version (March 7, 2012) of the CEPP Component and Alternative Development and Screening Tool (The Roadmap). These are the remaining measures after the first screening iteration.

Quantity and Quality	Conveyance and Distribution	Seepage Management
Operational Flexibility	Degrade Levees	Detention area
Shallow Reservoir (FEB)	Gap Levee	New pump stations
Deep Reservoir	Remove Levee	Raise Canal Stages
Strategic Aquifer Storage and Recovery	Spreader Canal	Flood attenuation reservoir
Stormwater Treatment Area	Pumping Stations	Relocate existing canals
	Canal Conveyance	New canals
	Focused Flows	Relocate existing pump stations
	Canal Backfill	Operational changes
	Spoil mound removal	In-ground seepage barriers
	Canal Plugging	
	Gated Control Structures	
	Culverts	
	Weirs	
	Operational Flexibility	
	DOI Bridging	
	Structural Improvements	
	Swales	
	Culvert/Canal Maintenance	
	Collector Canals	

Issues and Concerns

There is uncertainty as to how the next screening phase will be implemented. The team has been briefed by the modeling group, which indicated that some "upfront" modeling products will be used to screen and optimize management measures for compilation into components and subsequently into alternatives. The Service recommends that the Corps quickly define the methodology that will be used during this step and make sure that the modeling sensitivity, and hydrologic and ecological targets are robust enough to potentially remove or retain management measures. The Service would like to be included in discussions regarding the ecological targets that will be used during this process.

At a February 29, 2012, Core Planning Team meeting, the S-12 operational regime for protection of the CSSS was added to the *CEPP Roadmap* (second level of screening) with little discussion. The Service would like to reiterate comments from the first PAL that changes to the S-12 operations should be considered as part of the first-cut screening methodology because changes to all of the S-12 structures were considered during ERTP. In fact, the primary focus of ERTP was determining operational flexibility and optimizing the S-12 closure regime for improving WCA-3A water management while maintaining protection for the CSSS. During the recent ERTP multi-agency PDT meetings all options for change to the S-12 structures were screened out with the exception of S-12C, which became operational year round in the final plan. It is our understanding that there is no project objective in CEPP for the modification of these structures since the goal of the project is to restore flow to NESRS. It is unclear, at present, how the preliminary modeling will provide necessary information on S-12 operations to screen them out. The modeling group has indicated that the preliminary modeling will not consider impediments to flow along the Tamiami Trail or operations. The CEPP team has agreed to eliminate measures and components from other CERP projects, such as Decompartmentalization, due to the extensive study and project work done in those projects. The Service recommends the same screening process be incorporated for exclusion of the S-12 A/B, S-344, and S-343 structure operations for maintaining protection of the CSSS. We believe the team should focus on the primary goal of the project which is to restore flow from WCA-3A to WCA-3B and into NESRS.

The Service is also concerned about the process by which alternatives will be developed and evaluated. The general alternative formulation and evaluation process has been described by the Corps as a series of screening iterations using "upfront" modeling output whereby management measures are screened or combined into components which will then be screened out or combined to form the final array of alternatives. Relying on modeling products to choose alternative features for the final array of alternatives without regards to operations, adaptive management, and past experience could result in a plan with adverse impacts to the landscape and threatened and endangered species. The Service requests that we receive model output pertaining to threatened and endangered species, throughout the planning process from screening through alternative formulation, so that we may help the team identify all possible means to reduce or eliminate impacts and ensure the TSP will help restore these imperiled species [Act section 7(a)(1)].

Use of New Science in Planning

It is critical for the PDT to begin discussing the "transition strategy" for how we will slowly introduce larger volumes of water into a system which has had its spatial extent reduced by 50 percent and its biological systems acclimated to reduced water flow. For the purposes of comparing modeled alternative runs it may be appropriate to use Natural System Model-based hydrologic targets; however, it should be understood that the first increment of CEPP will probably not meet these, and they may be inappropriate for use in some areas of the system. It is likely that both species and their habitat will be impacted during the transition to full restoration and careful planning will be needed to ensure these natural resources remain on the landscape. Excessive increases in flow volumes could overwhelm the system and disrupt timing, which could be harmful to tree islands, wetland dependent bird nesting and foraging, apple snail survival and reproduction, among others. Both the landscape and species response will need time to adjust to new conditions.

In addition to the new science learned during the 2 day Science Workshop for CEPP, the team should also use information learned from other CERP projects. A good example of this is the Multi-species Transition Strategy (MSTS) used during ERTP-1. A group of interagency scientists, in coordination with species experts, compiled the latest information regarding a number of species and defined a WCA-3A water management strategy. This science-based strategy was designed for snail kites, apple snails, wading birds, and vegetation found within WCA-3A and was based on the current hydrologic system. For CEPP, this strategy can be refined and other species and locations within the project area can be added. One of the key benefits from the MSTS and ERTP-1 was opening a communication channel between regional water operators and interagency scientists responsible for managing the system for natural resources. The Periodic Scientist Calls and seasonal scientist meetings are simple and effective forms of adaptive management and should be utilized in CEPP.

The Service recommends that threatened and endangered species be considered regularly throughout the CEPP planning process, from screening through alternative formulation, to ensure species protection while restoring the ecosystem. The Service understands that the PDT would like to have definitive answers as to how threatened or endangered species will be affected by certain aspects of the project, and the Service will work with PDT to provide those answers as soon as feasible within the process. Most importantly, in the end, the CEPP water control and operational plan will have to be analyzed (by the Service) to determine any effects to threatened and endangered species.

CSSS Nesting and Habitat Criteria

CSSS inhabit the relatively short hydroperiod marl marsh which flanks the Taylor and Shark River Sloughs in the ENP. Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 60 to 180 days is optimal for the plant species important for sparrow nesting and for maintenance of sparrow habitat ([Kushlan et al. 1982]; Olmsted 1984; Kushlan 1990a; Wetzel 2001; Ross et al. 2006). Recent observed average annual hydroperiods in subpopulation A (CSSS-A), as measured at NP-205 near the sparrow's core breeding habitat in western Shark Slough, have been in the range of 240 days or more. The effect of these longer hydroperiods in consecutive years has been the conversion of short hydroperiod marsh suitable for sparrow nesting to a sawgrass-dominated, wetter, marsh-type habitat unsuitable for sparrows. While the habitat occupied by sparrows can tolerate occasional average annual hydroperiods to 240 or more days this condition should not occur in concurrent years. Hydroperiods of 60 to 180 days should be experienced at the highest frequencies (*e.g.*, 7 out of 10 years) with occasional years ranging from 210 to 240 days. The opposite is true in the eastern subpopulations where hydroperiods are shorter resulting in higher threats of catastrophic fires and woody plant encroachment. CEPP is expected to alleviate these conditions by shifting more water into NESRS.

Targets for CEPP alternative performance, with regards to sparrow nesting, in the vicinity of the six sparrow subpopulations (A-F) will remain the same as during Interim Operational Plan and ERTP-1. For all CSSS subpopulations the target is at least 60 consecutive days and preferably 80 or more consecutive days in most years during the nesting season from March 1 through July 15 with water levels at or below ground surface. For CSSS-A this equates to 60 days at or below 6.0 feet National Geodetic Vertical Datum (NGVD) at NP-205. In understanding this target, it is important to note that, due to topographic variation within the sparrow's habitat, available habitat at a higher elevation than the NP-205 reference point will remain dry for longer than habitat at the reference point elevation. Therefore this requirement, with current protective operations of S-12A/B, S-343, and S-344, should provide the 80 dry days required for completion of two successive broods over a larger percentage of habitat above 6.0 feet NGVD. At a stage elevation of 6.0 feet NGVD at NP-205, roughly 40 percent of the habitat is available for nesting by CSSS.

This requirement is less critical, though still important, in the eastern subpopulations (B, C, E, and F) because the habitat in these areas has been too dry in recent years and has become more susceptible to damaging human-induced and naturally occurring wildfires. It is anticipated that CEPP will greatly improve the habitat in these eastern populations due to the fact that a large proportion of current and new water from the project will be distributed to NESRS east of the L-67 extension. Subpopulation D, located to the east of Taylor Slough, has been maintained too wet in recent years due to its proximity to the C-111 Canal. The CERP Project, C-111 Spreader Canal, has implemented protective measures and habitat restoration actions for the benefit of this subpopulation.

Modeling

The Service recommends that the PDT not rely solely on modeling for CEPP. Values produced from modeling are not intended to be taken literally, but rather for observing trends and for making comparisons. All of the models being used in CEPP have a +/- 0.50 foot error along with inherent errors in data and topography. Best available science, best professional judgment, ecosystem observations from monitoring, and adaptive management should be the primary tools used to design and select the TSP as discussed in the PDT kick-off meeting.

It is the Service's understanding that early model runs, using preliminary performance measures and ecological targets, will be performed as a way to pre-screen alternatives. During this modeling process, the Service recommends making the model output of any screened-out scenarios available to the PDT members for their agency analyses to avoid any pre-decisional determinations. Current Everglades' performance measures and ecological targets, including those developed in the ERTP-1, should also be included as screening tools and in alternative model runs.

The Service also wants to point out that using NSM-4.6.2 targets for the entire Everglades may not be desirable. Models tend to work well in some areas of the project area and less in other areas. Some of these differences are due to current topographic information and mapping as well as resolution of the models. The CEPP planning and modeling cannot ignore micro-topography as it is extremely important to the species and their habitats.

Climate

The Service recommends that the CEPP PDT discuss and consider the current and predicted climate regimes that influence the rainfall patterns of the Florida Peninsula. Local, regional, and global regimes have important consequences for ecosystems, species, and habitats and should be a part of the planning process. Examples of regimes to be discussed are effects to land and sea breezes and tropical weather due to, but not limited to, the Atlantic Multi-Decadal Oscillation and the El Nino Southern Oscillation.

Climate Change

Climate change should also be a part of the active dialog in planning for Everglades restoration in determining the viability of recommended restoration targets and solutions with emphasis around the perimeter of the Greater Everglades. The Service recommends the use of "Addressing the Challenge of Climate Change in the Greater Everglades Landscape" research imitative that was recently completed by a group of researchers at the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (MIT) in coordination with the Service and U.S. Geological Survey. The study investigates possible trajectories of future landscape changes in and around the Greater Everglades landscape relative to four main drivers: climate change, shifts in planning approaches and regulations, population change, and variations in financial resources. This research identifies some of the major challenges to future conservation efforts and illustrates a planning method which can generate conservation strategies resilient to a variety of climatic and socioeconomic conditions (Vargas-Moreno and Flaxman 2011). CEPP needs to ensure that the theory and practice of restoration fits with the forecast of a changing environment (Harris et al. 2006). Sea level rise, especially, should be considered and planned for as it will likely affect structural operations, water management plans, ecology, and landscapes. We feel it is important to include the MIT scenarios in discussions and planning to insure we investigate the best methods to restore our resources.

In summary, the Service continues to support the strategy and vision for accomplishing this challenging but critical restoration project. We commend the Corps' sustained efforts to complete CEPP within the expedited schedule. We pledge our continuing support in planning of restoration projects to maximize opportunities and minimize potential adverse effects to the natural system. For assistance or if you have questions regarding the contents of this PAL, please contact Lori Miller or Kevin Palmer at 772-562-3909.

Sincerely yours,

Larry Williams

Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic copy only
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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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December 12, 2012

Eric Bush
Chief, Planning and Policy Division
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Dodd:

The U.S. Fish and Wildlife Service (Service) has prepared this third in a series of Planning Aid Letters (PAL) to assist in developing the Central Everglades Planning Project (CEPP), an expedited planning process to implement portions of the Comprehensive Everglades Restoration Plan (CERP) located in the central Everglades. This PAL is provided in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA) (48 Stat. 401; 16 U.S.C. 661 *et seq.*), and section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). This PAL does not constitute the report of the Secretary of Interior as required by section 2(b) of the FWCA, nor does it constitute a biological opinion under section 7 of the Act. The purpose of this PAL is to provide the U.S. Army Corps of Engineers (Corps) with recommendations regarding several aspects of the planning process including, but not limited to, management measure screening, alternative formulation, modeling strategy, and natural resource considerations.

Project Status

Since the last PAL was submitted on March 27, 2012, the interagency CEPP team has achieved several milestones including the completion of the 'screening phase' of alternative evaluation, brief introduction of the draft final array consisting of 5 alternatives, and several Internal Progress Review briefings of the vertical management teams of the Corps and South Florida Water Management District (District). The final step of the roughly 12-month long Execution phase, which started in late January 2012, will be an analysis of the final array of alternatives using the Regional Simulation Model (RSM) and RECOVER performance measures which will aid the team in selecting the Tentatively Selected Plan (TSP). The Project Implementation Report (PIR) will follow after the selection of the TSP. The focus of this letter will be on comments and recommendations regarding the conceptual design and modeling of the final array of alternatives. The Service understands that a 'hybird' alternative, or one in which contains the best components from several of the final alternatives, could be defined and selected as the TSP. It is unclear at this time if this alternative would then need a separate model run to satisfy the CERP Programmatic Regulations.

Draft Final Array of Alternatives

Background

For the past several months, the core planning team members, in conjunction with the project planning team (PDT) and participants of the Working Group-sponsored public workshops, have been analyzing screening level model output to determine which of the previously identified management measures should be retained and grouped into alternative scenarios (more detail regarding this process will be included in the Corps' PIR and Environmental Impact Statement). The latest of two tiers of screening level analyses allowed the group to reduce the number of draft alternative scenarios from 10 to 5 (Figures 1 – 5). All of these alternatives retain the same configuration above the redline but differ to varying degrees from the Hydropattern Restoration Feature (HRF) south through the green and blue lines and along the yellow line which represents the seepage management barrier along the urban boundary of the Everglades. The approach taken was to have a set of alternatives, composed of a wide array of management measures with three likely scenarios bound by "bookends" representing a minimum and maximum scenario. These alternatives will be simulated by the Regional Simulation Model (RSM) and evaluated using a set of REstoration COordination and VERification (RECOVER) performance measures. Scores from these metrics will be combined with estimated costs and entered into the Corps cost-benefit analysis to determine which of the alternatives are cost effective.

General Comments about the Alternatives

- All of the alternatives state that the A-2 Flow Equalization Basin (FEB) will be integrated with the FEB on A-1, which is now in the Future Without Project condition for CEPP; however, the operation of these basins is unclear at this time. Will the A-1 be used to collect up to 60,000 acre/feet of runoff from the Everglades Agricultural Area while the A-2 handles the 200,000 acre/feet of "new water" produced by CEPP?
- There are certain aspects about the project that have been shelved for decisions to be made at a later date. These include: conveyance capacity from Lake Okeechobee to the FEBs, operational plan for the entire project, L-6 diversion, eastern Hydropattern Restoration Feature (HRF), Miami Canal backfill method, planted spoil mound retention, L-28 cuts, C-11 Extension cuts, etc. It is unclear whether the RSM modeling of the final array will help us make these decisions.
- The Service suggests that an assumptions category be included for each alternative that would contain separable elements of the project such as retention of the Decompartmentalization Physical Model (DPM) Project and any modifications to the Tamiami Trail which the Department of Interior (DOI) would make under the Tamiami Trail Next Steps Project.
- There is no discussion of plugs in the L-67A Canal associated with the gated structures to help channel the flow into the pocket. Additionally, there is no discussion of cutoff walls to prevent short-circuiting of water down the pocket. The Service assumes that enough length of L-67 C canal and levee will be degraded to allow the water to flow into Water Conservation Area (WCA)-3B.

- The Service suggests that climate change scenarios be run on all of the alternatives instead of just the TSP.
- The Service is concerned about flow effects to Biscayne Bay under CEPP. Blue Line model sensitivity runs conducted in August 2012 indicated significant reduction in flows to the bay for several scenarios that are likely due to CEPP seepage management features. Total freshwater flow volumes currently entering Biscayne Bay are required for the protection of fish and wildlife resources in the bay, including threatened and endangered species. The Service believes that any CEPP alternative that causes reduction in flows to Biscayne Bay should be re-evaluated and potentially revised to maintain current or greater flows to the bay.
- The preliminary RECOVER analysis, of CEPPs effects on Lake Okeechobee, indicate that there is little difference between the FEB scenario and the existing condition base and future without project condition. However, the analysis does note that there may be times when higher stages impact the vegetation communities present in the lake. An adaptive management plan should be used to identify areas where CEPP can improve lake health in the future.

Specific Comments about the Alternatives

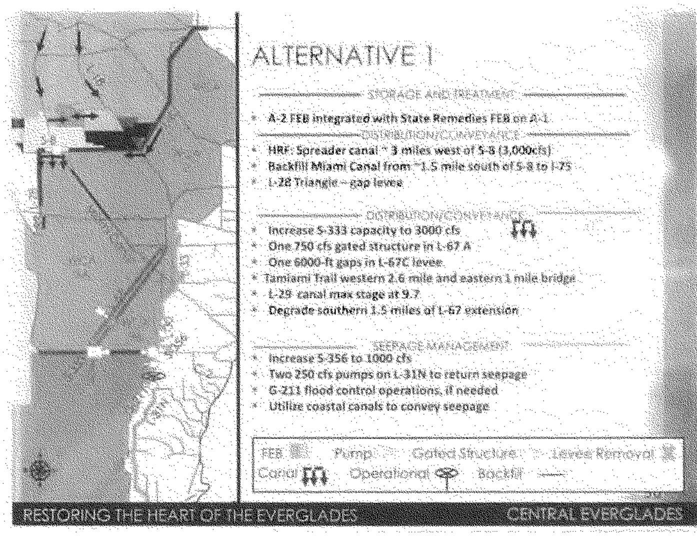

Figure 1. Alternative 1 of the Draft Final Array of alternatives for CEPP.

Alternative 1 was originally intended to be the minimal action plan or "bookend" and avoided any flow of water into WCA-3B. There is now a structure present on the L-67A and it is unclear if this is the retained DPM culvert or an additional culvert set. If we are planning to retain the

DPM structure, then this would be a cost savings for CEPP and it could possibly mean additional funding for monitoring of the DPM Project. The Service suggests that it should be listed as separate from the CEPP Project.

Additionally, it is not likely that one structure in the L-67A can provide enough flow into WCA-3B to alleviate concerns about the amount of time the WCA-3A regulation schedule would remain in Zone A. Although this alternative includes expansion of the S-333 structure capacity to 3,000 cubic feet per second (cfs), it is unclear at this time how this would be done and whether the hydraulic head in southern WCA-3A (under the lowered schedule implemented by the Everglades Restoration Transition Plan [ERTP]) would be sufficient to sustain 3,000-cfs flows.

The two 250-cfs pumps on the L-31N are not desirable as planned in this alternative. All other structures on the L-31 discharge into detention basins separate from the Everglades National Park (ENP) to reduce the likelihood of exotic fish transfer and to prevent impacts from poor quality water entering directly into the Park. Also, the location of the southern pump, which is currently sited directly north of and adjacent to the 8.5 Square Mile Area, would likely impact that projects ability to collect and remove seepage coming from Northeast Shark Slough (NESRS).

Finally, it is unclear how the benefit of degrading the lower 1.5-miles of the L-67 Extension will be evaluated. The Service does not recall data being generated by the iModel during the screening phase regarding partial degradation of the L-67 Extension. The Service recommends that this feature either be fully removed or left in place until future iterations of CEPP.

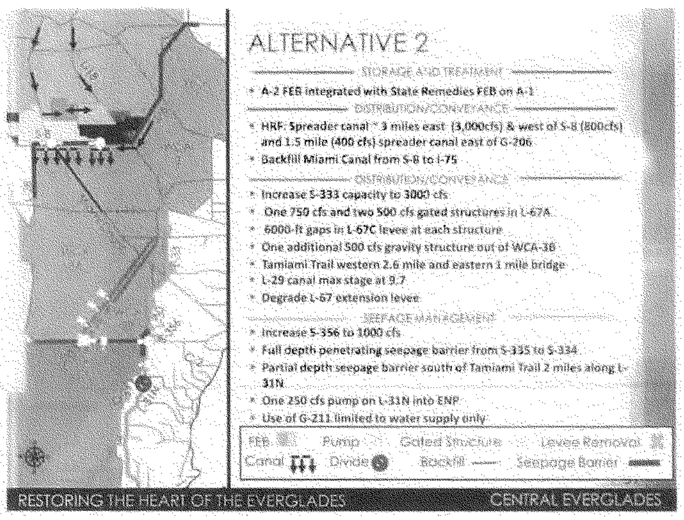

Figure 2. Alternative 2 of the Draft Final Array of alternatives for CEPP.

Alternative 2 is preferable to the Service at this point because it allows for a wider distribution of flows throughout the system while doing it in a passive manner. This alternative would allow rehydration of a majority of WCA-3B up to the newly defined stage at Site 71. Once this level is reached the structures on L-67A could be cycled off while discharge is increased at the S-333 with improved capacity. There is some uncertainty whether the one additional structure on the L-29, in conjunction with the existing S-355s, will match the inflows into WCA-3B. The RSM model output should be able to resolve this issue. An additional weir(s) may be necessary along the L-29 to ensure that new water added to WCA-3B can be discharged into the NESRS.

Degradation of the remaining portion of the L-67 Extension should benefit the spread of water at the downstream end of the S-12 structures. This would allow more water to move through the S-12 C and D and S-333 and help reduce the long hydroperiods currently observed in the western marl prairies.

Again, we believe direct discharge into ENP from L-31N is undesirable at this time, especially given that there is capacity in the South Dade Conveyance System and new Frog Pond detention areas associated with the C-111 Spreader Canal Project.

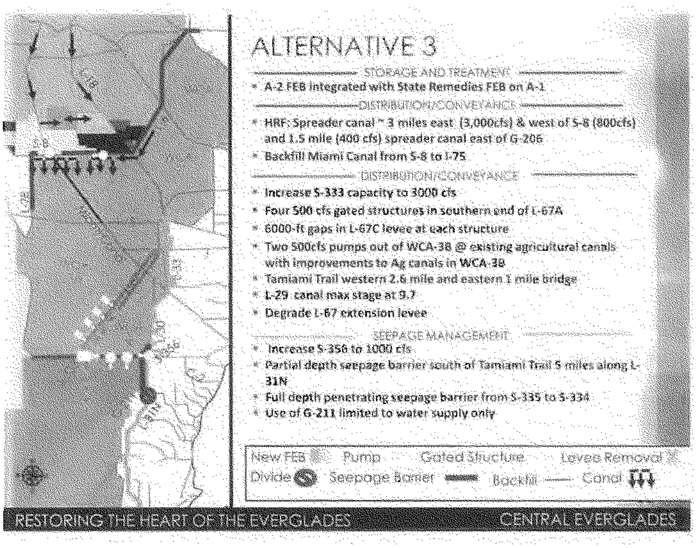

Figure 3. Alternative 3 of the Draft Final Array of alternatives for CEPP.

Should Alternative 2 not be able to move a sufficient amount of water from WCA-3A through WCA-3B passively (since this project is not providing additional storage of water in the North), then it may be necessary to utilize a temporary pump on the L-29 to facilitate the flow through

WCA-3B. Alternative 3 includes temporary pumps to move more water through WCA-3B, however, it seems to be slightly overbuilt for this increment of CEPP. The Service suggests removing one of the four structures on the L-67A and one of the temporary pumps on L-29. With the removal of those two features, this alternative would still move more water through WCA-3B than Alternative 2 but at less cost than currently conceptualized.

The Service would like to reiterate its desire to have the first increment of CEPP restore flow to as much of WCA-3B as possible and distribute flows east along a wide expanse of Tamiami Trail. We have recently been made aware by project managers that inclusion of pumps in this project is controversial. If a temporary pump on the L-29 means the difference between starting the restoration of WCA-3B at this time or delaying its restoration conceivably to a much later date, then a temporary pump seems desirable. A temporary pump on the L-29 would move clean water from WCA-3B into the NESRS of ENP.

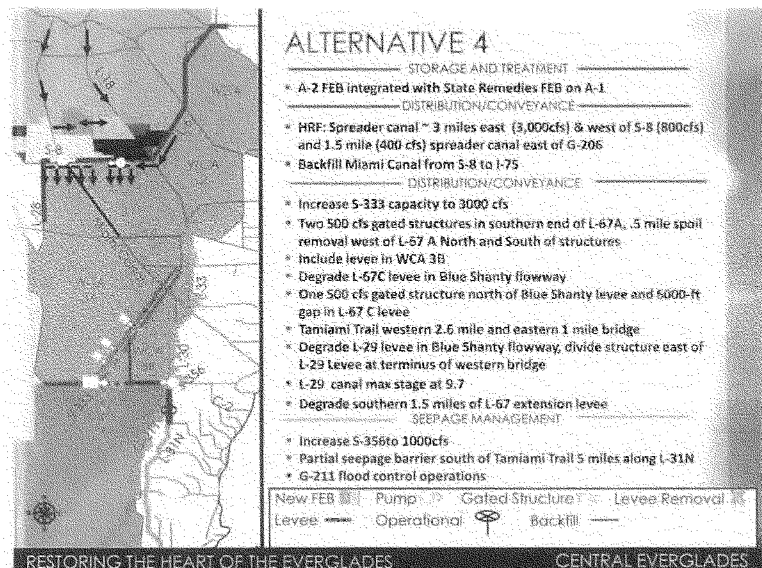

Figure 4. Alternative 4 of the Draft Final Array of alternatives for CEPP.

Alternative 4 is the "Blue Shanty Plan" and was originally designed to prevent high water from reaching the eastern portions of Tamiami Trail, in the event that DOI would not be able to modify the entire length of Tamiami Trail to accommodate higher water levels. This alternative originally included a temporary berm extending from L-67 A south to approximately 2 miles into ENP and a divide structure in the L-29 borrow canal. As the project progressed, we learned that DOI will, in fact, elevate the entire length of the Trail and that we should not consider it a constraint in CEPP. We also learned that the temporary berm would actually need to be a full-sized levee and that the National Park Service could not accept building a levee in a wilderness area.

The current conceptualization of this alternative retains the levee in WCA-3B and the divide structure in the L-29 in an effort to reduce the need for seepage management on the eastern side of WCA-3B. The Service does not feel that construction of a levee (roughly 20 acres of filled wetland) through WCA-3B and the resulting delay in shifting flows eastward through WCA-3B fits a first increment project like CEPP. If seepage management is needed in WCA-3B, in addition to the existing L-30/S-356 conveyance system and/or the Pensucco Wetlands, the Service feels that a seepage barrier along the already existing levee system would be the prudent choice.

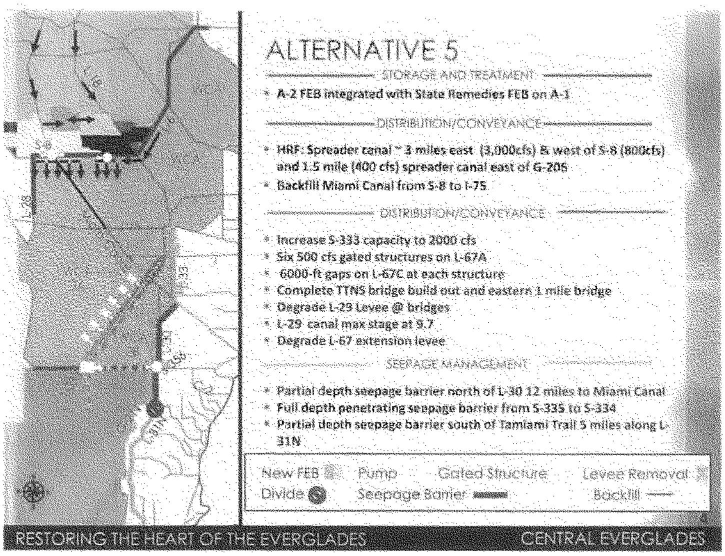

Figure 5. Alternative 5 of the Draft Final Array of alternatives for CEPP.

Although Alternative 5 contains some management measures that have the potential to move us closer to CERP-level restoration, it does not seem consistent with the scale of the other parts of the project. It is unlikely that enough flow could be provided in the dry season, without additional storage, to prevent WCA-3B from drying out in dry to average years if the entire L-29 is removed.

The Service believes this alternative should be removed at this time or modified to come more in line with the other alternatives. This would allow a potential hybrid plan to be included in the final array of alternatives.

Final Comments on CEPP Alternatives

The Service supports the Corps and District endeavors to model and analyze the proposed final array of alternatives. The Service is prepared to evaluate any and all data made available related to effects to threatened and endangered species, and all natural resources within the project area. We have a good idea of how these alternatives will perform from previous iModel results, and we believe Alternative 2 provides the most benefit to all areas of the system while still meeting the intent of an incremental project. We are concerned; however, that enough water will not be able to move through WCA-3B in this scenario which is why Alternative 3 with its temporary pump to facilitate the movement of water should be closely analyzed. We advocate, as we always have, a passive restoration system but understand the difficulty in flowing water across a degraded landscape that has lost much of its slough patterning and contains a high percentage of dense sawgrass. If, it is found through further modeling, a temporary pump could be utilized to effectively facilitate greater flow through WCA-3B into NESRS then the Service would support its temporary use. During the screening phase, plans that distributed water throughout WCA-3B, both with and without pumps, performed the best in the western marl prairies and WCA-3B while also providing substantial hydrologic lift in downstream areas of NESRS in ENP (Table 1). We look forward to receiving the first batch of RSM model output.

Table 1. The table below shows iModel screening output for the WCA-3B flow-through plans (Opt_3A1 – Opt_3B3) along with the target and base conditions. A1 and A2 scenarios do not include pumps while B2 and B3 do contain pumps which facilitate the movement of water from WCA-3B into NESRS (via L-29). Note that all plans make significant improvements above existing condition in NESRS (locations NE2 and P33). Plans with pumps improve hydroperiods in the western marl prairie (NP 205) over the existing conditions (ECB).

Hydroperiod							
Location	Target	ECB	FWO	Opt_3A1	Opt_3A2	Opt_3B2	Opt_3B3
				without pumps		with pumps	
NP205	58.14	73.53	74.04	79.37	78.95	67.54	66.00
Site71	99.53	93.36	91.16	97.01	97.10	99.02	96.73
NE2	99.53	87.75	87.28	99.67	99.86	99.77	100.00
P33	98.78	89.34	89.10	99.86	99.91	100.00	100.00
Average Water Depth							
NP205	-0.10	0.15	0.15	0.26	0.25	0.10	0.08
Site71	1.82	0.84	0.80	1.24	1.31	1.21	0.76
NE2	2.07	0.94	0.93	1.98	2.02	2.10	2.15
P33	2.05	0.96	0.96	1.57	1.62	1.65	1.65

Review of major points from previous PALs

- Reconnection of WCA-3B as a flow-through system connecting WCA-3A to ENP is the most critical part of restoration remaining to be planned. All options should be analyzed regarding how and to what extent this critical reconnection can be made.
- Relaxation of the G-3273 constraint, the integration of the S-356 pump station to control seepage in the L-30 and L-31N canals, and the expansion of S-333 structure to allow greater flow out of the ponded areas of WCA-3A into NESRS should be included in CEPP.
- Regulation schedules for WCAs 2 and 3B should be defined and the regulation schedule for WCA-3A should be refined.
- Further modification of the S-12s should not be considered as it was screened out in the recent ERTP for protection of the Cape Sable Seaside Sparrow (CSSS) (*Ammodramus maritimus mirabilis*). Once ERTP is authorized, the S-12C closure regime will be relaxed allowing for year-round operations.
- The general alternative formulation and evaluation process uses "upfront" modeling output whereby management measures are screened or combined into components which will then be screened out or combined to form the final array of alternatives. Relying on modeling products to choose alternative features for the final array of alternatives without regards to operations, adaptive management, and past experience could result in a plan with adverse impacts to the landscape and threatened and endangered species. The Service requests that we receive model output pertaining to threatened and endangered species throughout the planning process (including alternative screening, alternative formulation, operational plans, and adaptive management) so that we may help the team identify all possible means to reduce or eliminate impacts and ensure the TSP will help restore these imperiled species.
- It is critical for the PDT to begin discussing the "transition strategy" for how we will slowly introduce larger volumes of water into a system which has had its spatial extent reduced by 50 percent and its biological systems acclimated to reduced water flow.
- For the purposes of comparing modeled alternative runs it may be appropriate to use Natural System Model-based hydrologic targets; however, it should be understood that the first increment of CEPP will probably not meet these, and they may be inappropriate for use in some areas of the system.
- Use of the 2010 Multi-species Transition Strategy refined during ERTP-1 is highly recommended. A group of interagency scientists, in coordination with species experts, compiled the latest information regarding a number of species and defined a WCA-3A water management strategy. This science-based strategy was designed for Everglade snail kites (*Rostrhamus sociabilis plumbeus*), apple snails (*Pomacea paludosa*), wading birds, and vegetation found within WCA-3A and was based on the current hydrologic system. For CEPP, this strategy can be refined and other species and locations within the project area can be added.

- The Periodic Scientist Calls and seasonal scientist meetings should be utilized in CEPP. These meetings maintain a communication channel between regional water operators and interagency scientists responsible for managing the system for natural resources.
- The Service recommends that threatened and endangered species be considered regularly throughout the CEPP planning process, from screening, alternative formulation, water management plans, through adaptive management to ensure species protection while restoring the ecosystem.
- CSSS inhabit the relatively short hydroperiod marl marsh that flanks the Taylor and Shark River Sloughs in the ENP. Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 60 to 180 days is optimal for the plant species important for sparrow nesting and for maintenance of sparrow habitat. Recent observed average annual hydroperiods (since 2002 and implementation of Interim Operations Plan [IOP]) in subpopulation A (CSSS-A) as measured at NP-205 near the sparrow's core breeding habitat in western Shark Slough, have been in the range of 240 days or more. While the habitat occupied by sparrows can tolerate occasional average annual hydroperiods of 240 or more days this condition should not occur in concurrent years. Hydroperiods of 60 to 180 days should be experienced at the highest frequencies (*e.g.*, 7 out of 10 years) with occasional years ranging from 210 to 240 days. The opposite is true in the eastern subpopulations where hydroperiods are shorter resulting in higher threats of catastrophic fires and woody plant encroachment.
- Targets for CEPP alternative performance, with regards to sparrow nesting, in the vicinity of the six sparrow subpopulations (A-F) will remain the same as during IOP and ERTP-1. For all CSSS subpopulations the target is at least 60 consecutive days and preferably 80 or more consecutive days in most years during the nesting season from March 1 through July 15 with water levels at or below ground surface. For CSSS-A this equates to 60 days at or below 6.0 feet National Geodetic Vertical Datum (NGVD) at NP-205. In understanding this target, it is important to note that, due to topographic variation within the sparrow's habitat, available habitat at a higher elevation than the NP-205 reference point will remain dry for longer than habitat at the reference point elevation. Therefore this requirement, with current protective operations of S-12A/B, S-343, and S-344, should provide the 80 dry days required for completion of two successive broods over a larger percentage of habitat above 6.0 feet NGVD. At a stage elevation of 6.0 feet NGVD at NP-205, roughly 40 percent of the habitat is available for nesting by CSSS.
- The Service recommends that the PDT not rely solely on modeling for CEPP. Best available science, best professional judgment, ecosystem observations from monitoring, and adaptive management should be the primary tools used to design and select the TSP as discussed in the PDT kick-off meeting.
- The Service recommends making the model output of any screened-out scenarios available to the PDT members for their agency analyses to avoid any pre-decisional determinations. Current Everglades' performance measures and ecological targets, including those developed in the ERTP-1, should also be included as screening tools and in alternative model runs.

- The Service also wants to point out that using NSM-4.6.2 targets for the entire Everglades may not be desirable. The CEPP planning and modeling cannot ignore micro-topography as it is extremely important to the species and their habitats.
- The Service recommends that the CEPP PDT discuss and consider the current and predicted climate regimes that influence the rainfall patterns of the Florida Peninsula.
- Climate change should also be a part of the active dialog in planning for Everglades restoration in determining the viability of recommended restoration targets and solutions with emphasis around the perimeter of the Greater Everglades. Along with the Corps' climate change scenarios, the Service recommends the use of "Addressing the Challenge of Climate Change in the Greater Everglades Landscape" research initiative that was recently completed by a group of researchers at the Department of Urban Studies and Planning at the Massachusetts Institute of Technology (MIT) in coordination with the Service and U.S. Geological Survey. Sea level rise, especially, should be considered and planned for as it will likely affect structural operations, water management plans, ecology, and landscapes. We feel it is important to include the MIT scenarios in discussions and planning to insure we investigate the best methods to restore our resources.

In summary, the Service continues to support the strategy and vision for accomplishing this challenging but critical restoration project. We commend the Corps' sustained efforts to complete CEPP within the expedited schedule. We pledge our continuing support in planning of restoration projects to maximize opportunities and minimize potential adverse effects to the natural system. For assistance or if you have questions regarding the contents of this PAL, please contact Lori Miller or Kevin Palmer at 772-562-3909.

Sincerely yours,

For Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic copy only
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Corps, West Palm Beach, Florida (Kim Taplin)
DEP, Tallahassee, Florida (Ernie Marks)
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DOI, Miami, Florida (Shannon Estenoz)
ENP, Homestead, Florida (Bob Johnson, Carol Mitchell)
FWC, Tallahassee, Florida (Conservation Planning Services)
FWC, West Palm Beach, Florida (Chuck Collins, Barron Moody)
Service, Atlanta, Georgia (Dave Horning)
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APPENDIX B
Central Everglades Planning Project Biological Assessment

Modeling Assumptions for the Future Without Project, Existing Conditions 2012 Baseline, and Alternative 4R2

Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Basins (RSMBN) 2012 Existing Conditions (2012EC) Baseline Table of Assumptions

Note: RSMBN CEPP 2012EC (2/28/13) is identical to the RSMBN CEPP ECB (12/13/12)

Feature	
Climate	• The climatic period of record is from 1965 to 2005 • Rainfall estimates have been revised and updated for 1965-2005 • Revised evapotranspiration methods have been used for 1965-2005
Topography	The Topography dataset for RSM was Updated in 2009 using the following datasets: • South Florida Digital Elevation Model, USACE, 2004 • High Accuracy Elevation Data , US Geological Survey 2007 • Loxahatchee River LiDAR Study, Dewberry and Davis, 2004 • St. Lucie North Fork LiDAR, Dewberry and Davis, 2007 • Palm Beach County LiDAR Survey, Dewberry and Davis, 2004 • Stormwater Treatment Area stage-storage-area relationships based on G. Goforth spreadsheets.
Land Use	• Lake Okeechobee Service Area (LOSA) Basins were updated using consumptive use permit information as of 2/21/12, as reflected in the LOSA Ledger produced by the Water Use Bureau • C-43 Groundwater irrigated basins – Permitted as of 2010, the dataset was updated using land use, aerial imagery and 2010 consumptive use permit information • Dominant land use in EAA is sugar cane other land uses consist of shrub land, wet land, ridge and slough, and sawgrass
LOSA Basins	• Lower Istokpoga, North Lake Shore and Northeast Lake Shore demands and runoff estimated using the AFSIRS model and assumed permitted land use (see land use assumptions row).

Lake Okeechobee	• Lake Okeechobee Regulation Schedule 2008 (LORS 2008)
	  o Includes Lake Okeechobee regulatory releases to tide via L8/C51 canals
	  o Lake Okeechobee regulatory releases limited to 1,550 cfs for Miami Canal and 1,350 cfs for North New River Canal based on studies performed by USACE.
	  o A regional hydrologic surrogate for the 2010 Adaptive Protocol operations utilized. This attempts to mimic desired timing of releases without estimating salinity criteria
	• Lake Okeechobee Water Shortage Management (LOWSM) Plan
	• Interim Action Plan (IAP) for Lake Okeechobee (under which backpumping to the lake at S-2 and S-3 is to be minimized)
	• "Temporary" forward pumps as follows:
	  o S354 – 400 cfs
	  o S351 – 600 cfs
	  o S352 – 400 cfs

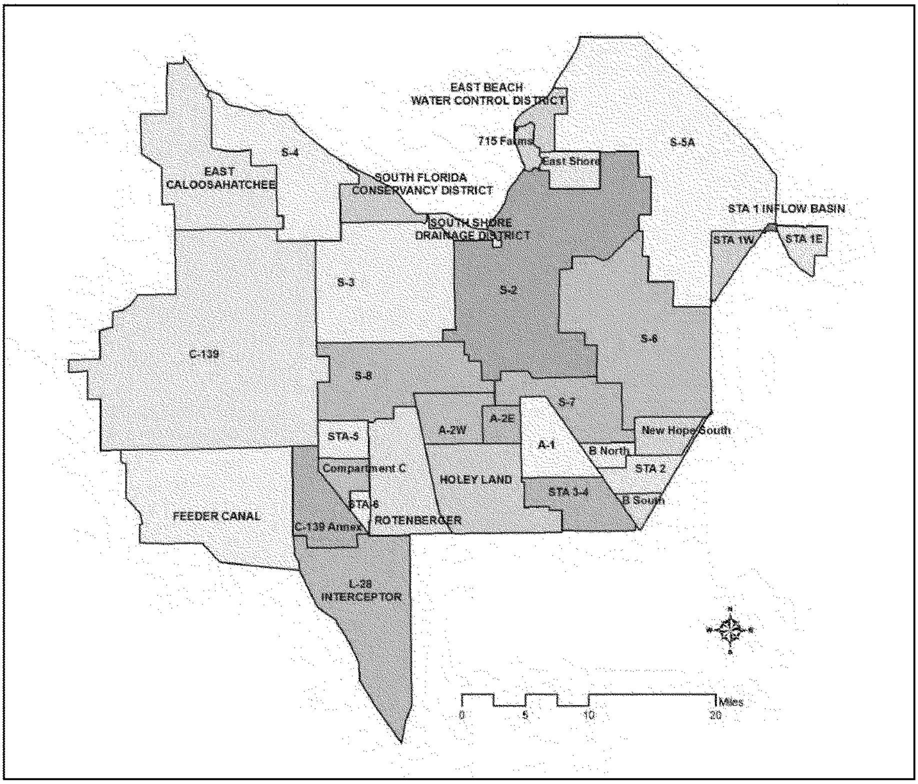
Feature	
	○ All pumps reduce to the above capacities when Lake Okeechobee stage falls below 10.2 ft and turn off when stages recover to greater than 11.2 ft. • No reduction in EAA runoff associated with the implementation of Best Management Practices (BMPs); No BMP makeup water deliveries to the WCAs • Operational intent is to treat LOK regulatory releases to the south through STA-3/4 • Backpumping of 298 Districts and 715 Farms into lake minimized
Northern Lake Okeechobee Watershed Inflows	• Kissimmee River inflows based on interim schedule for Kissimmee Chain of Lakes using the UKISS model • Restored reaches / pools of Kissimmee River as of 2010 • Fisheating Creek, Istokpoga & Taylor Creek / Nubbin Slough Basin Inflows calculated from historical runoff estimates.
Caloosahatchee River Basin	• Caloosahatchee River Basin irrigation demands and runoff estimated using the AFSIRS model and assumed permitted land use as of February 2012 (see land use assumptions row). • Public water supply daily intake from the river is included in the analysis.
St. Lucie Canal Basin	• St. Lucie Canal Basin demands estimated using the AFSIRS model and assumed permitted land use as of February 2012(see land use assumptions row). • Excess C-44 basin runoff is allowed to backflow into the Lake if the lake stage is 0.25 ft below the Zone D pulse release line. • Basin demands include the Florida Power & Light reservoir at Indiantown.
Seminole Brighton Reservation	• Brighton reservation demands were estimated using AFSIRS method based on existing planted acreage • The 2-in10 demand set forth in the Seminole Compact Work plan equals 2,262 MGM (million gallons per month). AFSIRS modeled 2-in-10 demands equaled 2,383 MGM • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per Table 7, Agreement 41-21 (Nov. 1992), tribal rights to these quantities are preserved • LOWSM applies to this agreement
Seminole Big Cypress Reservation	• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage • The 2-in-10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM • AFSIRS modeled 2-in-10 demands equaled 2,659 MGM • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District's Final Order and Tribe's Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved • LOWSM applies to this agreement

Feature	
Everglades Agricultural Area	• Model water-body components as shown in Figure 1 below. • Simulated runoff from the North New River – Hillsboro basin will be apportioned based on the relative size of contributing basins via S7 route vs. S6 route. • G-341 routes water from S-5A Basin to Hillsboro Basin • EAA runoff and irrigation demand compared to SFWMM (ECB) simulated runoff and demand from 1965-2005 for reasonability • Compartment C land in the Miami Canal Basin between STA-5 and STA-6 is not considered to be in production (shrub Land Use). Then, no irrigation demands are required in this area. • Compartment B (excluding cell 4) land in the North New River/Hillsboro is not considered to be in production (shrub Land Use). Then, no irrigation demands are required in this area.

Stormwater Treatment Areas	• STAs are simulated as single waterbodies
	• STA-1E: 6,546 acres total area
	• STA-1W: 7,488 acres total area
	• S-5A Basin runoff is to be treated in STA-1W first and when conveyance capacities are exceeded, rerouted to STA-1E
	• STA-2: includes first four cells: 9,910 acres total area
	• STA-3/4: 17,126 acres total area
	• STA-5: includes first 3 cells: 7,619 acres total area
	• STA-6: 2,486 acres total area
	• Assumed operations of STAs:
	  o 0.5 ft minimum depth below which supply from external sources is triggered
	  o 4 ft maximum depth above which inflows are discontinued
	• STA-3/4 receives Lake Okeechobee regulatory releases approximately at 60,000 acre-feet annual average for the entire period of record.

Holey Land Wildlife Management Area	• G-372HL is the only inflow structure for Holey Land used for environmental purposes only • Operations are similar to the existing condition as in the 1995 base simulation for the Lower East Coast Regional Water Supply Plan (LECRWSP, May 2000), as per the memorandum of agreement between the FWC and the SFWMD
Rotenberger Wildlife Management Area	• Operational Schedule as defined in the Operation Plan for Rotenberger WMA (SFWMD, March 2010)
Public Water Supply and Irrigation	• Regional water supply demands to maintain Lower East Coast canals as simulated from RSMGL ECB.
Western Basins	• C139 RSM basin is being modeled. Period is 1965-2005. • C139 basin runoff is modeled as follows: G136 flows is routed to Miami Canal; G342A-D flows routed to STA5; G406 flows routed to STA6 • C139 basin demand is met primarily by local groundwater

Feature	
Water Shortage Rules	• Reflects the existing water shortage policies as in South Florida Water Management District Chapters 40E-21 and 40E-22, FAC, including Lake Okeechobee Water Shortage Management (LOWSM) Plan.



Water-Body Components:
Miami Water-Body = S3 + S8 + A-2W --
NNR/HILLS Water-Body = S2 + S6 + S7 + A-2E + B North
+ B South + New Hope South
WPB Water-Body = S-5A

Fig. 1 RSMBSN Basin Definition within the EAA: 2012 Existing Conditions Simulation

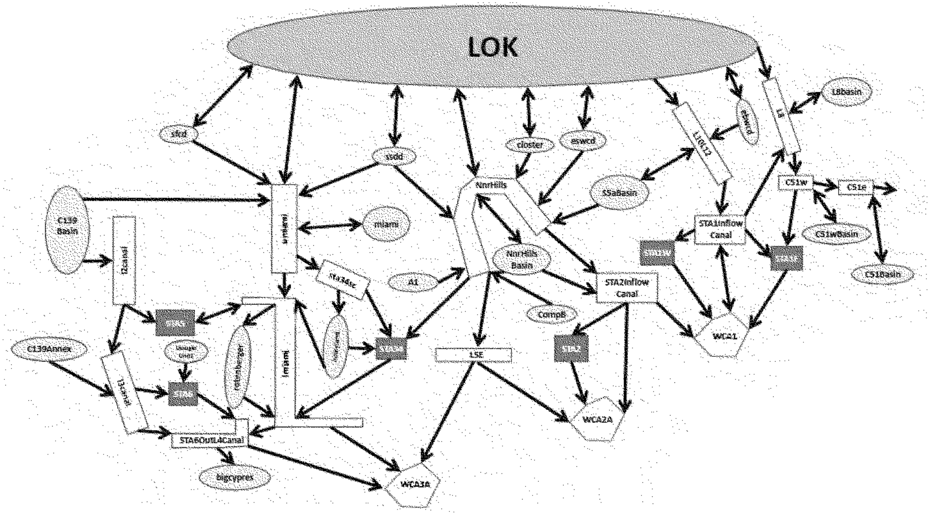


Fig. 2 RSMBSN Link-Node Routing Diagram: 2012 Existing Conditions Simulation

Notes:

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).
- The boundary conditions along the eastern and southern boundaries of the RSMBN model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Glades-LECSA Model (RSMGL). The SFWMM was the source of the eastern boundary groundwater/surface water flows, while the RSMGL was the source of the southern boundary structural flows.
- 2012EC assumptions were updated from the CEPP 12/13/2012 ECB scenario at the time that the CEPP tentatively selected plan was identified.

Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Glades-LECSA (RSMGL) 2012 Existing Conditions (2012EC) Table of Assumptions

Feature	
Meteorological Data	• Rainfall file used: rain_v3.0_beta_tin_14_05.bin • Reference Evapotranspiration (RET) file used: RET_48_05_MULTIQUAD_v1.0.bin (ARCADIS, 2008)
Topography	• Same as calibration topographic data set except where reservoirs are introduced (STA1-E, C4 Impoundment and C-111 reservoirs). • United States Geological Survey (USGS) High-Accuracy Elevation Data Collection (HAEDC) for the Water Conservation Areas (1, 2A, 2B, 3A, and 3B), the Big Cypress National Preserve and Everglades National Park.
Tidal Data	• Tidal data from two primary (Naples and Virginia Key) and five secondary NOAA stations (Flamingo, Everglades, Palm Beach, Delray Beach and Hollywood Beach) were used to generate a historic record to be used as sea level boundary conditions for the entire simulation period.
Land Use and Land Cover	• Land Use and Land Cover Classification for the Lower East Coast urban areas (east of the Lower East Coast Flood Protection Levee) use 2008-2009 Land Use coverage as prepared by the SFWMD, consumptive use permits as of 2011 were used to update the land use in areas where it did not reflect the permit information. • Land Use and Land Cover Classification for the natural areas (west of the Lower East Coast Flood Protection Levee) is the same as the Calibration Land Use and Land Cover Classification for that area. • Modified at locations where reservoirs are introduced (STA1-E, C4 Impoundment, Lakebelt Lakes and C-111 Reservoirs).
Water Control Districts (WCDs)	• Water Control Districts in Palm Beach and Broward Counties and in the Western Basins assumed.
Lake Belt Lakes	• Based on 2005 Lake Belt Lake coverage obtained from USACE.
Water Conservation Area 1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge)	• Current C&SF Regulation Schedule. Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 14 ft. The bottom floor of the schedule (Zone C) is the area below 14 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow. • Structure S10E connecting LNWR to the northeastern portion of WCA-2A is no longer considered part of the simulated regional System

Feature	
Water Conservation Area 2A & 2B	• Current C&SF regulation schedule. Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow.
Water Conservation Area 3A & 3B	• Everglades Restoration Transition Plan (ERTP) regulation schedule for WCA-3A, as per SFWMM modeled alternative 9E1 (USACE, 2012). • Includes regulatory releases to tide through LEC canals. Documented in Water Control Plan (USACE, June 2006) • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 7.5 ft in WCA-3A. Any water supply releases below the floor will be matched by an equivalent volume of inflow.
Everglades Construction Project Stormwater Treatment Areas	• STA-1E: 5,132 acres total treatment area. • A uniform bottom elevation equal to the spatial average over the extent of STA-1E is assumed.
Everglades National Park	• Water deliveries to Everglades National Park are based upon Everglades Restoration Transition Plan (ERTP), with the WCA-3A Regulation Schedule including the lowered Zone A (compared to IOP) and extended Zones D and E1. • L-29 stage constraint for operation of S-333 assumed to be 7.5 ft, NGVD. • G-3273 constraint for operation of S-333 assumed to be 6.8 ft, NGVD. • Tamiami Trail culverts east of the L67 Extension are simulated. • 5.5 miles remain of the L-67 Extension Levee. • S-355A & S-355B are operated. • S-356 is not operated. • Partial construction of C-111 project reservoirs consistent with the 2009 as-built information from USACE (does not include contract 8 or contract 9). A uniform bottom elevation equal to the spatial average over the extent of each reservoir is assumed. • S-332DX1 is not operated. • 8.5 SMA project feature as per federally authorized Alternative 6D of the MWD/8.5 SMA Project (USACE, 2000 GRR); operations per 2011 Interim Operating Criteria (USACE, June 2011) including S-331 trigger shifted from Angel's well to LPG-2.
Other Natural Areas	• Flows to Biscayne Bay are simulated through Snake Creek, North Bay, the Miami River, Central Bay and South Bay

Feature	
Pumpage and Irrigation	• Public Water Supply pumpage for the Lower East Coast was updated using 2010 consumptive use permit information as documented in the C-51 Reservoir Feasibility Study; permits under 0.1 MGD were not included • Residential Self Supported (RSS) pumpage are based on 2030 projections from the SFWMD Water Supply Bureau. • Industrial pumpage are based on 2030 projections from the SFWMD Water Supply Bureau. • Irrigation demands for the six irrigation land-use types are calculated internally by the model. • Seminole Hollywood Reservation demands are set forth under VI. C of the Tribal Rights Compact. Tribal sources of water supply include various bulk sale agreements with municipal service suppliers.

Canal Operations	• C&SF system and operating rules in effect in 2012
	• Includes operations to meet control elevations in the primary coastal canals for the prevention of saltwater intrusion
	• Includes existing secondary drainage/water supply system
	• C-4 Flood Mitigation Project
	• Western C-4, S-380 structure retained open
	• C-11 Water Quality Treatment Critical Project (S-381 and S-9A).
	  ○ S9/S9A operations modified for performance consistency with SFWMM ECB.
	• S-25B and S-26 pumps are not modeled since they are used very rarely during high tide conditions and the model uses a long-term average daily tidal boundary
	• Northwest Dade Lake Belt area assumes that the conditions caused by currently permitted mining exist and that the effects of any future mining are fully mitigated by industry
	• ACME Basin A flood control discharges are sent to C-51, west of the S-155A structure, to be pumped into STA-1E. ACME Basin B flood control discharges are sent to STA-1E through the S-319 structure
	• Releases from WCA-3A to ENP and the South Dade Conveyance System (SDCS) will follow the Everglades Restoration Transition Plan (ERTP) regulation schedule for WCA-3A, as per SFWMM modeled alternative 9E1
	  ○ Structures S-343A, S-343B, S-344 and S-12A are closed Nov. 1 to July 15
	  ○ Structure S-12B is closed Jan. 1 to July 15
	• South Dade Conveyance System operations will follow ERTP for protection of the Cape Sable seaside sparrow

Canal Configuration	• Canal configuration same as calibration except only 5.5 miles remain of the L-67 Extension Canal.
Lower East Coast Service Area Water Shortage Management	• Lower east coast water restriction zones and trigger cell locations are equivalent to SFWMM ECB implementation. An attempt was made to tie trigger cells with associated groundwater level gages to the extent possible. The Lower East Coast Subregional (LECsR) model is the source of this data.

Feature	
	• Periods where the Lower East Coast is under water restriction due to low Lake Okeechobee stages were extracted from the corresponding RSMBN ECB simulation.

Notes

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).
- The boundary conditions along the northern boundary of the RSMGL model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Basins Model (RSMBN). The SFWMM was the source of the northern boundary groundwater/surface water flows, while the RSMBN was the source of the northern boundary structural flows.
- 2012EC assumptions were updated from the CEPP 12/13/2012 ECB scenario at the time that the CEPP tentatively selected plan was identified.

Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Basins (RSMBN) 2050 Future Without Project Baseline (FWO) Table of Assumptions

Feature	
Climate	• The climatic period of record is from 1965 to 2005 • Rainfall estimates have been revised and updated for 1965-2005 • Revised evapotranspiration methods have been used for 1965-2005
Topography	The Topography dataset for RSM was Updated in 2009 using the following datasets: • South Florida Digital Elevation Model, USACE, 2004 • High Accuracy Elevation Data , US Geological Survey 2007 • Loxahatchee River LiDAR Study, Dewberry and Davis, 2004 • St. Lucie North Fork LiDAR, Dewberry and Davis, 2007 • Palm Beach County LiDAR Survey, Dewberry and Davis, 2004 • Stormwater Treatment Area stage-storage-area relationships based on G. Goforth spreadsheets.
Land Use	• Lake Okeechobee Service Area (LOSA) Basins were updated using consumptive use permit information as of 2/21/2012, as reflected in the LOSA Ledger produced by the Water Use Bureau. • C-43 Groundwater irrigated basins - Permitted as of 2010, the dataset was updated using land use, aerial imagery and 2010 consumptive use permit information • Dominant land use in EAA is sugar cane other land uses consist of shrub land, wet land, ridge and slough, and sawgrass
LOSA Basins	• Lower Istokpoga, North Lake Shore and Northeast Lake Shore demands and runoff estimated using the AFSIRS model and assumed permitted land use (see land use assumptions row).

Lake Okeechobee	• Lake Okeechobee Regulation Schedule 2008 (LORS 2008)
	  o Includes Lake Okeechobee regulatory releases to tide via L8/C51 canals
	  o Lake Okeechobee regulatory releases limited to 1,550 cfs for Miami Canal and 1,350 cfs for North New River Canal based on studies performed by USACE.
	  o Releases via S-77 can be diverted into C43 Reservoir
	• No Lake Okeechobee environmental releases.
	• Lake Okeechobee Water Shortage Management (LOWSM) Plan
	• Interim Action Plan (IAP) for Lake Okeechobee (under which backpumping to the lake at S-2 and s-3 is to be minimized)
	• "Temporary" forward pumps as follows:
	  o S354 - 400 cfs
	  o S351 - 600 cfs
	  o S352 - 400 cfs
	  o All pumps reduce to the above capacities when Lake Okeechobee stage falls below 10.2 ft and turn off when stages

Feature	
	recover to greater than 11.2 ft. • No reduction in EAA runoff associated with the implementation of Best Management Practices (BMPs); No BMP makeup water deliveries to the WCAs • Operational intent is to treat LOK regulatory releases to the south through STA-3/4 • Backpumping of 298 Districts and 715 Farms into lake minimized
Northern Lake Okeechobee Watershed Inflows	• Headwaters Revitalization schedule for Kissimmee Chain of Lakes using the UKISS model • Kissimmee River Restoration complete. • Fisheating Creek, Istokpoga & Taylor Creek / Nubbin Slough Basin Inflows calculated from historical runoff estimates.
Caloosahatchee River Basin	• Caloosahatchee River Basin irrigation demands and runoff estimated using the AFSIRS model and assumed permitted land use as of February 2012. (see land use assumptions row) • Public water supply daily intake from the river is included in the analysis. • Maximum reservoir height of 41.7 ft NGVD with a 9,379-acre footprint in Western C43 basin with a 175,800 acre-feet effective storage. • Proposed reservoir meets estuary demands while C-43 basin supplemental demands for surface water irrigation are met by Lake Okeechobee.

St. Lucie Canal Basin	• St. Lucie Canal Basin demands estimated using the AFSIRS model and assumed permitted land use as of February 2012(see land use assumptions row).
	• Excess C-44 basin runoff is allowed to backflow into the Lake if lake stage is 0.25 ft. below the Zone D pulse release line before being pumped into the C-44 reservoir.
	• Basin demands include the Florida Power & Light reservoir at Indiantown.
	• Indian River Lagoon South Project features
	  • Ten-mile Creek Reservoir and STA: 7,078 acre-feet storage capacity at 10.79 maximum depth on 820 acre footprint; receives excess water from North Folk Basin
	  • C-44 reservoir: 50,246 acre-feet storage capacity at 5.18 feet maximum depth on 12,125 acre footprint
	  • C-23/C-24 reservoir: 92,094 acre-feet storage capacity at 13.27 maximum depth on 8,675 acre footprint
	  • C-23/C-24 STA: 3,852 acre-feet storage capacity at 1.5 maximum depth on 2,568 acre footprint
	  • All proposed reservoirs meet estuary demands

Seminole Brighton Reservation	• Brighton reservation demands were estimated using AFSIRS method based on existing planted acreage. • The 2-in-10 demand set forth in the Seminole Compact Work plan equals 2,262 MGM (million gallons/month). AFSIRS modeled 2-in-10 demands equaled 2,383 MGM • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per Table 7, Agreement 41-21 (Nov. 1992), tribal

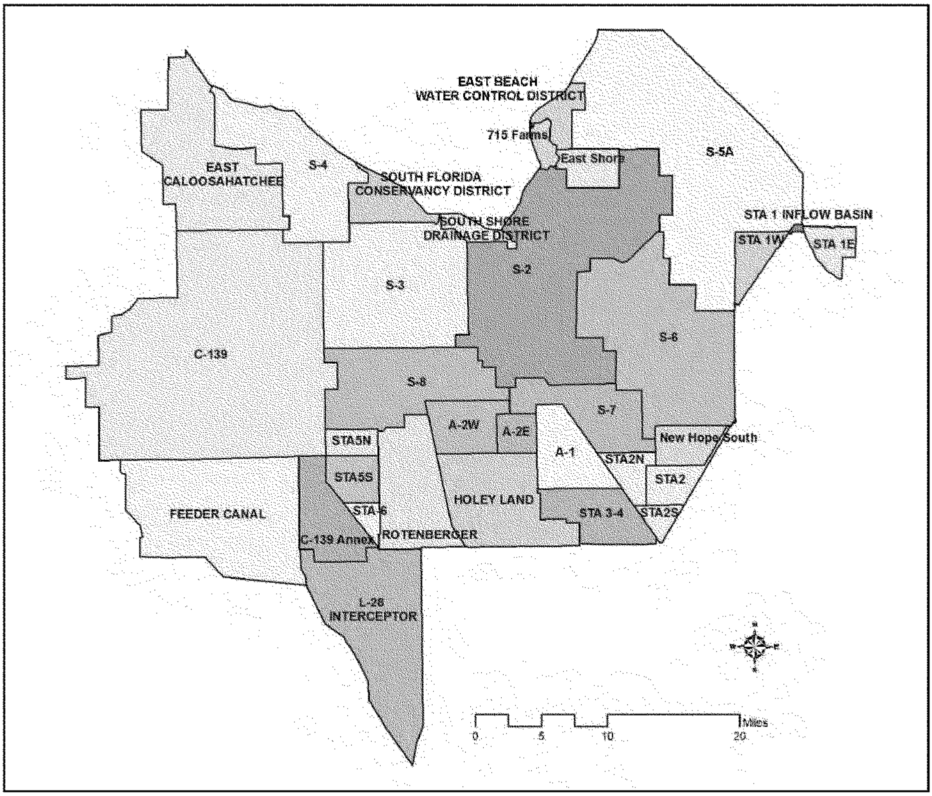
Feature	
	rights to these quantities are preserved • LOWSM applies to this agreement
Seminole Big Cypress Reservation	• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage • The 2-in-10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM • AFSIRS modeled 2-in-10 demands equaled 2,659 MGM • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District's Final Order and Tribe's Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved • LOWSM applies to this agreement
Everglades Agricultural Area	• Model water-body components as shown in Figure 1. • Simulated runoff from the North New River – Hillsboro basin apportioned based on the relative size of contributing basins via S7 route vs. S6 route. • G-341 routes water from S-5A Basin to Hillsboro Basin. • RSMBN ECB EAA runoff and irrigation demand compared to SFWMM ECB simulated runoff and demand from 1965-2005 for reasonability.

Everglades Construction Project Stormwater Treatment Areas	• STAs are simulated as single waterbodies
	• STA-1E: 6,546 acres total area
	• STA-1W: 7,488 acres total area
	• S-5A Basin runoff is to be treated in STA-1W first and when conveyance capacities are exceeded, rerouted to STA-1E
	• STA-2: cells 1,2 & 3: 7,681 acres total area
	• STA-2N: cells 4,5 & 6; refers to Comp B-North; 6,531 acres total area
	• STA-2S: cells 7 & 8; refers to Comp B-South; 3,570 acres total area
	• STA-3/4: 17,126 acres total area
	• STA-5N: includes cells 1 & 2: 5,081 acres total area
	• STA-5S: includes cells 3, 4 & 5; uses footprint of Compartment C: 8,469 acres total area
	• STA-6: expanded with phase 2: 3,054 acres total area
	• Assumed operations of STAs:
	  • 0.5 ft minimum depth below which supply from external sources is triggered
	  • 4 ft maximum depth above which inflows are discontinued
	  • Inflow targets established for STA-3/4, STA-2N and STA-2S based on DMSTA simulation; met from local basin runoff, LOK regulatory discharge and available A1FEB storage.
	  • STA-3/4 receives Lake Okeechobee regulation target releases approximately at 60,000 acre-feet annual average for the entire

Feature	

	period of record.
	• A 15,853-acre Flow Equalization Basin (FEB) located north of STA-3/4.
	• Assumed operations of A1FEB:
	  • FEB inflows are from excess EAA basin runoff above the established inflow targets at STA-3/4, STA-2N, and STA-2S, and from LOK flood releases south
	  • FEB outflows are used to help meet established inflow targets (as estimated using the Dynamic Model for Stormwater Treatment Areas) at STA-3/4, STA-2N, and STA-2S if EAA basin runoff and LOK regulatory discharge are not sufficient.
	  • 0.5 ft minimum depth below which no releases are allowed
	  • 3.8 ft maximum depth above which inflows are discontinued
	  • Assumed inlet pump from STA-3/4 supply canal with capacity equal to combined capacity of G-372 and G-370 structures.
	  • Outflow weirs, with similar discharge characteristics as STA-3/4 outlet structure, discharging into lower North New River canal.

Holey Land Wildlife Management Area	• G-372HL is the only inflow structure for Holey Land used for environmental purposes only • Operations are similar to the existing condition as in the 1995 base simulation for the Lower East Coast Regional Water Supply Plan (LECRWSP, May 2000), as per the memorandum of agreement between the FWC and the SFWMD
Rotenberger Wildlife Management Area	• Operational Schedule as defined in the Operation Plan for Rotenberger WMA (SFWMD, March 2010)
Public Water Supply and Irrigation	• Regional water supply demands to maintain Lower East Coast canals as simulated from RSMGL FWO.
Western Basins	• C139 RSM basin is being modeled. Period is 1965-2005. • C139 basin runoff is modeled as follows: G136 flows is routed to Miami Canal; G342A-D flows routed to STA5N; G508 flows routed to STA5S; G406 flows routed to STA6C139 basin demand is met primarily by local groundwater
Water Shortage Rules	• Reflects the existing water shortage policies as in South Florida Water Management District Chapters 40E-21 and 40E-22, FAC, including Lake Okeechobee Water Shortage Management (LOWSM) Plan



Water-Body Components:
Miami Water-Body = S3 + S8
NNR/HILLS Water-Body = S2 + S6 + S7 + A-2E + New Hope South
WPB Water-Body = S-5A
A1FEB = A-1

Fig. 1 RSMBSN Basin Definition within the EAA: Future Without Project Baseline Simulation

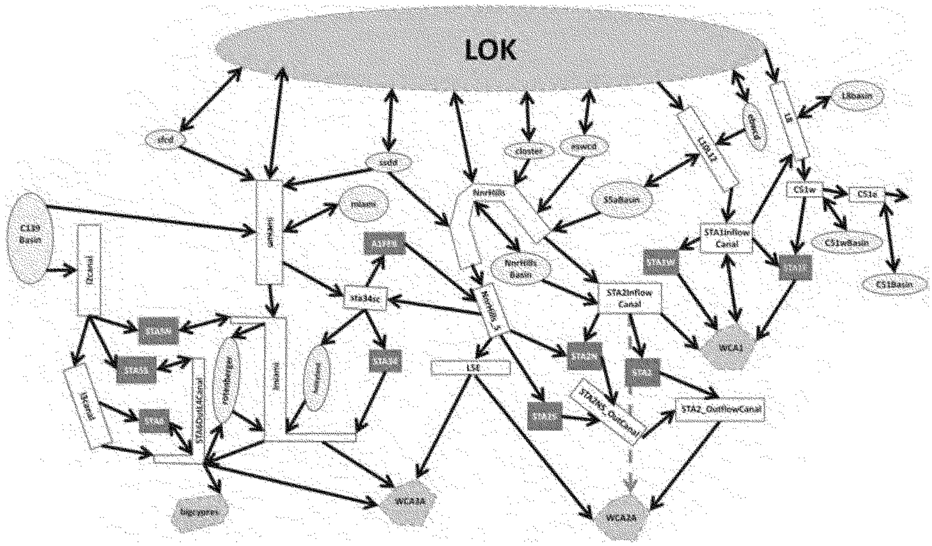


Fig. 2 RSMBSN Link-Node Routing Diagram: Future Without Project Baseline Simulation

Note:

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Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Glades-LECSA (RSMGL) 2050 Future Without Project Baseline (FWO) Table of Assumptions

Feature	
Meteorological Data	• Rainfall file used: rain_v3.0_beta_tin_14_05.bin • Reference Evapotranspiration (RET) file used: RET_48_05_MULTIQUAD_v1.0.bin (ARCADIS, 2008)
Topography	• Same as calibration topographic data set except where reservoirs are introduced (STA1-E, C4 Impoundment and C-111 reservoirs). • United States Geological Survey (USGS) High-Accuracy Elevation Data Collection (HAEDC) for the Water Conservation Areas (1, 2A, 2B, 3A, and 3B), the Big Cypress National Preserve and Everglades National Park.
Tidal Data	• Tidal data from two primary (Naples and Virginia Key) and five secondary NOAA stations (Flamingo, Everglades, Palm Beach, Delray Beach and Hollywood Beach) were used to generate a historic record to be used as sea level boundary conditions for the entire simulation period.
Land Use and Land Cover	• Land Use and Land Cover Classification for the Lower East Coast urban areas (east of the Lower East Coast Flood Protection Levee) use 2008-2009 Land Use coverage as prepared by the SFWMD, consumptive use permits as of 2011 were used to update the land use in areas where it did not reflect the permit information. • Land Use and Land Cover Classification for the natural areas (west of the Lower East Coast Flood Protection Levee) is the same as the Calibration Land Use and Land Cover Classification for that area. • Modified at locations where reservoirs are introduced (STA1-E, Site 1 Impoundment, Broward WPAs, C4 Impoundment, Lakebelt Lakes and C-111 Reservoirs).
Water Control Districts (WCDs)	• Water Control Districts in Palm Beach and Broward Counties and in the Western Basins assumed. • 8.5 SMA seepage canal is modeled as a WCD in ENP area.
Lake Belt Lakes	• Based on the permitted 2020 Lake Belt Lakes coverage obtained from USACE.
CERP Projects	• 1st Generation CERP – Site 1 Impoundment project is modeled as an above ground reservoir of area 1600 acres, with a maximum depth of 8 ft. • 2nd Generation CERP – Broward County Water Preserve Areas (WPAs) comprised of C-11 and C-9 impoundments were modeled as above ground reservoirs with areas 1221 and 1971 acres and maximum depths 4.3 and 4.0 ft. respectively.

Feature	
	• 2nd Generation CERP – C-111 Spreader Canal Project includes the Frog Pond Detention Area, which is modeled as an above ground impoundment with the S200 A, B and C pumps as inflow structures. In addition, the Aerojet canal is modeled with the inflow pumps S199 A, B and C. The S199 and S200 pumps are turned off based on the stage at the remote monitoring location EVER4 for the protection of the CSS Critical Habitat Unit 3. • 2nd Generation CERP – Biscayne Bay Coastal Wetlands project features were not modeled since these features along the coast in Miami-Dade County were not considered significant for CEPP. • Areal corrections were applied to the impoundment storages to account for the discrepancies of the areas in the model of the impoundments not matching the design areas.
Water Conservation Area 1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge)	• Current C&SF Regulation Schedule. Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 14 ft. The bottom floor of the schedule (Zone C) is the area below 14 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow. • Structure S10E connecting LNWR to the northeastern portion of WCA-2A is no longer considered part of the simulated regional System
Water Conservation Area 2A & 2B	• Current C&SF regulation schedule. Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels in WCA-2A are less than minimum operating criteria of 10.5 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow.
Water Conservation Area 3A & 3B	• Everglades Restoration Transition Plan (ERTP) regulation schedule for WCA-3A, as per SFWMM modeled alternative 9E1 (USACE, 2012) • Includes regulatory releases to tide through LEC canals. Documented in Water Control Plan (USACE, June 2002) • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 7.5 ft in WCA-3A. Any water supply releases below the floor will be matched by an equivalent volume of inflow.
Everglades Construction Project Stormwater Treatment Areas	• STA-1E: 5,132 acres total treatment area. • A uniform bottom elevation equal to the spatial average over the extent of STA-1E is assumed.

Feature	
Everglades National Park	• Water deliveries to Everglades National Park are based upon Everglades Restoration Transition Plan (ERTP), with the WCA-3A Regulation Schedule including the lowered Zone A (compared to IOP) and extended Zones D and E1. • L-29 stage constraint for operation of S-333 assumed to be 7.5 ft, NGVD. • G-3273 constraint for operation of S-333 assumed to be 6.8 ft, NGVD. • The one mile Tamiami Trail Bridge as per the 2008 Tamiami Trail Limited Reevaluation Report is modeled as a one mile weir. Located east of the L67 extension and west of the S334 structure. • Tamiami Trail culverts east of the L67 Extension are simulated where the bridge is not located. • 5.5 miles remain of the L-67 Extension Levee. • S-355A & S-355B are operated. • S-356 is not operated. • Full construction of C-111 project reservoirs consistent with the as-built information from USACE plus addition of contract 8 and contract 9 features. A uniform bottom elevation equal to the spatial average over the extent of each reservoir is assumed. • 8.5 SMA project feature as per federally authorized Alternative 6D of the MWD/8.5 SMA Project (USACE, 2000 GRR); operations per 2011 Interim Operating Criteria (USACE, June 2011) including S-331 trigger shifted from Angel's well to LPG-2. Outflow assumed from 8.5 SMA detention cell to the C-111 North Detention Area.
Other Natural Areas	• Flows to Biscayne Bay are simulated through Snake Creek, North Bay, the Miami River, Central Bay and South Bay
Pumpage and Irrigation	• Public Water Supply pumpage for the Lower East Coast was updated using 2010 consumptive use permit information as documented in the C-51 Reservoir Feasibility Study; permits under 0.1 MGD were not included • Residential Self Supported (RSS) pumpage are based on 2010 projections of residential population from the SFWMD Water Supply Bureau. • Industrial pumpage is based on 2010 permits. • Irrigation demands for the six irrigation land-use types are calculated internally by the model. • Seminole Hollywood Reservation demands are set forth under VI. C of the Tribal Rights Compact. Tribal sources of water supply include various bulk sale agreements with municipal service suppliers.
Canal Operations	• C&SF system and operating rules in effect in 2010 • Includes operations to meet control elevations in the primary coastal canals for the prevention of saltwater intrusion • Includes existing secondary drainage/water supply system • C-4 Flood Mitigation Project • Western C-4, S-380 structure retained open

Feature	

	• C-11 Water Quality Treatment Critical Project (S-381 and S-9A)
	• S-25B and S-26 backflow pumps are not modeled since they are used very rarely during high tide conditions and the model uses a long-term average daily tidal boundary
	• Northwest Dade Lake Belt area assumes that the conditions caused by currently permitted mining exist and that the effects of any future mining are fully mitigated by industry
	• ACME Basin A flood control discharges are sent to C-51, west of the S-155A structure, to be pumped into STA-1E. ACME Basin B flood control discharges are sent to STA-1E through the S-319 structure
	• Releases from WCA-3A to ENP and the South Dade Conveyance System (SDCS) will follow the Everglades Restoration Transition Plan (ERTP) regulation schedule for WCA-3A, as per SFWMM modeled alternative 9E1
	  o Structures S-343A, S-343B, S-344 and S-12A are closed Nov. 1 to July 15
	  o Structure S-12B is closed Jan. 1 to July 15

Canal Configuration	• Canal configuration same as calibration except only 5.5 miles remain of the L-67 Extension Canal and CERP project modifications.
Lower East Coast Service Area Water Shortage Management	• Lower east coast water restriction zones and trigger cell locations are equivalent to SFWMM ECB implementation. An attempt was made to tie trigger cells with associated groundwater level gages to the extent possible. The Lower East Coast Subregional (LECsR) model is the source of this data. • Periods where the Lower East Coast is under water restriction due to low Lake Okeechobee stages were extracted from the corresponding RSMBN FWO simulation.

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`Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Basins (RSMBN) Initial Operating Regime Baseline 1 (IORBL1) Table of Assumptions

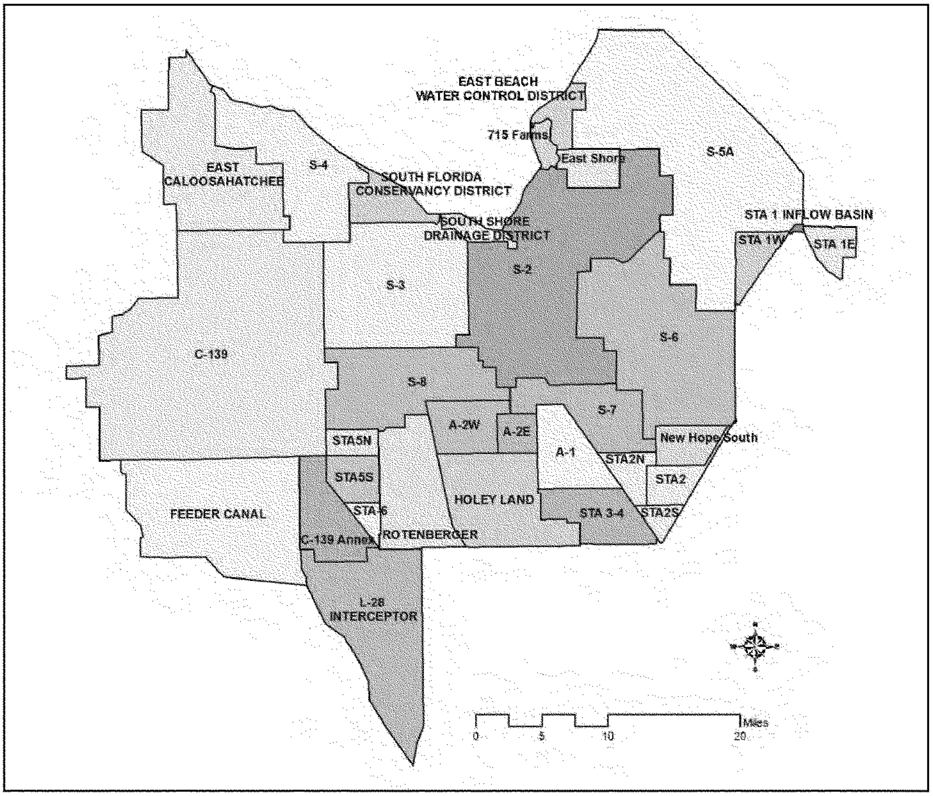
Feature	
Climate	• The climatic period of record is from 1965 to 2005 • Rainfall estimates have been revised and updated for 1965-2005 • Revised evapotranspiration methods have been used for 1965-2005
Topography	The topography dataset for RSM was updated in 2009 using the following datasets: • South Florida Digital Elevation Model, USACE, 2004 • High Accuracy Elevation Data , US Geological Survey 2007 • Loxahatchee River LiDAR Study, Dewberry and Davis, 2004 • St. Lucie North Fork LiDAR, Dewberry and Davis, 2007 • Palm Beach County LiDAR Survey, Dewberry and Davis, 2004 • Stormwater Treatment Area stage-storage-area relationships based on G. Goforth spreadsheets.
Land Use	• Lake Okeechobee Service Area (LOSA) Basins were updated using consumptive use permit information as of 2/21/2012, as reflected in the LOSA Ledger produced by the Water Use Bureau. • C-43 Groundwater irrigated basins - Permitted as of 2010, the dataset was updated using land use, aerial imagery and 2010 consumptive use permit information • Dominant land use in EAA is sugar cane other land uses consist of shrub land, wet land, ridge and slough, and sawgrass
LOSA Basins	• Lower Istokpoga, North Lake Shore and Northeast Lake Shore demands and runoff estimated using the AFSIRS model and assumed permitted land use (see land use assumptions row).

Lake Okeechobee	• Lake Okeechobee Regulation Schedule 2008 (LORS 2008)
	  ○ Includes Lake Okeechobee regulatory releases to tide via L8/C51 canals
	  ○ Lake Okeechobee regulatory releases limited to 1,550 cfs for Miami Canal and 1,350 cfs for North New River Canal based on studies performed by USACE.
	  ○ Releases via S-77 can be diverted into C43 Reservoir
	• No Lake Okeechobee environmental releases.
	• Lake Okeechobee Water Shortage Management (LOWSM) Plan
	• Interim Action Plan (IAP) for Lake Okeechobee (under which backpumping to the lake at S-2 and S-3 is to be minimized)
	• "Temporary" forward pumps as follows:
	  ○ S354 - 400 cfs
	  ○ S351 - 600 cfs
	  ○ S352 - 400 cfs

Feature	
	○ All pumps reduce to the above capacities when Lake Okeechobee stage falls below 10.2 ft and turn off when stages recover to greater than 11.2 ft. • No reduction in EAA runoff associated with the implementation of Best Management Practices (BMPs); No BMP makeup water deliveries to the WCAs • Operational intent is to treat LOK regulatory releases to the south through STA-3/4 • Backpumping of 298 Districts and 715 Farms into lake minimized
Northern Lake Okeechobee Watershed Inflows	• Headwaters Revitalization schedule for Kissimmee Chain of Lakes using the UKISS model • Kissimmee River Restoration complete. • Fisheating Creek, Istokpoga & Taylor Creek / Nubbin Slough Basin Inflows calculated from historical runoff estimates.
Caloosahatchee River Basin	• Caloosahatchee River Basin irrigation demands and runoff estimated using the AFSIRS model and assumed permitted land use as of February 2012. (see land use assumptions row) • Public water supply daily intake from the river is included in the analysis. • Maximum reservoir height of 41.7 ft NGVD with a 9,379-acre footprint in Western C43 basin with a 175,800 acre-feet effective storage. • Proposed reservoir meets estuary demands while C-43 basin supplemental demands for surface water irrigation are met by Lake Okeechobee.
St. Lucie Canal Basin	• St. Lucie Canal Basin demands estimated using the AFSIRS model and assumed permitted land use as of February 2012(see land use assumptions row). • Excess C-44 basin runoff is allowed to backflow into the Lake if lake stage is 0.25 ft. below the Zone D pulse release line before being pumped into the C-44 reservoir. • Basin demands include the Florida Power & Light reservoir at Indiantown. • Indian River Lagoon South Project features ○ Ten-mile Creek Reservoir and STA: 7,078 acre-feet storage capacity at 10.79 maximum depth on 820 acre footprint; receives excess water from North Folk Basin ○ C-44 reservoir: 50,246 acre-feet storage capacity at 5.18 feet maximum depth on 12,125 acre footprint ○ C-23/C-24 reservoir: 92,094 acre-feet storage capacity at 13.27 maximum depth on 8,675 acre footprint ○ C-23/C-24 STA: 3,852 acre-feet storage capacity at 1.5 maximum depth on 2,568 acre footprint ○ All proposed reservoirs meet estuary demands ○ IRL operations assumed are consistent with the March 2010 St. Lucie River Water Reservation Rule update. ○ Excess C23 basin water not needed to meet estuary demands can be diverted to the C44 reservoir if capacity exists.
Seminole Brighton	• Brighton reservation demands were estimated using AFSIRS method based on existing planted acreage.

Feature	
Reservation	• The 2-in-10 demand set forth in the Seminole Compact Work plan equals 2,262 MGM (million gallons per month). AFSIRS modeled 2-in-10 demands equaled 2,383 MGM • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per Table 7, Agreement 41-21 (Nov. 1992), tribal rights to these quantities are preserved • LOWSM applies to this agreement
Seminole Big Cypress Reservation	• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage • The 2-in-10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM • AFSIRS modeled 2-in-10 demands equaled 2,659 MGM • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District's Final Order and Tribe's Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved • LOWSM applies to this agreement
Everglades Agricultural Area	• Model water-body components as shown in Figure 1. • Simulated runoff from the North New River – Hillsboro basin apportioned based on the relative size of contributing basins via S7 route vs. S6 route. • G-341 routes water from S-5A Basin to Hillsboro Basin. • RSMBN ECB EAA runoff and irrigation demand compared to SFWMM ECB simulated runoff and demand from 1965-2005 for reasonability.
Everglades Construction Project Stormwater Treatment Areas	• STAs are simulated as single waterbodies • STA-1E: 6,546 acres total area • STA-1W: 7,488 acres total area • S-5A Basin runoff is to be treated in STA-1W first and when conveyance capacities are exceeded, rerouted to STA-1E • STA-2: cells 1,2 & 3: 7,681 acres total area • STA-2N: cells 4,5 & 6; refers to Comp B-North; 6,531 acres total area • STA-2S: cells 7 & 8; refers to Comp B-South; 3,570 acres total area • STA-3/4: 17,126 acres total area • STA-5N: includes cells 1 & 2: 5,081 acres total area • STA-5S: includes cells 3, 4 & 5; uses footprint of Compartment C: 8,469 acres total area • STA-6: expanded with phase 2: 3,054 acres total area • Assumed operations of STAs: ○ 0.5 ft minimum depth below which supply from external sources is triggered

Feature	
	○ 4 ft maximum depth above which inflows are discontinued ○ Inflow targets established for STA-3/4, STA-2N and STA-2S based on DMSTA simulation; met from local basin runoff, LOK regulatory discharge and available A1FEB storage. ○ STA-3/4 receives Lake Okeechobee regulation target releases approximately at 60,000 acre-feet annual average for the entire period of record. • A 15,853-acre Flow Equalization Basin (FEB) located north of STA-3/4 with assumed operations as follows: ○ FEB inflows are from excess EAA basin runoff above the established inflow targets at STA-3/4, STA-2N, and STA-2S, and from LOK flood releases south. ○ FEB outflows are used to help meet established inflow targets (as estimated using the Dynamic Model for Stormwater Treatment Areas) at STA-3/4, STA-2N, and STA-2S if EAA basin runoff and LOK regulatory discharge are not sufficient. ○ 0.5 ft minimum depth below which no releases are allowed ○ 3.8 ft maximum depth above which inflows are discontinued ○ Assumed inlet pump from STA-3/4 supply canal with capacity equal to combined capacity of G-372 and G-370 structures. ○ Outflow weirs, with similar discharge characteristics as STA-3/4 outlet structure, discharging into lower North New River canal. ○ Structure capacities and water quality operating rules are consistent with modeling assumptions assumed during the A-1 FEB EIS application process.
Holey Land Wildlife Management Area	• G-372HL is the only inflow structure for Holey Land used for environmental purposes only • Operations are similar to the existing condition as in the 1995 base simulation for the Lower East Coast Regional Water Supply Plan (LECRWSP, May 2000), as per the memorandum of agreement between the FWC and the SFWMD
Rotenberger Wildlife Management Area	• Operational Schedule as defined in the Operation Plan for Rotenberger WMA (SFWMD, March 2010)
Public Water Supply and Irrigation	• Regional water supply demands to maintain Lower East Coast canals as simulated from RSMGL.
Western Basins	• C139 RSM basin is being modeled. Period is 1965-2005. • C139 basin runoff is modeled as follows: G136 flows is routed to Miami Canal; G342A-D flows routed to STA5N; G508 flows routed to STA5S; G406 flows routed to STA6C139 basin demand is met primarily by local groundwater
Water Shortage Rules	• Reflects the existing water shortage policies as in South Florida Water Management District Chapters 40E-21 and 40E-22, FAC, including Lake Okeechobee Water Shortage Management (LOWSM) Plan



Water-Body Components:
Miami Water-Body = S3 + S8 + A-2W
NNR/HILLS Water-Body = S2 + S6 + S7 + A-2E + New Hope South
WPB Water-Body = S-5A
A1FEB = A-1

Fig. 1 RSMBSN Basin Definition within the EAA: Initial Operating Regime Baseline Simulation

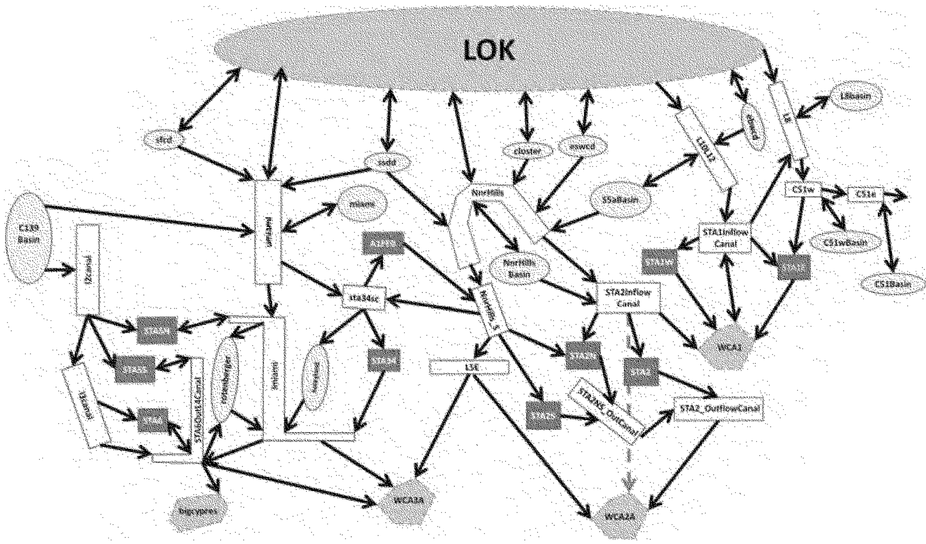


Fig. 2 RSMBSN Link-Node Routing Diagram: Initial Operating Regime Baseline Simulation

Notes:

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).
- The boundary conditions along the eastern and southern boundaries of the RSMBN model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Glades-LECSA Model (RSMGL). The SFWMM was the source of the eastern boundary groundwater/surface water flows, while the RSMGL was the source of the southern boundary structural flows.
- IORBL assumptions were updated from the CEPP 12/13/2012 FWO scenario at the time that the CEPP tentatively selected plan was identified and then adjusted for the IRL project to produce the IORBL1.

Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Basins (RSMBN) Updated Tentatively Selected Plan (ALT4R2) Table of Assumptions

Feature	
Climate	• The climatic period of record is from 1965 to 2005. • Rainfall estimates have been revised and updated for 1965-2005. • Revised evapotranspiration methods have been used for 1965-2005.
Topography	The Topography dataset for RSM was Updated in 2009 using the following datasets: • South Florida Digital Elevation Model, USACE, 2004; • High Accuracy Elevation Data, US Geological Survey 2007; • Loxahatchee River LiDAR Study, Dewberry and Davis, 2004; • St. Lucie North Fork LiDAR, Dewberry and Davis, 2007; • Palm Beach County LiDAR Surve, Dewberry and Davis, 2004; and • Stormwater Treatment Area stage-storage-area relationships based on G. Goforth spreadsheets.
Land Use	• Lake Okeechobee Service Area (LOSA) Basins were updated using consumptive use permit information as of 2/21/2012, as reflected in the LOSA Ledger produced by the Water Use Bureau. • C-43 Groundwater irrigated basins – Permitted as of 2010, the dataset was updated using land use, aerial imagery and 2010 consumptive use permit information . • Dominant land use in EAA is sugar cane other land uses consist of shrub land, wet land, ridge and slough, and sawgrass.
LOSA Basins	• Lower Istokpoga, North Lake Shore and Northeast Lake Shore demands and runoff estimated using the AFSIRS model and assumed permitted land use (see land use assumptions row).

Lake Okeechobee	• Lake Okeechobee Regulation Schedule 2008 (LORS 2008)
	  ○ CEPP optimized release guidance in order to improve selected performance within LOK, the northern estuaries and LOSA while meeting environmental targets in the Glades.
	  ○ Lake Okeechobee can send flood releases south through the Miami Canal and North New River Canal to the FEB when the LOK stage is above the bottom of Zone D and the FEB depth is below 2' (EAA basin runoff used to limit conveyance capacity: 1,550 cfs for Miami Canal and 1,350 cfs for North New River Canal).
	  ○ Lake Okeechobee can send flood releases south to help meet water-quality based flow targets at STA-3/4, STA-2N, and STA-2S when the LOK stage is above the bottom of the Baseflow Zone (EAA basin runoff used to limit conveyance capacity: 1,550 cfs for Miami Canal and 1,350 cfs for North New River Canal).
	  ○ Includes Lake Okeechobee regulatory releases to tide via L8 canal.

Feature	
	o Releases via S-77 can be diverted into C43 Reservoir • Lake Okeechobee Water Shortage Management (LOWSM) Plan. • Interim Action Plan (IAP) for Lake Okeechobee (under which backpumping to the lake at S-2 and S-3 is to be minimized). • "Temporary" forward pumps as follows: o S354 – 400 cfs o S351 – 600 cfs o S352 – 400 cfs o All pumps reduce to the above capacities when Lake Okeechobee stage falls below 10.2 ft and turn off when stages recover to greater than 11.2 ft • No reduction in EAA runoff associated with the implementation of Best Management Practices (BMPs); No BMP makeup water deliveries to the WCAs • Backpumping of 298 Districts and 715 Farms into lake minimized
Northern Lake Okeechobee Watershed Inflows	• Headwaters Revitalization schedule for Kissimmee Chain of Lakes using the UKISS model. • Kissimmee River Restoration complete. • Fisheating Creek, Istokpoga & Taylor Creek / Nubbin Slough Basin Inflows calculated from historical runoff estimates.
Caloosahatchee River Basin	• Caloosahatchee River Basin irrigation demands and runoff estimated using the AFSIRS model and assumed permitted land use as of February 2012. (see land use assumptions row) • Public water supply daily intake from the river is included in the analysis. • Maximum reservoir height of 41.7 ft NGVD with a 9,379-acre footprint in Western C43 basin with a 175,800 acre-feet effective storage. • Proposed reservoir meets estuary demands while C-43 basin supplemental demands for surface water irrigation are met by Lake Okeechobee.
St. Lucie Canal Basin	o St. Lucie Canal Basin demands estimated using the AFSIRS model and assumed permitted land use as of February 2012 (see land use assumptions row). o Excess C-44 basin runoff is allowed to backflow into the Lake if lake stage is 0.25 ft. below the Zone D pulse release line before being pumped into the C-44 reservoir. o Basin demands include the Florida Power & Light reservoir at Indiantown. o Indian River Lagoon South Project features o Ten-mile Creek Reservoir and STA: 7,078 acre-feet storage capacity at 10.79 maximum depth on 820 acre footprint; receives excess water from North Folk Basin; o C-44 reservoir: 50,246 acre-feet storage capacity at 5.18 feet maximum depth on 12,125 acre footprint; C44 reservoir releases water back to Lake Okeechobee when Lake stages are below the bottom of the Baseflow Zone. o C-23/C-24 reservoir: 92,094 acre-feet storage capacity at 13.27 maximum depth on 8,675 acre footprint; o C-23/C-24 STA: 3,852 acre-feet storage capacity at 1.5 maximum depth on 2,568 acre footprint;

Feature	
	○ All proposed reservoirs meet estuary demands. ○ IRL operations assumed are consistent with the March 2010 St. Lucie River Water Reservation Rule update. ○ Excess C23 basin water not needed to meet estuary demands can be diverted to the C44 reservoir if capacity exists. ○ C44 reservoir can discharge to C44 canal and backflow to Lake Okeechobee when the lake is below the baseflow zone.
Seminole Brighton Reservation	• Brighton reservation demands were estimated using AFSIRS method based on existing planted acreage. • The 2-in-10 demand set forth in the Seminole Compact Work plan equals 2,262 MGM (million gallons per month). AFSIRS modeled 2-in-10 demands equaled 2,383 MGM. • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per Table 7, Agreement 41-21 (Nov. 1992), tribal rights to these quantities are preserved. • LOWSM applies to this agreement.
Seminole Big Cypress Reservation	• Big Cypress Reservation irrigation demands and runoff were estimated using the AFSIRS method based on existing planted acreage. • The 2-in-10 demand set forth in the Seminole Compact Work Plan equals 2,606 MGM. • AFSIRS modeled 2-in-10 demands equaled 2,659 MGM. • While estimated demands, and therefore deliveries, for every month of simulation do not equate to monthly entitlement quantities as per the District's Final Order and Tribe's Resolution establishing the Big Cypress Reservation entitlement, tribal rights to these quantities are preserved. • LOWSM applies to this agreement.
Everglades Agricultural Area	• Model water-body components as shown in Figure 1. • Simulated runoff from the North New River – Hillsboro basin apportioned based on the relative size of contributing basins via S7 route vs. S6 route. • G-341 routes water from S-5A Basin to Hillsboro Basin. • RSMBN ECB EAA runoff and irrigation demand compared to SFWMM ECB simulated runoff and demand from 1965-2005 for reasonability.
Everglades Construction Project Stormwater Treatment Areas	• STAs are simulated as single waterbodies • STA-1E: 6,546 acres total area • STA-1W: 7,488 acres total area • S-5A Basin runoff is to be treated in STA-1W first and when conveyance capacities are exceeded, rerouted to STA-1E • STA-2: cells 1,2 & 3: 7,681 acres total area • STA-2N: cells 4,5 & 6; refers to Comp B-North; 6,531 acres total area • STA-2S: cells 7 & 8; refers to Comp B-South; 3,570 acres total area • STA-3/4: 17,126 acres total area

<table>
<tr><th>Feature</th><th></th></tr>
<tr><td></td><td>
STA-5N: includes cells 1 & 2: 5,081 acres total area
STA-5S: includes cells 3, 4 & 5; uses footprint of Compartment C: 8,469 acres total area
STA-6: expanded with phase 2: 3,054 acres total area
Assumed operations of STAs:

0.5 ft minimum depth below which supply from external sources is triggered;
4 ft maximum depth above which inflows are discontinued; and
Inflow targets established for STA-3/4, STA-2N and STA-2S based on DMSTA simulation; met from local basin runoff, LOK flood releases and available FEB storage.

A 29,617-acre Flow Equalization Basin (FEB) is located north of STA-3/4 and Holeyland. The total footprint represents the original 15,853-acre A-1 footprint plus the additional 13,764-acre A-2 footprint operated as follows:

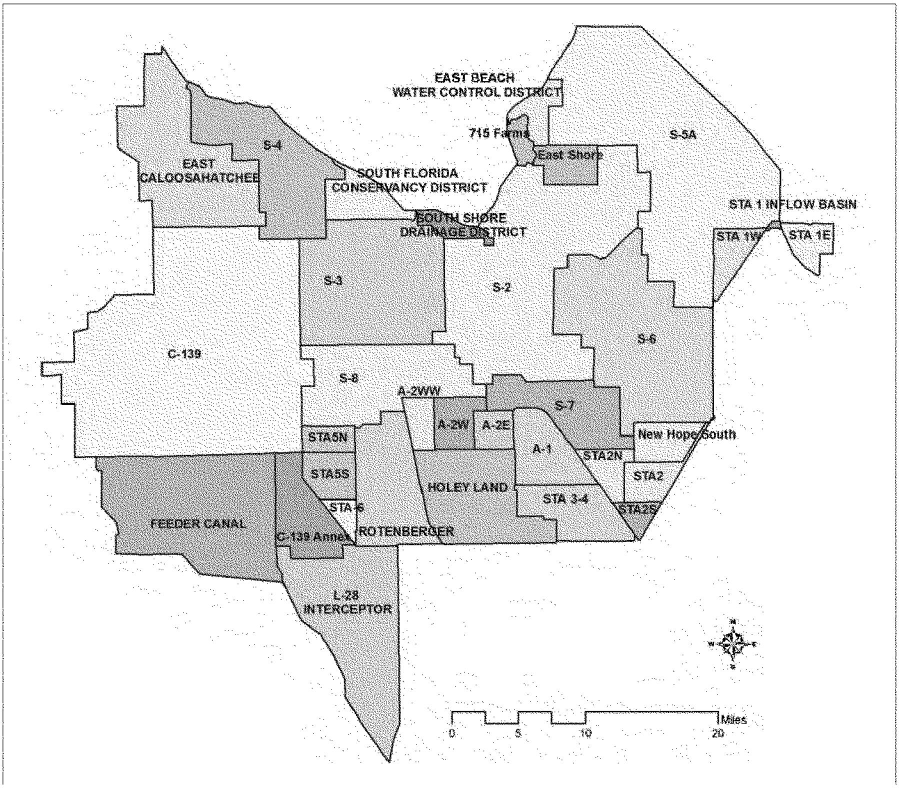
Assumed average topography of 9.63 ft NGVD. FEB inflows are from excess EAA basin runoff above the established inflow targets at STA-3/4, STA-2N, and STA-2S, and from LOK flood releases south;
FEB outflows are used to help meet established inflow targets at STA-3/4, STA-2N, and STA-2S if EAA basin runoff and LOK flood releases are not sufficient;
0.5 ft minimum depth below which no releases are allowed;
3.8 ft maximum depth above which inflows are discontinued;
No supplemental water supply provided to FEB;
Assumed inlet pump from STA-3/4 supply canal with capacity equal to combined capacity of G-372 and G-370 structures; and
Outflow weirs, with similar discharge characteristics as STA-3/4 outlet structure, discharging into lower Miami and lower North New River canals.

</td></tr>
<tr><td>Holey Land Wildlife Management Area</td><td>
G-372HL is the only inflow structure for Holey Land used for keeping the water table from going lower than half a foot below land surface elevation.
Operations are similar to the existing condition as in the 1995 base simulation for the Lower East Coast Regional Water Supply Plan (LECRWSP, May 2000), as per the memorandum of agreement between the FL Fish and Wildlife Conservation (FWC) Commission and the SFWMD.
</td></tr>
<tr><td>Rotenberger Wildlife Management Area</td><td>
Operational Schedule as defined in the Operation Plan for Rotenberger WMA. (SFWMD, March 2010)
</td></tr>
<tr><td>Public Water Supply and Irrigation</td><td>
Regional water supply demands to maintain Lower East Coast canals as simulated from RSMGL FWO.
</td></tr>
</table>

Feature	
Western Basins	• C139 RSM basin is being modeled. Period is 1965-2005. • C139 basin runoff is modeled as follows: G136 flows is routed to Miami Canal; G342A-D flows routed to STA5N; G508 flows routed to STA5S; G406 flows routed to STA6. • C139 basin demand is met primarily by local groundwater.
Water Shortage Rules	• Reflects the existing water shortage policies as in South Florida Water Management District Chapters 40E-21 and 40E-22, FAC, including Lake Okeechobee Water Shortage Management (LOWSM) Plan.

Notes:

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).
- The boundary conditions along the eastern and southern boundaries of the RSMBN model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Glades-LECSA Model (RSMGL). The SFWMM was the source of the eastern boundary groundwater/surface water flows, while the RSMGL was the source of the southern boundary structural flows.
- The RSMBN CEPP representation of ALT4R2 is the same as the June 2, 2013 ALT4R1 scenario.



Water-Body Components:
Miami Water-Body = S3 + S8 + A-2WW
NNR/HILLS Water-Body = S2 + S6 + S7 + New Hope South
WPB Water-Body = S-5A
FEB = A-2W + A-2E + A-1

Fig. 1 RSMBSN Basin Definition within the EAA: Updated Tentatively Selected Plan (ALT4R2)

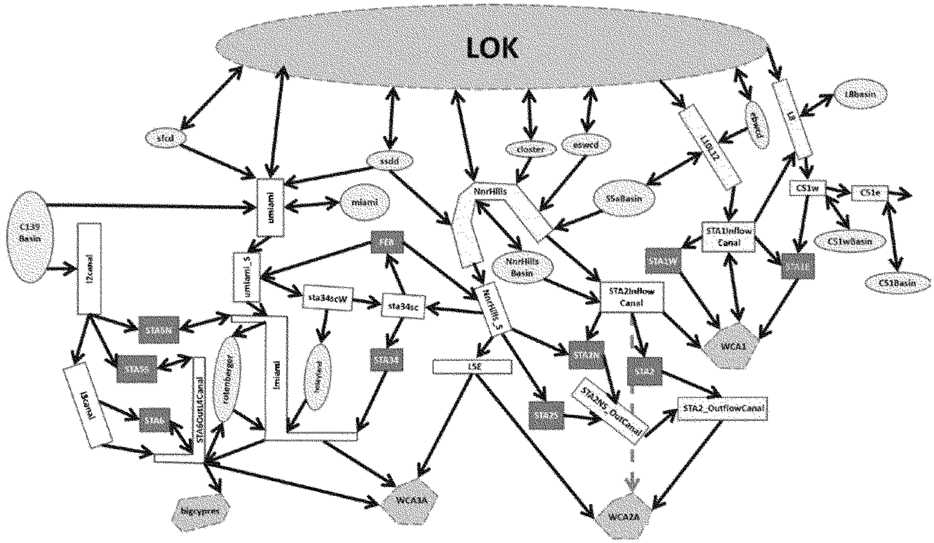


Fig. 2 RSMBSN Link-Node Routing Diagram: Updated Tentatively Selected Plan (ALT4R2)

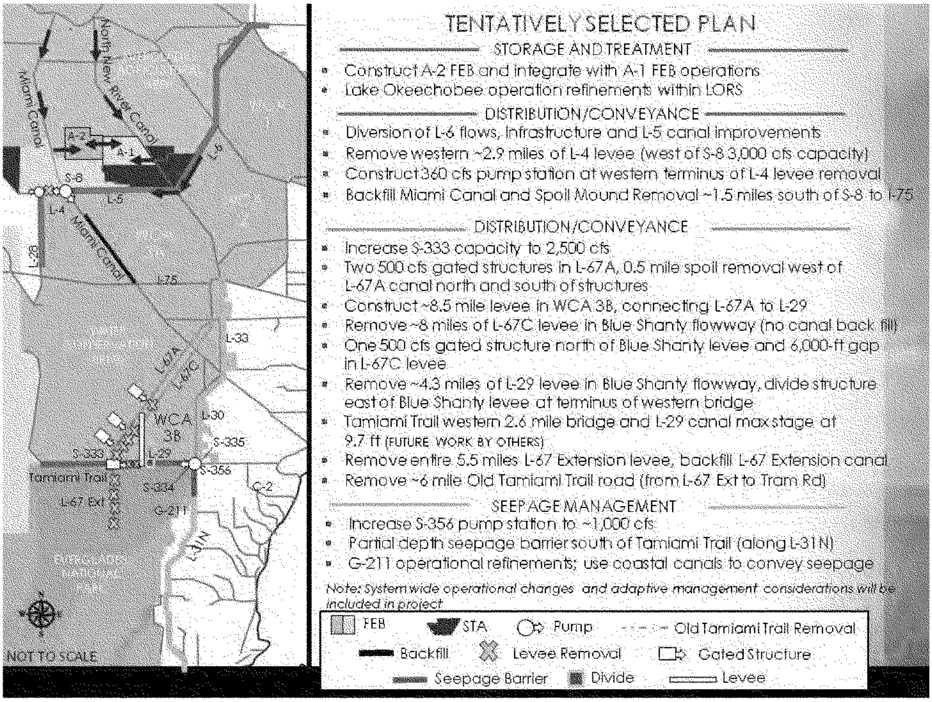


Fig. 3 CEPP ALT4R2 Features as defined by CEPP project team

Hydrologic and Environmental Systems Modeling & Interagency Modeling Center

Regional Simulation Model Glades-LECSA (RSMGL) Updated Tentatively Selected Plan (ALT4R2) Table of Assumptions

Feature	
Meteorological Data	• Rainfall file used: rain_v3.0_beta_tin_14_05.bin • Reference Evapotranspiration (RET) file used: RET_48_05_MULTIQUAD_v1.0.bin (ARCADIS, 2008)
Topography	• Same as calibration topographic data set except where reservoirs are introduced (STA1-E, C4 Impoundment and C-111 reservoirs). • United States Geological Survey (USGS) High-Accuracy Elevation Data Collection (HAEDC) for the Water Conservation Areas (1, 2A, 2B, 3A, and 3B), the Big Cypress National Preserve and Everglades National Park.
Tidal Data	• Tidal data from two primary (Naples and Virginia Key) and five secondary NOAA stations (Flamingo, Everglades, Palm Beach, Delray Beach and Hollywood Beach) were used to generate a historic record to be used as sea level boundary conditions for the entire simulation period.
Land Use and Land Cover	• Land Use and Land Cover Classification for the Lower East Coast urban areas (east of the Lower East Coast Flood Protection Levee) use 2008-2009 Land Use coverage as prepared by the SFWMD, consumptive use permits as of 2011 were used to update the land use in areas where it did not reflect the permit information. • Land Use and Land Cover Classification for the natural areas (west of the Lower East Coast Flood Protection Levee) is the same as the Calibration Land Use and Land Cover Classification for that area. Modified at locations where reservoirs are introduced (STA1-E, Site 1 Impoundment, Broward WPAs, C4 Impoundment, Lakebelt Lakes and C-111 Reservoirs).
Water Control Districts (WCDs)	• Water Control Districts in Palm Beach and Broward Counties and in the Western Basins assumed. • 8.5 SMA seepage canal is modeled as a WCD in ENP area.
Lake Belt Lakes	• Based on the permitted 2020 Lake Belt Lakes coverage obtained from USACE.
CERP Projects	• 1st Generation CERP – Site 1 Impoundment project is modeled as an above ground reservoir of area 1600 acres, with a maximum depth of 8 ft. • 2nd Generation CERP – Broward County Water Preserve Areas (WPAs) comprised of C-11 and C-9 impoundments were modeled as above ground reservoirs with areas 1221 and 1971 acres and maximum depths 4.3 and 4.0 ft. respectively. Operations refined in RSM model to closer represent project intent and outcomes.

Feature	
	• 2nd Generation CERP – C-111 Spreader Canal Project includes the Frog Pond Detention Area, which is modeled as an above ground impoundment with the S200 A, B and C pumps as inflow structures. In addition, the Aerojet canal is modeled with the inflow pumps S199 A, B and C. The S199 and S200 pumps are turned off based on the stage at the remote monitoring location EVER4 for the protection of the CSS Critical Habitat Unit 3. • 2nd Generation CERP – Biscayne Bay Coastal Wetlands project features were not modeled since these features along the coast in Miami-Dade County were not considered significant for CEPP. • Areal corrections were applied to the impoundment storages to account for the discrepancies of the areas in the model of the impoundments not matching the design areas.
Water Conservation Area 1 (Arthur R. Marshall Loxahatchee National Wildlife Refuge)	• Current C&SF Regulation Schedule. Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 14 ft. The bottom floor of the schedule (Zone C) is the area below 14 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow. • Structure S10E connecting LNWR to the northeastern portion of WCA-2A is no longer considered part of the simulated regional System
Water Conservation Area 2A & 2B	• Current C&SF regulation schedule. Includes regulatory releases to tide through LEC canals • No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 10.5 ft in WCA-2A, defined as when WCA2-U1 marsh gauge falls below 10.5 ft or L38 canal stage falls below 10.0 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow.
Water Conservation Area 3A & 3B	• Diversion of L-6 flows with additional 500 cfs structure and improvements to the L-5 canal • STA-3/4 outflows routed based on Rainfall Driven Operations (RDO) – a maximum of 2500 cfs is routed to S8 and G404, with the remainder being sent to S7 • Western L-4 levee degrade with 1.5 miles retained west of S8 (west of S-8 = 3,000 cfs capacity) • Miami Canal backfilled and spoil mound removed 1.5 miles south of S-8 to I-75 • Everglades Restoration Transition Plan (ERTP) regulation schedule for WCA-3A, as per SFWMM modeled alternative 9E1 (USACE, 2012) • One 500 cfs gated structure in L-67A north of Blue Shanty levee (S345D) and associated gap in L-67C levee

Feature	

	• Two 500 cfs gated structures in L-67A (S345F & S345G) discharging into Blue Shanty Flowway
	• Environmental target deliveries through the S345s are determined through RDO and is spatially distributed as 40% to 345D, 35% to 345F and 25% to 345G
	• Blue Shanty Flowway assumed as follows:
	  o Construction of ~8.5 mile levee in WCA 3B, connecting L-67A to L-29
	  o Removal of L-67C levee in Blue Shanty Flowway (no canal back fill)
	  o Removal of L-29 levee in Blue Shanty Flowway.
	• Includes regulatory releases to tide through LEC canals. Documented in Water Control Plan (USACE, June 2002)
	• No net outflow to maintain minimum stages in the LEC Service Area canals (salinity control), if water levels are less than minimum operating criteria of 7.5 ft in WCA-3A, defined as when 3-69W marsh gauge falls below 7.5 ft or CA3 canal stage falls below 7.0 ft. Any water supply releases below the floor will be matched by an equivalent volume of inflow.

Everglades Construction Project Stormwater Treatment Areas	• STA-1E: 5,132 acres total treatment area. • A uniform bottom elevation equal to the spatial average over the extent of STA-1E is assumed.
Everglades National Park	• Water deliveries to Everglades National Park are based upon Everglades Restoration Transition Plan (ERTP), with the WCA-3A Regulation Schedule including the lowered Zone A (compared to IOP) and extended Zones D and E1. The environmental component of the schedule is defined by RDO. If hydraulic capacity exists at the 345s, then flood control discharges are made into 3B instead of at the S12s. • S-333 capacity increased to 2,500 cfs • L29 Divide structure assumed and is operated to send water from L29W to L29E to equilibrate canals when L29E falls below 7 ft. • L29 canal can receive inflow up to 9.7 ft (applies to both E and W segments / i.e. S333 & S356 as well as S345F & S345G structure on Blue Shanty Flowway) • G-3273 constraint for operation of S-333 assumed to be 9.5 ft, NGVD. • The one mile Tamiami Trail Bridge as per the 2008 Tamiami Trail Limited Reevaluation Report is modeled as a one mile weir. Located east of the L67 extension and west of the S334 structure. • Western 2.6 mile Tamiami Trail Bridge, modeled as a 2.6 mile long weir, and is located east of Osceola Camp and west of Frog City. • Tamiami Trail culverts east of the L67 Extension are simulated where the bridge is not located.

Feature	
	• Removal of the entire 5.5 miles L-67 Extension levee, with backfill of L-67 Extension canal • S-355A & S-355B are operated. • Capacity of S-356 pump increased to 1000 cfs. S-356 is operated to manage seepage. • Full construction of C-111 project reservoirs consistent with the as-built information from USACE plus addition of contract 8 and contract 9 features. A uniform bottom elevation equal to the spatial average over the extent of each reservoir is assumed. • 8.5 SMA project feature as per federally authorized Alternative 6D of the MWD/8.5 SMA Project (USACE, 2000 GRR); operations per 2011 Interim Operating Criteria (USACE, June 2011) including S-331 trigger shifted from Angel's well to LPG-2. Outflow assumed from 8.5 SMA detention cell to the C-111 North Detention Area. o An additional length of seepage canal is assumed in the model to allow water to be collected for S357 operation. • Partial depth, approximately 4 mile long seepage barrier south of Tamiami Trail (along L-31N)
Other Natural Areas	• Flows to Biscayne Bay are simulated through Snake Creek, North Bay, the Miami River, Central Bay and South Bay
Pumpage and Irrigation	• Public Water Supply pumpage for the Lower East Coast was updated using 2010 consumptive use permit information as documented in the C-51 Reservoir Feasibility Study; permits under 0.1 MGD were not included • Modeling of the TSP assumes an additional public water supply withdrawal of 12 MGD in Service Area 2 and 5 MGD in Service Area 3. • Residential Self Supported (RSS) pumpage are based on 2030 projections of residential population from the SFWMD Water Supply Bureau. • Industrial pumpage is also based on 2030 projections of industrial use from the Water Supply Bureau. • Irrigation demands for the six irrigation land-use types are calculated internally by the model. • Seminole Hollywood Reservation demands are set forth under VI. C of the Tribal Rights Compact. Tribal sources of water supply include various bulk sale agreements with municipal service suppliers.
Canal Operations	• C&SF system and operating rules in effect in 2012 • Includes operations to meet control elevations in the primary coastal canals for the prevention of saltwater intrusion • Includes existing secondary drainage/water supply system • C-4 Flood Mitigation Project • Western C-4, S-380 structure retained open • C-11 Water Quality Treatment Critical Project (S-381 and S-9A) • S-25B and S-26 backflow pumps are not modeled since they are used very rarely during high tide conditions and the model uses a long-term average daily tidal boundary

Feature	

	• Northwest Dade Lake Belt area assumes that the conditions caused by currently permitted mining exist and that the effects of any future mining are fully mitigated by industry
	• ACME Basin A flood control discharges are sent to C-51, west of the S-155A structure, to be pumped into STA-1E. ACME Basin B flood control discharges are sent to STA-1E through the S-319 structure
	• Releases from WCA-3A to ENP and the South Dade Conveyance System (SDCS) will follow the Everglades Restoration Transition Plan (ERTP) regulation schedule for WCA-3A, as per SFWMM modeled alternative 9E1
	  ○ Structures S-343A, S-343B, S-344 and S-12A are closed Nov. 1 to July 15
	  ○ Structure S-12B is closed Jan. 1 to July 15
	• Water supply deliveries from regional system (from WCA3A: S-151/S-337) are used to maintain the L30 canal with a minimum seasonal level varying from 6.25 ft in the dry season to 5.2 ft. at the beginning of the wet season
	• G-211 / S338 operational refinements; use coastal canals to convey seepage toward Biscayne Bay during drier times.

Canal Configuration	• Canal configuration same as calibration except no L-67 Extension Canal and CERP & CEPP project modifications.
Lower East Coast Service Area Water Shortage Management	• Lower east coast water restriction zones and trigger cell locations are equivalent to SFWMM ECB implementation. An attempt was made to tie trigger cells with associated groundwater level gages to the extent possible. The Lower East Coast Subregional (LECsR) model is the source of this data. • Periods where the Lower East Coast is under water restriction due to low Lake Okeechobee stages were extracted from the corresponding RSMBN FWO simulation.

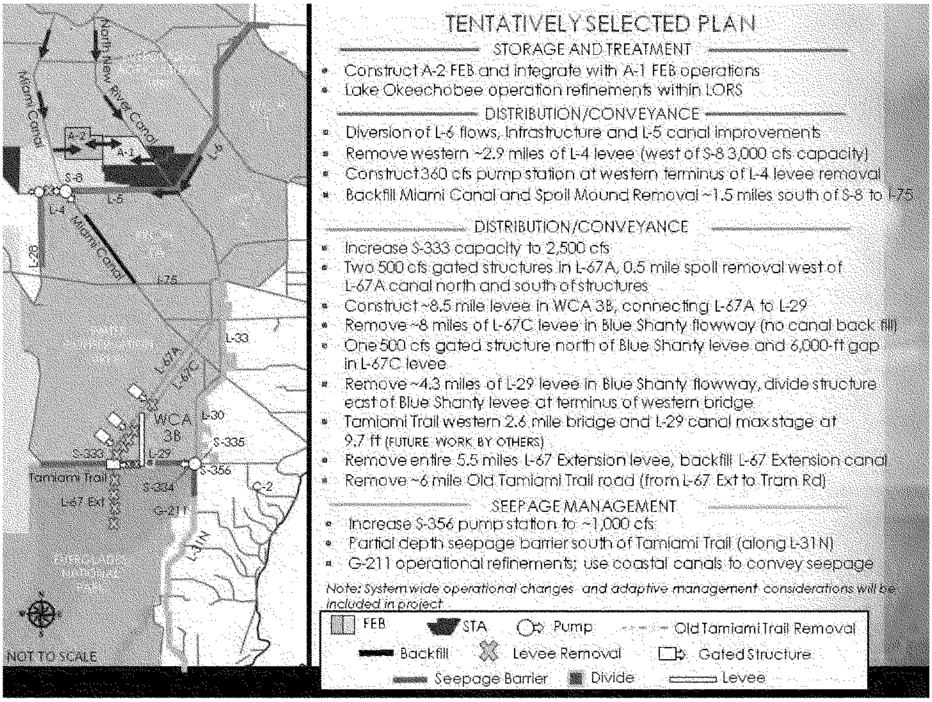


Fig. 1 CEPP ALT4R2 Features as defined by CEPP project team

Notes:

- The RSM is a robust and complex regional scale model. Due to the scale of the model, it is frequently necessary to implement abstractions of system infrastructure and operations that will, in general, mimic the intent and result of the desired project features while not matching the exact mechanism by which these results would be obtained in the real world. Additionally, it is sometimes necessary to work within established paradigms and foundations within the model code (e.g. use available input-driven options to represent more complex project operations).
- The boundary conditions along the northern boundary of the RSMGL model were provided from either the South Florida Water Management Model (SFWMM) or the RSM Basins Model (RSMBN). The SFWMM was the source of the northern boundary groundwater/surface water flows, while the RSMBN was the source of the northern boundary structural flows.

A.5.2.1 US Fish and Wildlife Service Request for Additional Information

United States Department of the Interior

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

September 4, 2013

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

Service CPA Code: 04EF2000-2012-CPA-0270
Service Consultation Code: 04EF2000-2012-F-0290
Date Received: August 6, 2013
Project: Central Everglades Planning Project

Dear Colonel Dodd:

The U.S. Fish and Wildlife Service (Service) has reviewed the information in your Biological Assessment (BA), dated August 5, 2013, for the above referenced project in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act or ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). We appreciate the hard work your staff has dedicated to the development of this complex document. We are providing comments and requesting additional information needed to properly evaluate the Central Everglades Planning Project (CEPP) and to determine an appropriate strategy for ESA consultation.

PROJECT DESCRIPTION

The purpose of the CEPP is to assess Federal and non-Federal interest in implementing components of the Comprehensive Everglades Restoration Plan (CERP). 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 clean freshwater into the central Everglades and associated timing and distribution problems. The U.S. Army Corps of Engineers (Corps) and the South Florida Water Management District (District) initiated the CEPP in November 2011 to evaluate alternatives for restoring ecosystem conditions and opportunities for providing for other water-related needs in the region.

The plan formulation strategy for CEPP followed the natural southerly flow of water from Lake Okeechobee through the Everglades ecosystem to Florida Bay. The strategy involved the formulation of management measures and components that serve to capture, store,

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and deliver water to restore the central portions of the Everglades (including Water Conservation Area [WCA] 3 and Everglades National Park), while improving the northern (St Lucie, and Caloosahatchee Estuaries) and southern (Biscayne and Florida Bays) estuary ecosystems, and making water supply more available for municipal and agricultural users.

The Corps' BA evaluated the effects of CEPP on federally-listed species and critical habitats and made the following effect determinations under the Act:

Common Name	Scientific Name	Status*	Determination
Mammals			
Florida bonneted bat	*Eumops floridanus*	PrE	No Effect
Florida panther	*Puma concolor coryi*	E	May Affect
Florida manatee	*Trichechus manatus latirostris*	E, CH	May Affect
Birds			
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	May Affect
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	May Affect
Northern crested caracara	*Caracara cheriway*	T	No Effect
Piping plover	*Charadrius melodus*	T	No Effect
Red-cockaded woodpecker	*Picoides borealis*	E	No Effect
Roseate tern	*Sterna dougallii dougallii*	T	No Effect
Wood stork	*Mycteria americana*	E	May Affect
Reptiles			
American alligator	*Alligator mississippiensis*	T/SA	May Affect
American crocodile	*Crocodylus acutus*	T, CH	May Affect
Eastern indigo snake	*Drymarchon corais couperi*	T	May Affect
Gopher tortoise	*Gopherus polyphemus*	C	
Invertebrates			
Bartram's hairstreak butterfly	*Strymon acis bartrami*	C	No Effect
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C	No Effect
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	No Effect
Stock Island tree snail	*Orthalicus reses* (not incl. nesodryas)	T	No Effect
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E	No Effect
Plants			
Beach jacquemonia	*Jacquemontia reclinata*	E	No Effect
Big pine partridge pea	*Chamaecrista* var. *keyensis*	C	
Blodgett's silverbush	*Argythamnia blodgettii*	C	
Cape Sable thoroughwort	*Chromolaena frustrata*	PrE, PrCH	No Effect
Carter's small-flowered flax	*Linum carteri* var. *carteri*	C	
Crenulate lead plant	*Amorpha crenulata*	E	No Effect
Deltoid spurge	*Chamaesyce deltoidea spp. deltoidea*	E	May Affect
Everglades bully	*Sideroxylon reclinatum spp. austrofloridense*	C	

Plants (continued)			
Florida brickell-bush	*Brickellia mosieri*	C	
Florida bristle fern	*Trichomanes punctatum spp. floridanum*	C	
Florida pineland crabgrass	*Digitaria pauciflora*	C	
Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	C	
Florida semaphore cactus	*Consolea corallicola*	PrE	
Garber's spurge	*Chamaesyce garberi*	T	May Affect
Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeenis*	E	No Effect
Pineland sandmat	*Chamaesyce deltoidea spp. pinetorum*	C	
Sand flax	*Linum arenicola*	C	
Small's milkpea	*Galactia smallii*	E	May Affect
Tiny polygala	*Polygala smallii*	E	May Affect

*Status Codes: E= Endangered, T=Threatened, T/SA=Threatened Similar Appearance, C= Candidate, CH=Critical Habitat, PrE=Proposed Endangered; PrCH=Proposed Critical Habitat.

The Corps has further refined these determinations and requested formal consultation on the Cape Sable seaside sparrow (CSSS), Everglade snail kite, wood stork, Florida panther, and eastern indigo snake. The Corps requests informal consultation on the American crocodile, Florida manatee, deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala. The Corps did not make an effect determination on the Florida semaphore cactus (proposed endangered).

REQUEST FOR ADDITIONAL INFORMATION

We have reviewed the information in your BA, and have some additional questions and comments we believe should be addressed to make it correct and complete. Recognizing the status of the Cape Sable seaside sparrow, Everglade snail kite, wood stork, Florida panther, and eastern indigo snake, we are requesting additional information to assist us in determining the proper path for ESA consultation.

General Comment No. 1: We spent many hours reviewing and providing comments to the Corps on the first draft of the BA (May 2013). We were concerned to see that many of those comments, particularly those relating to the snail'kite and CSSS, were not addressed in this draft.

General Comment No. 2: There is increasing discussion in public forums and in the draft Project Implementation Report (PIR) about how incremental implementation of CEPP will take place; however, there is no mention of incremental impacts on listed species. This will affect the timing and magnitude of impacts to species and needs to be discussed in the BA.

General Comment No. 3: There is no description of any known unrelated future non-Federal activities ("cumulative effects") reasonably certain to occur within the action area that are likely to affect the listed species.

General Comment No. 4: The Service requests the following information on the acreages to complete the eastern indigo snake analysis:

1. Miami Canal spoil mounds to be degraded,
2. L-4 degrade,
3. L-29 degrade,
4. L-67C gap degrade,
5. L-67C flow way degrade,
6. L-67 extension levee degrade,
7. Old Tamiami Trail Road degrade,
8. Tree islands to be created on the Miami Canal, and
9. The upland areas on the new Blue Shanty Levee.

General Comment No. 5: The use of Existing Condition Baseline (ECB) verses ECB 2012 yields different results (*e.g.*, hydroperiods in indicator region A-1) that are not intuitive to those familiar with the Everglades Restoration Transition Plan (ERTP). As we recall, ERTP did not result in benefits to Subpopulation A (CSSS-A) (as it was meant to make conditions in WCA-3A better while maintaining CSSS-A) but now the baseline has been modified. ERTP has barely been in place a year and we have little data to judge its effect on sparrows in CSSS-A or to analyze a proposed change to the base conditions from a model run that is unsupported by on-the-ground data (*e.g.*, ERTP lowered the top of the 3A regulation schedule, however, this cannot be met in the real world because the system is not designed to do so). An analysis should be included to determine what, if any, effect the changing of the base conditions has on sparrow results and the extent that ERTP will indeed provide the modeled base condition.

General Comment No. 6: Is the acreage (or general location, if exact acreages are not known) impacted in CSSS-D demonstrated by the CEPP modeling the same acreage as that shown impacted under the C-111 Spreader Canal Project? If so, are they really an impact? If not, are they cumulative and what impact to sparrows in this area will occur from the additional impact?

Page 41.
The BA indicates that total annual flows to Biscayne Bay are expected to increase under CEPP, which should improve crocodile habitat. However, the Corps failed to note that the seasonal timing of flows changes and that there are reductions in flows to some areas of Biscayne Bay during the dry season. What are the effects of this on juvenile crocodile survival/habitat?

Page 41.
Additionally, if you are not requesting a formal consultation on crocodiles then your effect determination should be changed from "may affect" to "may affect, but not likely to adversely affect."

Page 44.
The only effect ascribed to indigo snake in the A-2 Flow Equalization Basin is "displacement." We believe it is just as likely that eastern indigo snakes will be injured or killed due to their tendency to occupy burrows or other underground refugia in vegetative areas where they may not be readily observable by equipment/vehicle operators.

Page 48.
The analysis of effects of CEPP on the Florida panther is missing. Please include an analysis of how many acres are fallow and provide habitat for panthers, and how many acres of panther habitat will be lost or altered with implementation of CEPP. Please also include a discussion of the credits available at Picayune for compensation of adverse effects. Also, recognize that any panther compensation through restoration activities at Picayune must be complete before impacts to panthers from CEPP occur.

Page 54.
The BA indicates that kite nesting activity has been low "since the Emergency Deviations to the WCA 3A Regulation Schedule" in 1998. Is it the Corps' determination that these deviations are responsible for the kite population decline? Please also provide a population graph that shows each year for which kite nesting data are available and discuss whether nesting success was considered good or poor on a per year basis.

Page 58. Section 6.2.6.4.
The BA applies the Multi-Species Transition Strategy (MSTS) inappropriately in that it cannot be used to evaluate effects of water depth on kites. The MSTS windows can only be used to evaluate the 3AVG stage, and the target area for that and the snail recommendation is southwest WCA3A (no other areas within the Everglades). This is explained further in the MSTS white paper and the Service's 2010 ERTP Biological Opinion. At this time, the Corps' snail kite analysis is insufficient.

Page 58.
Please provide the kite analyses for gages W-2 and 3AS3W1. These gages were defined in the 2010 ERTP Biological Opinion as very important to monitoring and analyzing the kite and snails by the Service and Dr. Darby. This was noted early on and throughout the CEPP planning process.

Page 64. Section 6.2.6.5 Snail Kite Species Effect Determination
The BA states, "*The Corps could utilize the operational flexibility inherent*" to achieve appropriate snail kite recession rates. Please explain what operation capabilities exist now and in the future with CEPP that could be used to benefit snail kites (especially with regards to recession rates). Is this part of the project description that the Corps will provide?

Page 77.
The BA presents a discussion of where foraging conditions, as indicated by hydrologic changes, may occur relative to Alternative (Alt) 4R2. It should also indicate the number of wood stork rookeries that could be either adversely affected or benefitted by the project. The BA also needs to present an analysis of likely effects from these hydrologic changes (particularly the negative effects) to the wood stork.

Page 79.
The BA states, "*Wood storks generally showed increased numbers in northern WCA 3A, WCA 3B, and southern ENP under Alt 4R2 compared to the FWO (Figure 6-19). The existing conditions showed a similar trend in percent differences to the FWO, indicating that Alt 4R2 also performs better than existing conditions (Figure 6-20).*" The BA does present two color-coded graphics depicting differences, but neither of these show the difference between Alt 4R2 and the existing condition. Nor are there any data tabulated to support the previous conclusion of "increased numbers" of wood storks.

Page 81.
In regards to recommendations made during Periodic Scientist calls regarding wood storks, the BA states, "*The Corps could utilize the operational flexibility inherent within operations to achieve the recommendation.*" Again, what flexibilities exist now for storks and what would under the CEPP? Is this part of the project description that the Corps will provide?

Page 81. Figure 6-21.
In ERTP, the Service used water depth and recession rate graphs to depict whether conditions were going to become too dry or too wet at sites near rookeries within the core foraging areas. The Corps provides a "stop light" column graph that shows conditions are not good, but there is no indication as to whether conditions are becoming drier or wetter or if recession rates are too fast or too slow for foraging. Please provide site-specific analyses of water depths and recession rates.

Page 82. 6.2.7.2 Wood Stork Species Effect Determination
The Corps recognizes an impact to wood storks via permanent loss of wetland habitat from the construction of the proposed Blue Shanty Levee, yet they did not assess it in the BA. Additionally, there is no discussion in this section of the potential effects to existing wood stork colonies, only a discussion of potential benefits to areas that could be used by storks in the future. Please address these issues.

Page 83.
The BA indicates that CSSS research by Lockwood "*have revealed substantial movements between subpopulations east of SRS suggesting that the CSSS has considerable capacity to colonize unoccupied suitable habitat.*" Lockwood's research showed that only 4 of 299 tagged birds moved from one subpopulation to another. Please explain how this equates to "considerable capacity"? Are you stating that movements between subpopulations

is likely or only that it is possible, but rarely documented (and most of these birds were males). Additionally, are you assuming that there is suitable habitat outside the known subpopulations? If so, where would that be?

Page 92. Table 6-5.
Table is missing data for E-2.

Page 93.
The X axis scale is incorrectly labeled in Figures 6-25 through 6-37.

Page 100.
The BA states "*Research suggests that CSSS are capable of short and long range movement which could suggest that if the area around CSSS-E and CSSS-D becomes too wet, the birds could reside in the CSSS-B...*" The vast majority of research on CSSS movement documents that they exhibit strong site fidelity moving only within several hectares of their natal site. The distance between either CSSS-E or CSSS-D and CSSS-B are at the upper (*i.e.*, longest) range of the distances recorded for CSSS movement. Also, most of these movements have only been recorded over contiguous prairie habitat. Your statement that birds could move to and reside in CSSS-B, pre-supposes that those immigrating sparrows: (a) know that CSSS-B exists, (b) know which direction to fly to get there; (c) have the energetic resources to travel that distance, (d) will encounter suitable habitat, space, and forage conditions in CSSS-B, and probably most importantly, (e) that enough birds will make this journey to make a difference to the population's persistence. We recommend you base your analysis on likely effects of the project on the species of interest without drawing overly speculative conclusions from available sources.

Page 100.
The BA states "*These areas* [CSSS-F and CSSS-C] *have a smaller population count than E, however, if birds from areas that are becoming too wet migrated towards B, F, and C, the populations may have a better chance of survival with increased subpopulation size.*" What evidence do you have to support this conclusion (is there available sparrow habitat that is not being utilized in F and C)?

Page 100.
Please also provide information that the likelihood that sparrow movement is a viable alternative to enhancement of habitat within the subpopulations as a means to improve subpopulation size and survival.

Page101.
Field research has shown that even though a 60-day dry period criterion is met, other conditions such as weather, temperature, food availability, etc. may delay the onset of breeding by up to a month. The 60-day criterion should be considered a minimum in terms of nesting condition availability. The CEPP modeling does not seem to indicate that water moves to the east as much

as originally anticipated; therefore, please discuss the effects on CSSS-A of continued low numbers of years (22 out of 40) meeting the 60-day criterion in Indicator Region-A1 and the significant reduction to 25 years in Indicator Region-A2, in a subpopulation that at one time was the largest, and has been severely reduced since 1993 with no indication of meaningful recovery to date. Please also discuss the same for CSSS-D and E.

Page 102. Table 6-6 through 6-9.
It appears that the Corps used different locations (*i.e.*, single gauge locations instead of the indicator regions we provided them) for this metric than were used for the hydroperiod metric. The metrics should use the same indicator regions. Also, these tables contain a wealth of information on the potential length of CSSS breeding season. Although it is understood the PM-A metric was one tool to evaluate effects of the project on nesting, a more complete understanding of effects could be obtained by expanding the analysis to include consideration of multiple (2 or more) consecutive years meeting/not meeting the target in IR-A2, and an average continuous dry period over the period of record compared for each scenario (in the case of multiple days per year, use the largest number of contiguous days). This may indicate overall effects between the scenarios rather than just identifying years as red, yellow, or green. Also, in multiple consecutive wet (*i.e.*, yellow or red) years, what operational flexibility is there in the system to potentially avoid cumulative impacts to sparrow habitat? Additionally, please describe the conditions in the 1990s that seem to result in more negative effects in CSSS sub populations A-2, E-1 and E-2.

Page 106. Ecological Target 2.
Please discuss the potential effects of Ecological Target 2 analysis on the CSSS. This metric is the key indicator that affects the quality of habitat for sparrows. In every subpopulation except for A-1, this metric indicates a degraded condition with the project (and specifically in CSSS-E-1). In every subpopulation except B, this metric is met less than half the period of record (8 to 18 years). What have been and what will be the long term ramifications of this? There are much data available from the RSM model and post-processing, but very little of it was used in this analysis. An analysis of acreage changes by scenario should have been performed to quantify effects.

Page 112. Marl Prairie Indicator.
Given the availability of RSM post-processed data, the BA should include an analysis on the aerial extent of changes (acreages, distribution, location, etc.). The marl prairie indicator shows a 50 percent reduction in the index for CSSS-A, 30 percent reduction for CSSS-D and E, 16 percent reduction for CSSS-F, 8 percent reduction for CSSS-B, with only a 19 percent increase in the indicator for CSSS-C one of the smallest subpopulations. What is your interpretation of these effects on the sparrow?

Page 112.
The BA states that "*differences in marl prairie habitat suitability within CSSS-B, CSSS-D, and CSSS-F for Alt 4R2 were minor.*" However, there are no values or statistics to back up that

statement. There appears to be a 30 percent drop in habitat suitability in CSSS- D from the existing condition to Alt 4R2. Please explain how a 30 percent drop is a "minor" difference in habitat suitability for sparrows.

Page 114. Third paragraph.
The BA states, "*Further changes in operations that limit flows into ENP for protection of CSSS have the potential to limit CEPP benefits to the northern estuaries, WCA-3A, ENP, Florida Bay, the southwestern coastal estuaries, and other threatened and endangered species....*" This statement is misleading in that it lacks definition of the "changes in operations" and quantification of flows that could actually reduce downstream benefits. It also does not recognize the level of uncertainty with the method used to calculate potential benefits. As written, it is an unfounded statement and should be either substantiated with evidence or removed from the BA.

Page 114.
The BA states "*...the action related hydrologic changes as compared to the existing conditions are expected to be minimal throughout much of CSSS habitat ...*". Given the degree of negative effects indicated by the hydroperiod and marl prairie metrics, it is not apparent to the Service how the Corps reached this conclusion. Please explain.

Page 117. 6.2.8.3.4 Hydrologic Regime-Nesting Criteria.
It appears that the author has mixed the nesting and habitat performance measures and did not include an analysis of these criteria. Please do an analysis for this metric.

Page 118. Section 6.2.8.4.4.
Modeling seems to indicate the greatest potential for habitat change due to the CEPP will occur in CSSS-E. Please quantify the acreages and locations of where the altered hydroperiod will occur in CSSS-E. The result of this assessment will be a primary factor in determining adverse modification of critical habitat for CSSS.

Page 119.
The BA states, "*The CEPP goal of increasing the hydroperiod throughout WCA 3A and ENP does not coincide with the hydroperiods needed to maintain a drier, marl prairie habitat that is necessary for the CSSS.*" This is an inappropriate statement in that it generalizes the CSSS's requirements (relative to the CEPP) and perpetuates inaccuracies to the reader that the CEPP and the existence of CSSS are in opposition. It is not just a question of water depth, but where, when, and how long that depth occurs. To say the CEPP "does not coincide" with the needs of the CSSS minimizes the efforts that the Service and the Corps have put forth over the last 15 years to shift flows from WCA-3A easterly and into Everglades National Park. The Corps' statement also presupposes a level of knowledge about the habitat, topography, CSSS population size, and overall uncertainty of the CEPP that is not demonstrated in the BA.

Page 121. Conservation Measures
The BA identifies a number of CSSS conservation measures but does not indicate a willingness to implement them. Does the Corps intend to implement any or all of these measures as part of the proposed action?

Page 121. Conservation Measures
The BA states, "*Additional monitoring of panthers should not be necessary due to use of the approved mitigation bank.*" We cannot agree to this statement at this time. It may be appropriate to use a proportional amount of CEPP funding to monitor panthers at Picayune in accordance with the amount of compensation. It is not acceptable to have no accounting of whether or not the panther credits "purchased" were maintained as anticipated in the original compensation agreement.

Page 123.
The BA concludes, "*Comparisons of existing conditions and the CEPP recommended plan (Section 6) show that some areas utilized by sparrows are slightly improved by CEPP implementation, while others remain the same or slightly worse than existing conditions. Slight improvements to critical habitat areas in CSSS-A, CSSS-F, and CSSS-B (some metrics) could potentially provide the interim habitat needed to keep the CSSS population as is, with potential for physical habitat improvements as well.*" The Corps' analysis is not sufficient to support these conclusions. A more robust analysis is needed to provide a better understanding of the processes underlying the current decline of the species, actions needed for its recovery, and how the proposed project will interact with those.

The Service continues to support this project as a significant step forward in Everglades restoration and conservation. At this time, we have not determined when we will conclude consultation under the Act for those species which the Corps has requested formal consultation. We recognize the time-sensitive nature of the Corps' new planning process. We will work diligently to find a mutually successful conclusion under the Act. Thank you for your cooperation and efforts in protecting federally-listed species. We are available to your staff to discuss possible solutions to information gaps in the BAs effects analyses. If you have any questions regarding this letter, please contact Kevin Palmer by email Kevin_Palmer@fws.gov, or by telephone at 772-469-4280.

Sincerely yours,

Donald R Progulske
For Larry Williams
Field Supervisor
South Florida Ecological Services Office

cc: electronic copy only
Corps, Jacksonville, Florida (Eric Bush, Eric Summa, Gina Ralph)
Corps, West Palm Beach, Florida (Kim Taplin)
District, West Palm Beach, Florida (Matthew Morrison)
Service, Atlanta, Georgia (David Horning)
Service, Jacksonville, Florida (Miles Meyer)
ENP, Homestead, Florida (Robert Johnson, Tylan Dean)
DOI, Jacksonville, Florida (Dennis Duke)
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FWC, West Palm Beach, Florida (Chuck Collins, Barron Moody)

A.5.2.2 Supplemental Technical Analysis in response to Fish and Wildlife Service Request for Additional Information on the Central Everglades Planning Project Biological Assessment

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

OCT 24 2013

Mr. Larry Williams, Field Supervisor
South Florida Ecological Services Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Williams,

In a letter dated September 4, 2013, the USFWS provided comments and a request for additional information to the Corps regarding the Corps August 5, 2013 Central Everglades Planning Project Endangered Species Act Biological Assessment. Please find enclosed information prepared in response to the request for additional information as well as a Supplemental Technical Analysis in Response to Fish and Wildlife Service Request for Additional Information on the Central Everglades Planning Project Endangered Species Act Biological Assessment.

We hope you find this information complete and appropriate to meet the previously discussed schedule of a final biological opinion on December 17th, 2013. As you review this information, please consider providing written acknowledgement of receipt of a complete Biological Assessment.

The Jacksonville District sincerely values the effort that you and your staff have put into this tremendously important restoration project. We look forward to our continued partnership as we move forward with Everglades restoration through the implementation of CEPP. The POC is Gretchen Ehlinger, 701 San Marco Blvd, Jacksonville, FL 32207, telephone 904-232-1682 or gretchen.s.ehlinger@usace.army.mil.

Sincerely,

Eric P. Summa
Chief, Environmental Branch
Planning and Policy Division

Enclosure

SUPPLEMENTAL TECHNICAL ANALYSIS IN RESPONSE TO FISH AND WILDLIFE SERVICE REQUEST FOR ADDITIONAL INFORMATION ON THE CENTRAL EVERGLADES PLANNING PROJECT ENDANGERED SPECIES ACT BIOLOGICAL ASSESSMENT

Central Everglades Planning Project

Prepared by
Department of the Army
U.S. Corps of Engineers, Jacksonville District

October 2013

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A

B

BA Biological Assessment
BCNP Big Cypress National Preserve
BO Biological Opinion

C

C-111 Canal-111
C-111 SC C-111 Spreader Canal
C-x Canal
C&SF Central & south Florida Project
CEPP Central Everglades Planning Project
CEM Conceptual Ecological Models
CERP Comprehensive Everglades Restoration Plan
CFA Core Foraging Area
CFR Code of Federal Regulation
cfs Cubic Feet per Second
COP Combined Operational Plan
Corps U.S. Army Corps of Engineers (see also the Corps)
CM Centimeters
CSSS Cape Sable seaside sparrow (or sparrow)

D

E

EAA Everglades Agricultural Area
ECB Existing Conditions Baseline 2012
EIS Environmental Impact Statement
ENP Everglades National Park
EPA Environmental Protection Agency
ERTP Everglades Restoration Transition Plan
ESA Endangered Species Act
ET Ecological Target

F

FEB Flow Equalization Basin
FWC Florida Fish and Wildlife Conservation Commission
FWS U.S. Fish and Wildlife Service
FEIS Final Environmental Impact Statement
FWCA Fish and Wildlife Coordination Act
FWO Future Without Project Condition
FWS U.S. Fish and Wildlife Service (see also USFWS)

G

G-x Gauging Station or Culvert Structure

H

HSI Habitat Suitability Index

I

IAR Incremental Adaptive Restoration
IOP Interim Operational Plan
ISOP Interim Structural and Operational Plan

J

K

KCOL Kissimmee Chain of Lakes

L

L-x Levee
LEC Lower East Coast

M

MSTS Multi-Species Transition Strategy
MWD Modified Water Deliveries (to ENP)

N

NESRS Northeast Shark River Slough
NGVD National Geodetic Vertical Datum
NMFS National Marine Fisheries Service
NRC National Research Council

O

P

PAL Planning Aid Letter
PDT Project Delivery Team
PL Public Law
PM Performance Measure
ppt parts per thousand
psu practical salinity units

Q

R

RECOVER Restoration, Coordination, and Verification
RPA Reasonable and Prudent Alternative
RSM-BN Regional Simulation Model for Basins
RSM-GL Regional Simulation Model for the Glades and Lower East Coast Service Area

S

S-x Pump Station, Spillway or Culvert

SAV Submerged Aquatic Vegetation
SDCS South Dade Conveyance System (ENP)
SFWMD South Florida Water Management District
SRS Shark River Slough
STA Stormwater Treatment Area

T
TSP Tentatively Selected Plan
U
Corps U.S. Army Corps of Engineers (see also Corps)
USFWS U.S. Fish and Wildlife Service (see also FWS)
USGS U.S. Geological Survey

V
W
WCA Water Conservation Area
WCA-3 AVG Water Conservation Area 3 Gauge Average
WQ Water Quality
WRDA Water Resources Development Act
WSRS Western Shark River Slough

1.0 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 BA is also used in determining 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 or 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)).

2.0 CONSULTATION SUMMARY FOR CEPP

Beginning in November of 2011 and throughout the Central Everglades planning process, employees of the United States Fish and Wildlife Service (FWS) have attended CEPP Project Delivery Team (PDT) and core planning team meetings, as well as South Florida Ecosystem Task Force Working Group sponsored workshops. The FWS has provided substantive comments informally at meetings and through e-mails. Formal comments have been submitted in Planning Aid Letters (PALs) in accordance with the Fish and Wildlife Coordination Act of 1958, as amended (FWCA), 16 U.S.C. 661 *et seq.*, and section 7 of the Endangered Species Act (ESA) of 1973, as amended (Act), 16 U.S.C. 1531 *et seq*. Provided below is a brief consultation summary of the PALs received to date. The FWS PALs are located within Appendix A.

- January 20, 2012: The FWS provided comments on the project goals and objectives, management actions that should be considered (i.e., project components), as well as ecological performance measures.
- March 27, 2012: The FWS provided comments on the planning process including, but not limited to management measure screening, alternative formulation, modeling strategy, and natural resource considerations.
- December 12, 2012: The FWS provided comments on the conceptual design and modeling of the final array of alternatives.
- May 10, 2013: The FWS provided a list of potentially occurring listed species within the project area.

In addition, the US Army Corps of Engineers (Corps) has consulted with FWS by letter dated January 23, 2013 on federally listed threatened and endangered species that may be present in the action study area. In an email dated February 19, 2013, FWS provided concurrence with the Corps' finding of listed species that may be encountered within or adjacent to the action area. Federally threatened and endangered species that may occur within the action area include Florida panther (*Puma concolor coryi*), Florida population of West Indian Manatee (Florida manatee) (*Trichechus manatus*), Cape Sable seaside sparrow (*Ammodramus maritimus mirabilis*), Everglade snail kite (*Rostrhamus sociablis plumbeus*), Northern crested caracara (*Caracara cheriway*), piping plover (*Charadrius melodus*), red-cockaded woodpecker (*Picoides borealis*), roseate tern (*Sterna dougallii dougallii*), wood stork (*Mycteria americana*), American alligator (*Alligator mississippiensis*), American crocodile (*Crocodylus acutus*), Eastern indigo snake (*Drymarchon corais couperi*), Schaus swallowtail butterfly (*Heraclides aristodemus ponceanus*), Miami blue butterfly (*Cyclargus thomasi bethunebakeri*), Stock Island tree snail (*Orthalicus reses* [not incl. *nesodryas*]), crenulate lead-plant (*Amorpha crenulata*), deltoid spurge (*Chamaesyce* *deltoidea* ssp. *deltoidea*), Garber's spurge (*Chamaesyce garberii*), Okeechobee gourd (*Cucurbita okeechobeensis* ssp. *okeechobeenis*), Small's milkpea (*Galactia smallii*), and tiny polygala (*Polygala smallii*). The bald eagle (*Haliaeetus leucocephalus*) has been delisted under the ESA but continues to be protected under the Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act. In addition, the study area contains designated critical habitat for the American crocodile, Everglade snail kite, Cape Sable seaside sparrow, and Florida manatee.

The Corps is coordinating with National Marine Fisheries Service (NMFS) pertaining to potential effects on listed species under their purview by letter and programmatic BA. NMFS will provide a letter to the Corps based on their concurrence with the Corps' finding of listed species that may be encountered or adjacent to the study area. Federally listed species under the purview of NMFS include the 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 study area contains designated critical habitat for the smalltooth sawfish, elkhorn coral, staghorn coral, and Johnson's seagrass.

3.0 STUDY AREA

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 (EAA), the Water Conservation Areas (WCA), Everglades National Park (ENP), the Southern Estuaries (Florida Bay and Biscayne Bay), and the Lower East Coast (LEC) (**Figure 3-1**).

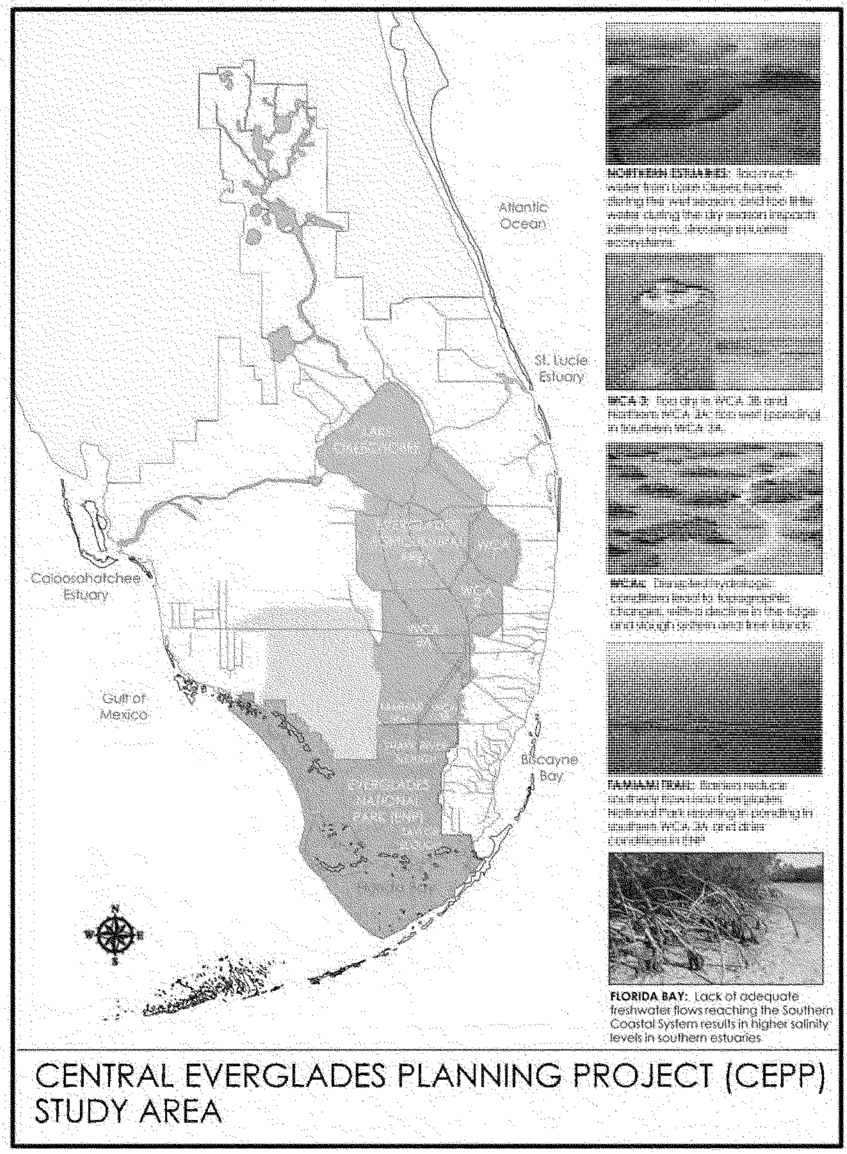


Figure 3-1. Central Everglades Planning Project Study Area

4.0 CEPP PROJECT DESCRIPTION

The purpose of the Central Everglades Planning Project (CEPP) is to improve the quantity, quality, timing, and distribution of water flows to the central Everglades (Water Conservation Area 3 [WCA 3] and ENP). The CEPP will be composed of project components that were identified in the Comprehensive Everglades Restoration Plan (CERP). This study approach is consistent with the recommendations from the National Resource Council (NRC) to utilize Incremental Adaptive Restoration (IAR) to both achieve timely, meaningful benefits of CERP and to lessen the continuing decline of the Everglades ecosystem.

Prior planning efforts and the development of scientific goals and targets for CERP have led to a determination that some components are interdependent features that necessitate formulation from a systems approach. Recently authorized CERP projects are "perimeter" projects that generally do not greatly depend upon or influence other CERP projects. However, the components in the central part of the Everglades (interior CERP projects) are hydraulically connected from Lake Okeechobee to Florida Bay, and are reliant on one another for both inflows and outflows. These interdependencies required system plan formulation and analysis in order to optimize structural and operational components, rather than formulating separable components that may not be compatible when looking at the cumulative effects.

The tentatively selected plan (TSP) will benefit the St. Lucie and Caloosahatchee Estuaries by decreasing the number and severity of high-volume regulatory flood control releases sent from Lake Okeechobee. This will be accomplished by redirecting approximately 210,000 acre feet of additional water to the historical southerly flow path south through flow equalization basins (FEBs) and existing stormwater treatment areas (STAs). The STAs reduce phosphorus concentrations in the water to meet required water quality standards. Rerouting this treated water south and redistributing it across the degraded L-4 Levee will facilitate hydropattern restoration in WCA 3A. This, in combination with Miami Canal backfilling and other CEPP components, is paramount to re-establishing a 500,000-acre flowing system through the northern most extent of the remnant Everglades. The treated water will be distributed through WCA 3A to WCA 3B and ENP via new gated control structures and creation of the Blue Shanty Flowway. The Blue Shanty Flowway will restore continuous sheet-flow and re-connection of a portion of WCA 3B to ENP (**Figure 4-1**).

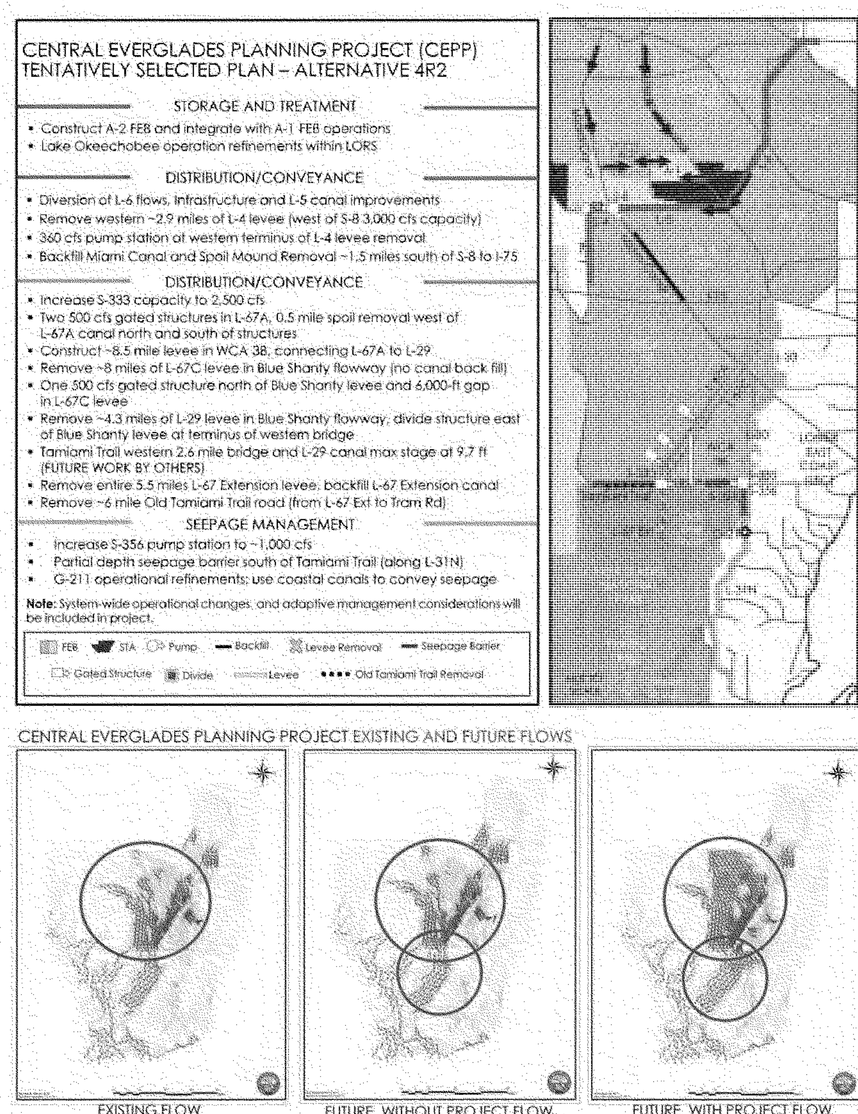


Figure 4-1. CEPP Project Components and Flows

4.1 Plan Features

The components of the TSP, Alternative 4R2 (Alt 4R2), are organized into four geographic areas: North of the Redline, South of the Redline, the Green/Blue lines and along the Yellowline.

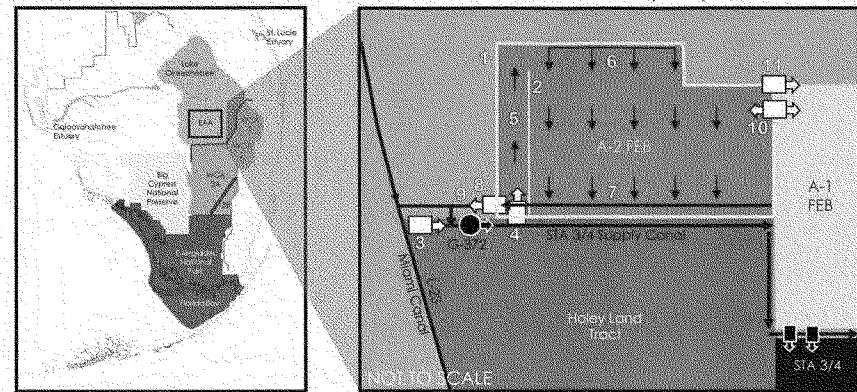
4.1.1 Everglades Agricultural Area (EAA) (North of the Redline)

This includes construction and operations to divert, store and treat Lake Okeechobee regulatory releases (**Figure 4-2**).

Storage and treatment of new water will be possible with the construction of a 14,000 acre FEB and associated distribution features on the A-2 footprint that is operationally integrated with the state-funded and state-constructed A-1 FEB and existing STAs. The A-2 FEB will accept EAA runoff and a portion of the Lake Okeechobee water currently discharged to the estuaries. This Lake Okeechobee water is diverted to the FEB when FEB/STAs and canals have capacity. The C-44 reservoir also collects water that would go to the St. Lucie Estuary and returns some of this water back to Lake Okeechobee, from where it can be delivered to the FEB.

It is anticipated that changes to the 2008 LORS will be needed in order to achieve the complete ecological benefits envisioned through implementation of CEPP. Operational changes to the LORS were incorporated into the hydrologic modeling conducted for the CEPP alternatives, including Alternative 4R2, in efforts to optimize CEPP system-wide performance within the current Zones of the 2008 LORS. More specifically, the hydrologic modeling of the CEPP alternatives included proposed revisions to the 2008 LORS decision tree outcome maximum allowable discharges dependant on the following criteria: Lake Okeechobee inflow and climate forecasts (class limits were modified for tributary hydrologic conditions, seasonal climate outlook, and multi-seasonal climate outlook), stage level (regulation zone), and stage trends (receding or ascending). While some refinements were made within the operational flexibility available in the 2008 LORS, assumptions ultimately extended beyond this flexibility due to adjustments made to the tributary/climatological classifications. Additional information of these assumptions are found in the **Appendix B**. The CEPP Project Implementation Reports/Environmental Impact Statement (PIR/EIS) will not be the mechanism to propose or conduct the required NEPA evaluation or biological assessment of modifications to the Lake Okeechobee Regulation Schedule.

NORTH OF THE REDLINE
STORAGE AND TREATMENT EQUALIZATION BASIN (FEB) – A2



LEGEND: Pump Gated Structure Levee Spreader Canal Existing Structure

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	L-624	Levee		Perimeter Levee (~ 20 miles, 11.3 feet high, 14 feet wide, 3:1 side slope)
2	L-625	Levee		Interior levee (~ 4 miles, 11.3 feet high, 12 feet wide, 3:1 side slope)
3	S-623	Gated Spillway	3700	Delivers water from Miami Canal to existing G-372 pump station
4	S-624	Gated Sag Culvert (FEB inflow structure)	1550	Receives water from existing pump station G-372 via STA 3/4 Supply Canal and delivers it to C-624 FEB inflow canal
5	C-624	FEB Inflow Canal	1550	Conveys water from FEB inflow structure S-624 to FEB C-624 E spreader canal (length: ~ 4 miles)
6	C-624E	FEB Spreader Canal		Distributes FEB inflows across northern FEB; sheetflow within FEB is generally north to south (length: ~ 4 miles)
7	C-625E	FEB Collection Canal	400	Existing seepage canal for STA 3/4 Supply Canal, used to supplement FEB sheetflow during normal operating conditions
8	S-625	Gated Culverts (FEB discharge structure)	1550	Delivers water to FEB outflow canal (C-625W)
9	C-625W	FEB Outflow Canal	1550	FEB Outflow Canal is the extended seepage canal for the STA 3/4 Supply Canal; delivers water via existing G-372 pump station to STA 3/4 for water quality treatment
10	S-628	Gated Culvert (FEB intake/discharge structure)	930	Delivers water in both directions between A-2 FEB and A-1 FEB for operational flexibility
11	S-627	Emergency Overflow weir	445	Location to be determined
A-2 FEB design also includes an exterior seepage collection system (not illustrated):				
	C-626	Seepage Canal	400	~ 11 miles
	S-626	Seepage Pump Station	500	Delivers seepage back into the FEB outflow canal C-625W

Figure 4-2. TSP Treatment and Storage Features and Location

4.1.2 WCA 2A and Northern WCA 3A (South of the Redline)

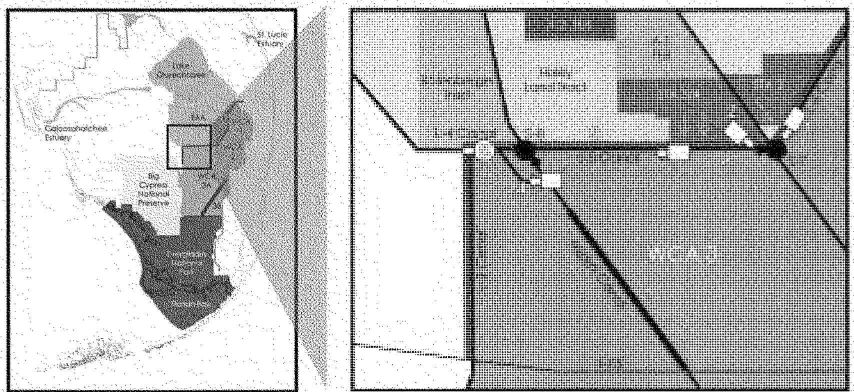
This includes conveyance features to deliver and distribute existing flows and the redirected Lake Okeechobee water through WCA 3A (**Figure 4-3**).

Backfilling 13.5 miles of the Miami Canal between I-75 and 1.5 miles south of the S-8 pump station, and converting the L-4 canal into a spreader canal by removing 2.9 miles of the southern L-4 levee are the key features needed to ensure spatial distribution and flow directionality of the water entering WCA 3A.

Conveyance features to move water into and through the northwest portion of WCA 3A include: a gated culvert to deliver water from the L-6 Canal to the remnant L-5 Canal, a new gated spillway to deliver water from the remnant L-5 canal to the western L-5 canal (during L-6 diversion operations); a new gated spillway to deliver water from STA 3/4 to the S-7 pump station during peak discharge events (eastern flow route is not typically used during normal operations), including L-6 diversion operations; a 360 cubic feet per second (cfs) pump station to maintain Seminole Tribe water supply deliveries west of the L-4 Canal; and new gated culverts to deliver water from the Miami Canal (downstream of S-8, which pulls water from the L-5 Canal) to the L-4 Canal.

The Miami Canal will be backfilled to approximately 1.5 feet below the peat surface of the adjacent marsh. Spoil mounds on the east and west side of the Miami Canal from S-8 to I-75 will be used as a source for Miami Canal backfill material. Refuge for fur-bearing animals and other upland species will continue to be provided by the retention of 22 of the highest priority Florida Fish and Wildlife Conservation Commission (FWC) enhanced spoil mounds between S-339 to I-75 and the creation of additional upland landscape (constructed tree islands) approximately every mile along the entire reach of the backfilled Miami canal section (S-8 to I-75) where historic ridges or tree islands once existed. The constructed tree islands will block flow down the backfilled canal due to the tree island having a profile across the landscape that varies, or undulates, in elevation. Miami Canal constructed tree island design details will be determined during CEPP preconstruction, engineering and design (PED) phase. Tree island design, construction/planting will be coordinated with appropriate science team members with expertise in these topics to accomplish the restoration vision and intent of CEPP's canal backfilling and tree island construction. A diverse array of species will be planted, including trees, shrubs, and herbaceous species that are appropriate for these tree islands.

SOUTH OF THE REDLINE
DISTRIBUTION AND CONVEYANCE



LEGEND: Pump Gated Structure Levee Removal Existing Structure

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-620	Gated Culvert	500	Delivers water from L-6 Canal to L-5 Canal
2	S-621	Gated Spillway	2500	Closed to direct STA 3/4 discharges to western L-5 Canal during normal operations; controls water from STA 3 /4 to the existing S-7 pump station during peak events
3	S-622	Gated Spillway	500	Delivers water from east to west in L-5 Canal (replaces existing L-5 canal plug)
4	S-8A	Gated Culverts with Canal	3080 & 1020	Existing S-8 pump station delivers water from L-5 Canal to Miami Canal; S-8A delivers water from Miami Canal to L-4 Canal (3120 cfs) and remaining Miami Canal segment (1040 cfs); potential design modifications to the existing S-8/G-404 complex will be assessed during PED
5	S-630	Pump Station	360	Delivers water from L-4 Canal west to maintain existing water supply deliveries
6		L-4 Levee Removal		Removes ~2.9 miles of south L-4 Levee
7		Miami Canal Backfill with Tree Islands Mounds		Remove ~ 13.5 miles of Miami Canal , from 1.5 miles south of S-8 to I-75; tree island mounds create habitat and promote sheetflow in WCA-3A within the footprint of the former Miami Canal
8		L-5 Remnant Canal	500	Enlarging canal to expand capacity of L-5 Canal (between S-621 & S-622)
9		L-5 Canal	3000	Enlarging canal to expand capacity of L-5 Canal (between S-622 & S-8)

Figure 4-3. TSP Northern Conveyance and Distribution Features and Location

4.1.3 Southern WCA 3A, WCA 3B, and ENP (Green/Blue Lines)

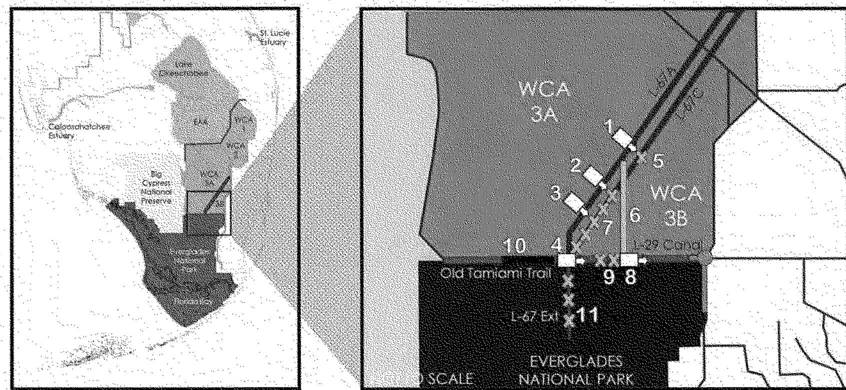
This includes conveyance features to deliver and distribute water from WCA3A to WCA 3B and ENP (**Figure 4-4**).

A new Blue Shanty levee extending from Tamiami Trail northward to the L-67A levee will be constructed. This Blue Shanty levee will divide WCA 3B into two subunits, a large eastern unit (3B-E) and a smaller western unit, the Blue Shanty Flowway (3B-W). A new levee is the most efficient means to restore continuous southerly sheetflow through a practicable section of WCA 3B and alleviates concerns over effects on tree islands by maintaining lower water depths and stages in WCA 3B-E. The width of the 3B-W flowway is aligned to the width of the downstream 2.6-Mile Tamiami Trail Next Steps bridge, optimizing the effectiveness of both the flowway and bridge.

In the western unit, construction of two new gated control structures on the L-67A, removal of the L-67C and L-29 Levees within the flowway, and construction of a divide structure in the L-29 Canal will enable continuous sheetflow of water to be delivered from WCA 3A through WCA 3B to ENP. A gated control structure will also be added to the L-67A, outside the flowway, to improve the hydroperiod of the eastern unit of WCA 3B.

Increased outlet capability at the S-333 structure at the terminus of the L-67A canal, removal of approximately 5.5 miles of the L-67 Extension Levee, and removal of approximately 6 miles of Old Tamiami Trail between the ENP Tram Road and the L-67 Extension Levee will facilitate additional deliveries of water from WCA 3A directly to ENP. Detailed design and construction of these features will consider improving recreation access and minimize project footprints due to the nature of these environmentally sensitive areas. Establishment of expanded maintenance easements along the old Tamiami Trail for existing and new infrastructure, to facilitate road modifications, maintenance and water delivery is recommended.

BLUE AND GREEN LINES
DISTRIBUTION AND CONVEYANCE



LEGEND: Pump   Gated Structure   Levee   Levee Removal   Road Removal   Yellow Line Features

#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-631	Gated Culvert	500	Delivers water from WCA 3A to 3B, east of L-67D Levee
2	S-632	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
3	S-633	Gated Culvert	500	Delivers water from WCA 3A to 3B, west of L-67D Levee
4	S-333 (N)	Gated Spillway w/new canal	1150	Delivers water from L-67A Canal to L-29 Canal; supplements existing S-333 gated spillway
5		L-67C Levee Removal Gap		Gap, ~ 6000 feet (corresponding to S-631)
6	L-67D	Blue Shanty Levee		Levee, ~ 8.5 miles, connecting from L-67A to L-29 (6 feet high, 14-foot crest width, 3:1 side slopes)
7		L-67C Levee Removal		Complete removal of ~ 8 miles from New Blue Shanty Levee (L-67D)south to intersection of L-67A/L-67C; L-67C canal is not backfilled
8	S-355W	Gated Spillway	1230	Maintains water deliveries to eastern L-29 Canal
9		Levee Removal (L-29)		Removal of ~ 4.3 miles between L-67A and Blue Shanty Levee intersection with L-29 Levee
10		Removal of remnants of Old Tamiami Trail roadway		Removal of ~ 6 miles of roadway west of L-67 Extension
11		L-67 Extension Levee Removal and Canal Backfill)		Complete removal of ~ 5.5 miles of remaining L-67 Extension, including S-346 culvert

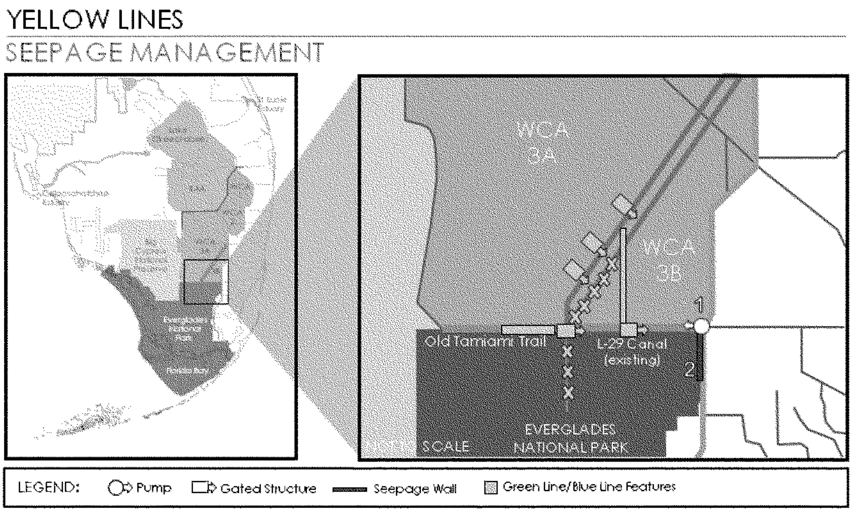
Figure 4-4. TSP Southern Distribution and Conveyance Features and Location.

4.1.4 Lower East Coast Protective Levee (Yellowline)

The LEC protective levee Includes features primarily for seepage management, which are required to mitigate for increased seepage resulting from the additional flows into WCA 3B and ENP (**Figure 4-5**).

A newly constructed pump station with a combined capacity of 1,000 cfs will replace the existing temporary S-356 pump station, and a 4.2 mile seepage barrier cutoff wall will be built along the L-31N Levee south of Tamiami Trail.

There is an existing 2-mile seepage cut-off wall in the same vicinity that was constructed by a permittee as mitigation. There is a possibility that the same permittee may construct an additional 5 miles of seepage wall south of the 2-mile seepage wall, if permitted. Since the capability and effectiveness of the existing seepage wall to mitigate seepage losses from ENP remains under investigation, the CEPP TSP conservatively includes an approximately 4.2 mile long, 35 feet deep tapering seepage barrier cutoff wall in the event construction is necessary.



#	STRUCTURE	STRUCTURE/FEATURE TYPE	CFS	TECHNICAL NOTES
1	S-356	Pump Station	1000	Provides seepage management for WCA 3B and NESRS stages
2		Seepage Barrier Cutoff Wall		Soil cement bentonite (SCB) wall (~4.2 miles, 3 feet wide, 35 feet deep)

Figure 4-5. TSP Seepage Management Features and Location.

4.2 PROJECT AUTHORITY

The 2000 Water Resources Development Act (WRDA) provided authority for future projects in Section 601(d)(1)(A) under the CERP project. Specific authorization for CEPP will be sought under Section 601(d) as a future CERP project:

(d) AUTHORIZATION OF FUTURE PROJECTS.—

(1) IN GENERAL.—Except for a project authorized by subsection (b) or (c), any project included in the Plan shall require a specific authorization by Congress.

(2) SUBMISSION OF REPORT.—Before seeking congressional authorization for a project under paragraph (1), the Secretary shall submit to Congress—

(A) a description of the project; and

(B) a project implementation report for the project prepared in accordance with subsections (f) and (h).

Sections 601(f) and (h) provide for evaluation of projects and assurance of project benefits. This is accomplished in Project Implementation Reports.

4.3 PROJECT GOAL, OBJECTIVES, CONSTRAINTS AND PERFORMANCE MEASURES

The goals of CEPP remain consistent with prior planning efforts of CERP (USACE 1999). Specific CEPP objectives were created to address the central part of the southern Florida ecosystem to improve the quantity, quality, timing, and distribution of water flows to the central Everglades, including WCA 3 and ENP.

4.3.1 Goal and Objectives

The six CEPP objectives were built upon the overall CERP goals and objectives (**Table 4-1**) in order to provide the needed linkages between the projects. 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"*.

Table 4-1. Goals and Objectives of CEPP. Goals and objectives for CERP are also depicted to acknowledge the direct linkage between the two projects.

CERP Objective	CEPP Objective
CERP GOAL: Enhance Ecological Values	
Increase the total spatial extent of natural areas	No corresponding CEPP objective; consider this objective in future increments
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 & industrial)	Increase availability of water supply to the Lake Okeechobee Service Area, Lower East Coast, and Broward
Reduce flood damages (agricultural/urban)	No corresponding CEPP objective; consider this objective in future increments
Provide recreational and navigation opportunities	Provide recreational opportunities
Protect cultural and archeological resources and values	Protect cultural and archeological resources and values

4.3.2 Constraints

Project constraints were recognized to ensure that the proposed project would not reduce the level of service for flood protection, protect existing legal users, and meet applicable water quality standards for the natural system. In accordance with Section 601(h)(5) of WRDA 2000 and Chapter 373.1501(4)(d), Federal Statute (F.S.), the following are constraints for CEPP implementation:

- Avoid any reduction in the existing level of service for flood protection caused by Plan implementation
- Provide replacement sources of water of comparable quantity and quality for existing legal users caused by Plan implementation
- Meet applicable Water Quality Standards

4.3.3 Performance Measures

The overall objective of CEPP is to rehydrate the Everglades through improvements in quantity, quality, timing, and distribution of flows. Rehydration within the Greater Everglades would improve habitat for some threatened and endangered species within the project area. The Corps and FWS, in conjunction with the multi-agency CEPP team, evaluated potential project effects on Everglade snail kite, wood stork, alligator, crocodile, vegetation, and Cape Sable seaside sparrow using performance measures (PMs) and ecological targets (ETs) for these species and their habitat previously developed for the Everglades Restoration Transition Plan (ERTP 2012). The ERTP PMs and ETs were adapted for use in CEPP and are defined as follows. The PMs are defined as a set of operational rules that identify optimal

WCA 3A water stages and recession rates to improve conditions in WCA 3A for Everglade snail kite, wood stork, wading birds, and tree islands. The ERTP PM-A addresses the nesting window for Cape Sable Seaside Sparrow subpopulation A (CSSS-A), as outlined in the 1999 FWS Reasonable and Prudent Alternative (RPA; FWS 1999). The ETs are designed to support the intention of PMs by providing hydroperiod guidelines to help maintain appropriate nesting and foraging habitat. For example, ET-1 outlines a NP-205 stage of less than 7.0 feet National Geodetic Vertical Datum (NGVD) by December 31. Based upon NP-205 recession rate calculations, a stage of less than 7.0 at NP-205 on December 31 will enable water levels to reach less than 6.0 feet NGVD by mid-March (PM-A). As referenced in the ERTP PMs and ETs, **Figure 4-6** shows the locations of the gauges.

The FWS, along with Wiley Kitchens, Ph.D. of the University of Florida, Phil Darby, Ph.D. of the University of West Florida, and Christa Zweig, Ph.D. of the University of Florida, developed a series of water depth recommendations for WCA 3A that addresses the needs of the Everglade snail kite, apple snail, and vegetation characteristics of their habitat (**Figure 4-7**). This water management strategy is divided into three time periods representing the height of the wet season (September 15 to October 15), the pre-breeding season (January) and the breeding season (termed dry season low, May 1 to June 1) and illustrates appropriate water depths to attain within each time period. Water depth recommendations as measured at the WCA 3AVG (average of Site 63 [Gauge 3A-3], Site 64 [Gauge 3A-4] and Site 65 {Gauge 3A-28]) proposed within the FWS Multi-Species Transition Strategy (MSTS, FWS 2010) form the basis for ERTP PMs and ETs. Please note that these water depths are not targets, but used as guidance and represent a compromise between the needs of the multiple species. Inter-annual variability is extremely important in the management of the system to promote recovery of the species.

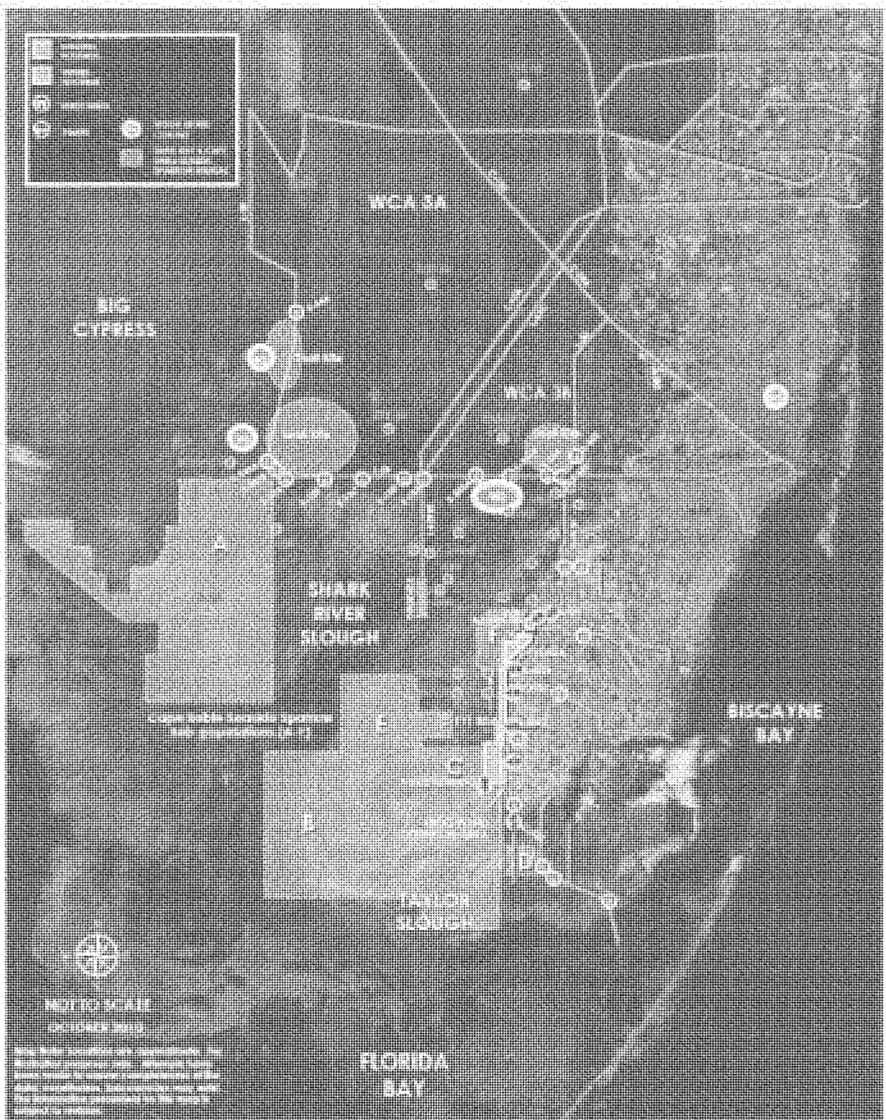


Figure 4-6. Location of gauges within the CEPP action area as referenced in the Everglades Restoration Transition Plan Performance Measures and Ecological Targets

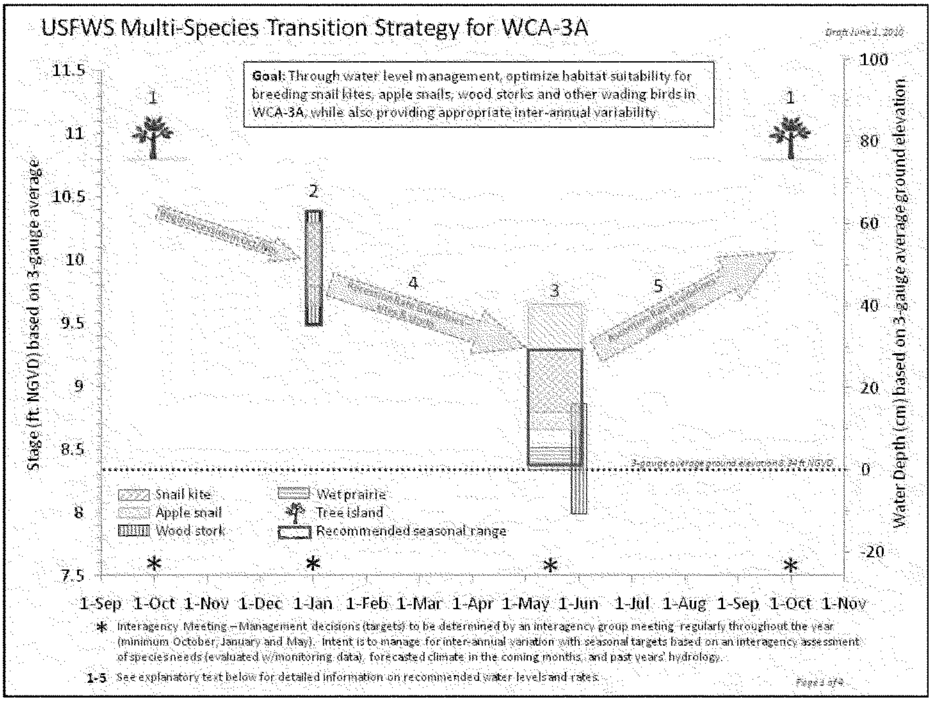


Figure 4-7. U.S. Fish and Wildlife Service Multi-Species Transition Strategy for Water Conservation Area 3A

The FWS MSTS (2010) for WCA 3A includes species-specific ranges (windows) which reflect water levels or water depths identified by species experts based on the best available science that are believed to provide optimal conditions for wading bird breeding and foraging as well as tree island considerations.

Many ERTP PMs and ETs were used to evaluate potential effects of CEPP on threatened and endangered species within the project area (**Table 4-2**). It is important to note that for the evaluation of potential effects on Everglade snail kite, PM-B and PM-C were adapted in order to evaluate depths within specific areas throughout WCA 3A and WCA 3B to give a broader spatial perspective of habitat suitability. Additional detail is located within **Section 6.2.6** of this document. In addition, Ecological Planning Tools were also used to evaluate potential project effects on listed species. Ecological Planning Tools used within this assessment include, Alligator Production Model (South Florida Natural Resources Center [SFNRC] 2013a), Juvenile Crocodile Habitat Suitability Index (Brandt 2013), Apple Snail Production Model (SFNRC 2013d), and Wood Stork Foraging Potential Model (SFNRC 2013b). Details of these models and analyses are outlined in further detail within relevant sections of this document.

In addition to the PMs and ETs mentioned above, additional hydrologic and ecologic PMs developed by CERP's interagency science group, the Restoration, Coordination, and Verification group, (RECOVER) were used in the evaluation of alternative plans and assessment of CERP performance from a system-wide perspective. RECOVER PMs identify hydrologic and ecological indicators expected to respond to implementation of CERP and are developed from Conceptual Ecological Models (CEMs) 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.

Table 4-2. ERTP Performance Measures Used to Evaluate Potential CEPP Effects on Threatened and Endangered Species CEPP.

Species	PM	Description of PM
CSSS	A	*NP-205 (CSSS-A): Provide a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD beginning no later than March 15*
Everglade Snail kite	B	*WCA-3A: For Everglade snail kites, strive to reach waters levels between 9.8 and 10.3 feet NGVD by December 31, and between 8.8 and 9.3 feet between May 1 and June 1.*
	C	*WCA-3A: For apple snails, strive to reach water levels between 9.7 and 10.3 feet NGVD by December 31 and between 8.7 and 9.7 feet between May 1 and June 1.*
	D	*WCA-3A (Dry Season Recession Rate): Strive to maintain a recession rate of 0.05 feet per week from January 1 to June 1 (or onset of the wet season). This equates to a stage difference of approximately 1.0 feet between January and the dry season low.*
	E	*WCA-3A (Wet Season Rate of Rise): Manage for a monthly rate of rise less than or equal to 0 .25 feet per week to avoid drowning of apple snail egg clusters.*

*Note: All stages for WCA-3A are as measured at WCA 3- gauge average [WCA-3AVG] [Sites 63, 64, 65])

4.3.4 Ecological Targets

Cape Sable Seaside Sparrow

1. NP-205 (CSSS-A): Strive to reach a water level of less than or equal to 7.0 feet NGVD at NP-205 by December 31 for nesting season water levels to reach 6.0 feet NGVD by mid- March.

2. CSSS: Strive to maintain a hydroperiod between 90 and 210 days (3 to 7 months) per year throughout sparrow habitat to maintain marl prairie vegetation (hydroperiod depths depend upon averages of gauges).

4.3.5 Model Assumptions

Since ERTP operations are consistently represented between the latest project baselines (2012EC), relative comparisons between these baselines and the CEPP TSP Alternative 4R2 should provide suitable information for assessment of future without project effects (2012EC versus FWO) and CEPP effects (FWO versus Alternative 4R2). Since the previous water management regime, the 2006 Interim Operational Plan for Protection of the Cape Sable Seaside Sparrow (IOP) has been superseded by 2012 ERTP, the ECB baseline no longer accurately represents the existing conditions. ERTP modeling was conducted in 2010 with the 2006 version of the South Florida Water Management Model (SFWMM, version 5.5.2.2), including a 36-year period of simulation (1965-2000). The CEPP modeling was conducted in 2012-2013 using the Regional Simulation Model for Basins (RSM-BN) and the Regional Simulation Model for the Glades and the Lower East Coast Service Area (RSM-GL) with a 41-year period of simulation (1965-2005). The RSM-GL model was selected as the preferred modeling tool for CEPP, given consideration of the increased grid cell resolution within the Greater Everglades, the increased user-input flexibility for operational rules, and the successful application of RSM-GL during the CERP Decompartmentalization (DECOMP) project. At the time of the initial baseline model development for

CEPP, ERTP operations were not implemented and the Existing Condition Baseline (ECB) was developed. Following implementation of ERTP operations in October 2012 and prior to completion of CEPP Project Assurances assessments, the baseline was updated to better represent existing regional water management rules with ERTP -- the resultant 2012 Existing Conditions (2012EC) was initially completed in February 2013. The initial FWO baseline condition for CEPP included ERTP, in addition to the SFWMD Restoration Strategies and other CERP projects.

Comparisons across models with different assumptions and different underlying software are generally not recommended. Relative performance comparisons should instead only be conducted between alternatives/baselines simulated with the same model and application version. The SFWMM and RSM-GL models utilize different grid cell meshes, which result in slightly different topography at the CSSS-A monitoring gauges despite reliance on the same topographic data sources: NP-205 varies from 6.01 ft NGVD with the RSM-GL to 6.45 ft NGVD with the SFWMM; P-34 varies from 2.19 ft NGVD with the RSM-GL to 2.41 ft NGVD with the SFWMM. The model topography affects computed nesting days and hydroperiod statistics. Calibration and validation statistics between the two models also includes significant variability, including at the CSSS-A monitoring gauges. For the calibration period (1984-1995), NP-205 bias and root mean square error (RMSE) were reported as 0.21/0.54 feet for the RSM-GL and 0.091/0.504 for the SFWMM. For the calibration period, P-34 bias and RMSE were reported as 0.12/0.43 feet for the RSM-GL and 0.066/0.431 for the SFWMM. For the validation period (1981-1983 and 1996-2000), NP-205 bias and RMSE were reported as 0.02/0.36 feet for the RSM-GL and 0.121/0.539 for the SFWMM. For the validation period, P-34 bias and RMSE were reported as -0.18/0.39 feet for the RSM-GL and -0.060/0.371 for the SFWMM. Calibration and validation reports for the SFWMM and RSM-GL are available, including graphical plots for the calibration and validation performance. In general, the SFWMM version 5.5 calibration performance for P-34 is slightly improved compared to the RSM-GL (**Figure 4-8** and **Figure 4-9**), although it should be noted that the SFWMM recalibration for the 41 and 46 year periods of simulation are currently in progress and this trend may change.

Model simulations of the effects of ERTP operations compared to IOP do demonstrate differences between the SFWMM simulations conducted during ERTP (LORS_T3 for IOP; 9E1 for ERTP) and the RSM-GL simulations conducted during CEPP (ECB for IOP; 2012EC for ERTP), particularly for P-34. Although the P-34 gauge location was not specifically evaluated in the 2011 Final EIS (NP-205 was evaluated), the SFWMM simulation results did not indicate significant change at P-34 (see **Figure 4-10** which shows the 1984-1995 calibration period). The baseline simulations for CEPP generally track similarly to the ERTP simulations, although minor differences are observed during springtime recession periods (see **Figure 4-11** which shows the 1984-1995 calibration period). The RSM-GL simulated stages also generally do not recede below ground to the degree observed with the SFWMM simulations, typically differing by 0.25-0.5 feet.

Compared to the RSM-GL ECB baseline simulation for CEPP, the 2012EC updated base condition indicates an average annual hydroperiod increase of 2 days for NP-205 (269 versus 271) and 8 days for P-34 (263 versus 255). According to the CEPP performance measures for CSSS nesting, the number of years with more than 60 days below ground during the March through July nesting period is unchanged for NP-205 (26 of 40 years) and reduced by 2 years for P-34 (30 of 40 years for ECB; 28 of 40 years for 2012EC).

Since ERTP operations are consistently represented between the latest project baselines (2012EC), relative comparisons between these baselines and the CEPP TSP Alternative 4R2 should provide suitable information for assessment of future without project affects (2012EC versus FWO) and CEPP affects

(FWO versus Alternative 4R2). Since IOP has been superseded by ERTP, the ECB baseline no longer accurately represents the existing conditions.

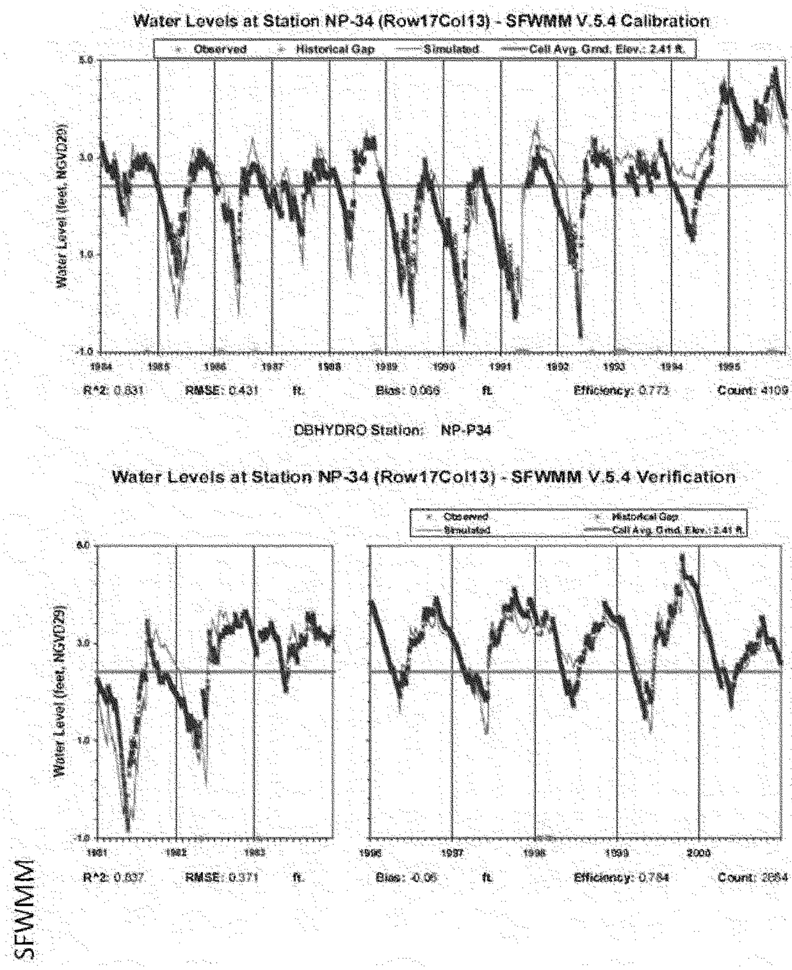


Figure 4-8. Calibration/validation for SFWMM at NP-34.

RSM-GL

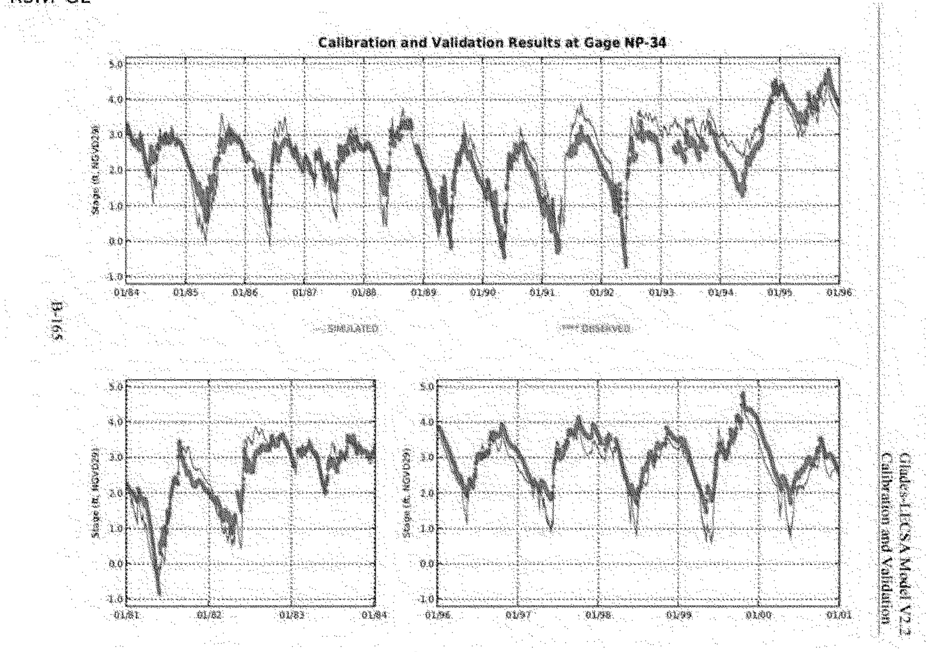


Figure 4-9. Validation/calibration for RSM-GL at NP-34.

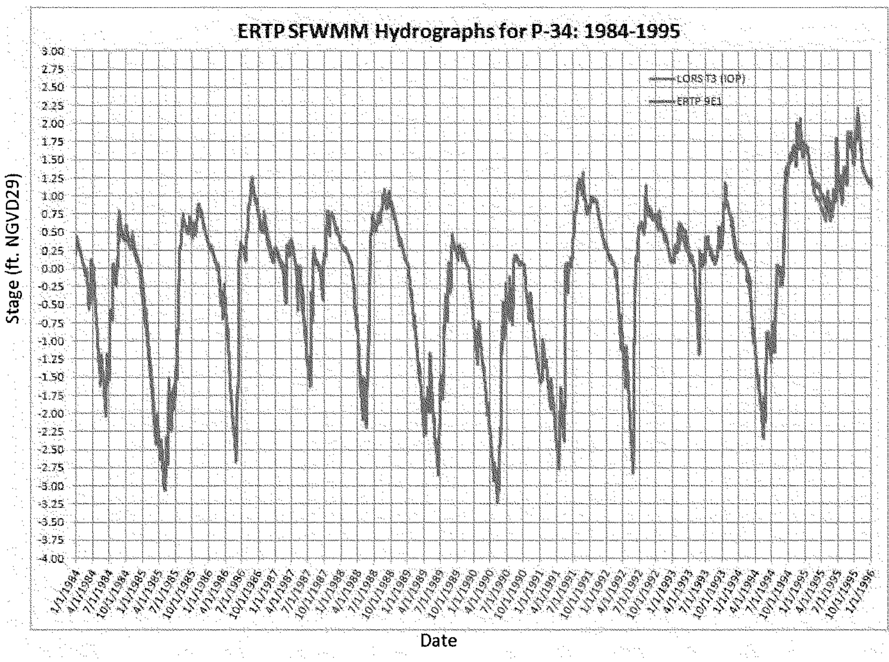


Figure 4-10. IOP vs ERTP for P-34.

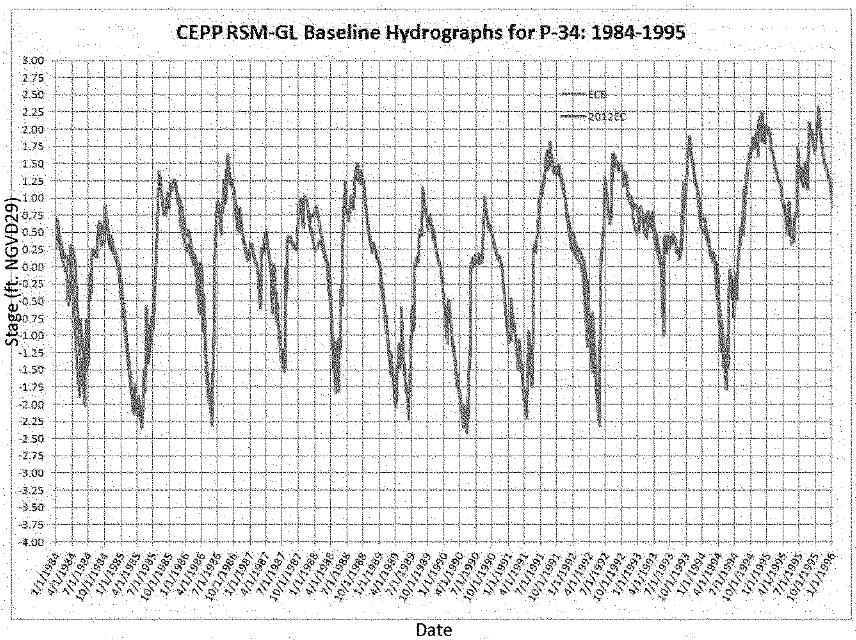


Figure 4-11. Baseline comparisons at P-34 between ECB and 2012 ECB with RSM-GL.

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

The following describes existing conditions within the action area. **Error! Reference source not found.** provides a brief description of each region of the study area.

5.1 Existing Conditions

Table 5-1. Existing Conditions of the CEPP Study Area.

CEPP Study Area Region	Description of the Study Area Region
Lake Okeechobee	Lake Okeechobee is a large, shallow lake (surface area 730 square miles) 30 miles west of the Atlantic coast and 60 miles east of the Gulf of Mexico. 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). The lake is surrounded by the 143 mile long Herbert Hoover Dike. The lake has many functions, including flood risk management, urban and agricultural water supply, navigation, recreation, fisheries, and wildlife habitat. It is critical for flood control during wet seasons and water supply during dry seasons. Agriculture in the Lake Okeechobee Service Area (LOSA), including the EAA, is the predominate user of lake water. The lake is an economic driver for both the surrounding areas and south Florida's economy.
Northern Estuaries	Lake Okeechobee discharges into the 2 Northern Estuaries. The St. Lucie Canal flows eastward into the St. Lucie Estuary, which is part of the larger Indian River Lagoon Estuary.

CEPP Study Area Region	Description of the Study Area Region
	The Caloosahatchee Canal/River flows westward into the Caloosahatchee Estuary and San Carlos Bay, which are part of the larger Charlotte Harbor Estuary. The St. Lucie and Caloosahatchee estuaries are designated Estuaries of National Significance, and the larger Indian River Lagoon and Charlotte Harbor estuaries are part of the U.S. Environmental Protection Agency (USEPA)-sponsored National Estuary Program. The landscape includes pine-flatwoods, wetlands, mangrove forests, submerged aquatic vegetation, estuarine benthic areas (mud and sand) and near-shore reefs.
Everglades Agricultural Area	The EAA is approximately 630,000 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. The landscape includes natural and man-made areas of open water such as canals, ditches, and ponds, wetlands, and lands associated with agricultural and urban use. Within the EAA there is approximately 45,000 acres of STAs and the Holey Land and Rotenberg Wildlife Management Areas.
Water Conservation Areas	WCA 1, WCA 2, and, WCA 3 (the largest of the three) are situated southeast of the EAA and are approximately 1,328 square miles. The WCAs extend from EAA to ENP. They provide floodwater retention, public water supply, and are the headwaters of ENP. The landscape includes open water sloughs, sawgrass marshes, and tree islands.
Everglades National Park	ENP was established in 1947, covering ~2,353 square miles (total elevation changes of only 6 feet from its northern boundary at Tamiami Trail south to include much of Florida Bay). The landscape includes sawgrass sloughs, tropical hardwood hammocks, mangrove forest, lakes, ponds, and bays.
Florida Bay	Florida Bay is a shallow estuarine system (average depth less than 3 feet comprising a large portion of ENP. It 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. The landscape includes saline emergent wetlands, seagrass beds, and mangrove forests.
Lower East Coast	The LEC encompasses Palm Beach, Broward, Monroe and Miami-Dade Counties. Water levels in this area are highly controlled by the Central and Southern Florida (C&SF) water management system to provide flood damage reduction and sufficient water supply to minimize the risk of detrimental saltwater intrusion. The CEPP is focused on the portions of the LEC adjacent to the natural areas and susceptible to seepage.

5.1.1 Vegetative Communities

5.1.1.1 Lake Okeechobee

The vegetation and cover types within the Lake Okeechobee region have been greatly altered during the last century. Historically the natural vegetation was a mix of freshwater marshes, hardwood swamps, cypress swamps, pond apple forests, and pine flatwoods. Freshwater marshes were the predominant cover type throughout, especially along the southern portion of Lake Okeechobee where it flowed into the Everglades. These marshes were 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*) occurred in riverine areas feeding Lake Okeechobee, while cypress swamps were found in depressional areas throughout the region. Pine flatwoods composed of slash pine (*Pinus elliottii*), cabbage palm (*Sabal palmetto*), and saw palmetto (*Serenoa repens*) were prevalent in upland areas especially to the north.

The majority of the surface of Lake Okeechobee is not vegetated and provides open water (pelagic) habitat. Open water habitat within Lake Okeechobee covers about 75% of the lake's surface area. Lake Okeechobee has an extensive littoral zone that occupies approximately 150 square miles (about 25 percent) of the lake's surface (Milleson 1987). Littoral vegetation occurs along much of Lake Okeechobee's perimeter, but is most extensive along the southern and western borders (Milleson 1987). The littoral zone plant community is composed of a mosaic of emergent and submergent plant species. Emergent vegetation within the littoral zone is dominated by herbaceous species such as cattail (*Typha spp.*), spike rush (*Eleocharis cellulose*), and torpedo grass (*Panicum repens*) an invasive exotic species. 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*), sourthern 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 melaleuca (*Melaleuca quiquenervia*), an invasive exotic species. Over the years, there has been an on-going effort to eradicate melaleuca. The eradictation effort has been extremely effective.

The submerged vegetation is composed almost entirely of hydrilla (*Hydrilla verticillata*), which is an invasive exotic species, pondweed (*Potoamogeton illinoensis*), bladderwort (*Utricularia spp.*), Chara (*Chara spp.*), 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*), water hyacinth (*Eichhornia crassipes*) which is an invasive exotic species, water lettuce (*Pistia stratiotes*), duckweed (*Lemna spp.*), coinwort (*Hydrocotyle umbellate*), and ludwigia (*Ludwigia leptocarpa*).

5.1.1.2 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 CCMP, 1996). Many commercial and recreational fisheries (i.e. clams, shrimp, lobster, fish) are associated with healthy seagrass beds (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.

5.1.1.2.1 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 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).

The effects of hurricane water releases in 2005 resulted in decreased plant cover and density in the latter half of 2005. Compounding the high turbidity effects from freshwater releases in 2005, precipitous increases in salinities beginning in October 2006 raised salinity levels from 10 to 25 psu from November 2006 through April 2008. During the December 2005 to April 2006 period, the lower water clarity 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 recovery has been slow. This may be related to a lack of propagules as nearly all the *V. americana* was lost during the 2007 to 2008 high salinity period. It may also be related to herbivory or other impacts on the initial recolonization of recruits into the area (RECOVER 2009).

5.1.1.2.2 Lower Caloosahatchee River 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.

5.1.1.2.3 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.

5.1.1.3 Everglades Agricultural Area

Currently, much of the native south Florida landscape has been destroyed or substantially reduced by development, hydrologic change, increased nutrients, and the invasion of exotic plants. South of Lake Okeechobee, the historic pond apple swamps and sawgrass marshes have been converted to agriculture. Habitat types within the EAA are divided into five general groups: aquatic, wetland, upland, disturbed (mostly agricultural), and urban/extractive.

The aquatic communities within the EAA include both natural and man-made areas of open water such as canals, ditches, and ponds. The primary canals include Bolles, Cross, Hillsboro, Miami, North New River, and West Palm Beach. All of Compartment A of the Talisman Land Exchange property is considered to be atypical jurisdictional wetlands based on hydric soils and hydrology. Wetland vegetation is anticipated to return to the site should agricultural practices cease. Upland land cover classes include dry prairie, hardwood hammock and forests, pinelands, and mixed hardwood pine forests. Disturbed communities consist of mostly agricultural lands including pasture (improved and unimproved), row crops, sugarcane, citrus, and other agricultural lands. Most of the urban and extractive lands are concentrated around the Belle Glade area. Low impact urban areas consist of either vegetated or non vegetated lands within areas such as lawns, golf courses, road shoulders, and grassy areas surrounding development. High impact urban areas are non vegetated sites such as buildings, roads, and parking lots. Extractive cover areas consist of surface mining operations such as limestone quarries, phosphate mines, and sand pits as well as the associated industrial complexes.

5.1.1.4 Greater Everglades

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 hydrologic regime (FWS 1999). These communities generally occur along a hydrologic 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 Everglades freshwater wetlands eventually grade into intertidal mangrove wetlands and sub tidal 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 2.96 million acres 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.

Many areas of WCA 3A still contain relatively good wetland habitat consisting of a complex of tree islands, sawgrass marshes, wet prairies, and aquatic sloughs. However, reduced freshwater inflow and drainage by the Miami Canal has overdrained the northern portion of WCA 3A, resulting in increased fire frequency and the associated loss of tree islands, wet prairie, and aquatic slough habitat. Northern WCA 3A is currently dominated largely by mono-specific sawgrass stands and lacks the diversity of communities that exists in southern WCA 3A. In southern WCA 3A, Wood and Tanner (1990) documented the trend toward deep water lily dominated sloughs due to impoundment. In approximately 1991, the hydrology of southern WCA 3A shifted to the deeper water and extended hydroperiods of the new, wet hydrologic era resulting in a northward shift in slough vegetation communities within the WCA 3A impoundment (Zweig and Kitchens 2008). Typical Everglades vegetation, including tree islands, wet prairies, sawgrass marshes, and aquatic sloughs also occurs throughout WCA 3B. However, a shift in vegetation has occurred in WCA 3B toward shorter hydroperiod sawgrass marshes.

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 et al. 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).

In contrast to the vast extent of wetland communities, upland communities comprise a relatively small component of the Everglades landscape and are largely restricted to Long Pine Key, the northern shores of Florida Bay, and the many tree islands scattered throughout the region. Vegetative communities of Long Pine Key include rockland pine forest and tropical hardwood forest. In addition, substantial areas of tropical hardwood hammock occur along the northern shores of Florida Bay and on elevated portions of some forested islands.

5.1.1.4.1 Slough/Open Water Marsh

The slough/open water marsh community occurs in the lowest, wettest areas of the Everglades. This community is a complex of open water marshes containing emergent, floating aquatic, and submerged aquatic vegetation components. The emergent marsh vegetation is typically dominated by spikerushes

(*Eleocharis cellulosa* and *E. elongata*), beakrushes (*Rhynchospora tracyi* and *R. inundata*), and maidencane (*Panicum hemitomon*). Common floating aquatic dominants include fragrant water lily (*Nymphaea odorata*), floating hearts (*Nymphoides aquatica*), and spatterdock (*Nuphar lutea*); and the submerged aquatic community is typically dominated by bladderwort (*Utricularia foliosa*) and periphyton. As shown by Davis et al. (1994), vegetative trends in ENP have included the conversion of slough/open-water marsh communities to shorter hydroperiod sawgrass marshes.

5.1.1.4.2 Sawgrass Marsh

Sawgrass marshes are dominated by dense to sparse stands of *Cladium jamaicense*. Sawgrass marshes occurring on deep organic soils (more than one meter) form tall, dense, nearly monospecific stands. Sawgrass marshes occurring on shallow organic soils (less than one meter) form sparse, short stands that contain additional herbaceous species such as spikerush, water hyssop (*Bacopa caroliniana*), and marsh mermaid weed (*Proserpinaca palustris*) (Gunderson et al. 1997). The adaptations of sawgrass to flooding, burning, and oligotrophic conditions contribute to its dominance of the Everglades vegetation. Sawgrass-dominated marshes once covered an estimated 300,000 acres of the Everglades. Approximately 70,000 acres of tall, monospecific sawgrass marshes have been converted to agriculture in the EAA. Urban encroachment from the east and development within other portions of the Everglades has consumed an additional 79,000 acres of sawgrass-dominated communities (Davis and Ogden 1997).

5.1.1.4.3 Wet Marl Prairies

Wet marl prairies occur on marl soils and exposed limestone and experience the shortest hydroperiods of the slough/marsh/prairie wetland complex. Marl prairie is a sparsely vegetated community that is typically dominated by muhly grass (*Muhlenbergia capillaris*) and short-stature sawgrass. Additional important constituents include black sedge (*Schoenus nigricans*), arrowfeather (*Aristida purpurascens*), Florida little bluestem (*Schizachyrium rhizomatum*), and Elliot's lovegrass (*Eragrostis elliottii*). Periphyton mats that grow loosely attached to the vegetation and exposed limestone also form an important component of this community. Marl prairies occur in the southern Everglades along the eastern and western periphery of Shark River slough (SRS). Approximately 146,000 acres of the eastern marl prairie have been lost to urban and agricultural encroachment (Davis and Ogden 1997). Prior to the modifications, plant communities at the sites analyzed by Bernhardt and Willard (2006) in western SRS consisted of sawgrass marshes. Based on their analysis of pollen records, the authors concluded that "the current spatial distribution and community composition of marl prairies are a response to water management and land cover changes of the twentieth century, and further sampling of modern marl prairie communities and adjacent communities is necessary to document the pre- and post-drainage distribution of marl prairie" (Bernhardt and Willard 2006).

5.1.1.4.4 Tree Islands

Tree islands occur within the freshwater marshes on areas of slightly higher elevation relative to the surrounding marsh. The lower portions of tree islands are dominated by hydrophytic, evergreen, broad-leaved hardwoods such as red bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), dahoon holly (*Ilex cassine*), and pond apple (*Annona glabra*). Tree islands typically have a dense shrub layer that is dominated by coco-plum (*Chrysobalanus icaco*). Additional constituents of the shrub layer commonly include buttonbush (*Cephalanthus occidentalis*) and large leather fern (*Acrostichum danaeifolium*). Elevated areas on the upstream side of some tree islands may contain an upland tropical hardwood hammock community dominated by species of West Indian origin (Gunderson et al. 1997), with species composition shifting toward the north toward more temperate hardwood hammock species. Extended periods of flooding may result in tree mortality and conversion to a non-forested community. In the over-drained areas of WCA 3A, historic wildfires have consumed tree island vegetation and soils. Overall, the spatial extent of tree islands in WCA 3 declined by 61% between 1940 and 1995 (Patterson and Finck 1999). Portions of the WCAs have been flooded to the extent that many forested islands have lost all tropical hardwood hammock trees. Tree islands are considered an extremely important contributor to habitat heterogeneity and overall species diversity within the Everglades ecosystem because they provide nesting habitat and refugia for birds and upland species and serve as hotspots of plant species diversity within the Greater Everglades (Sklar et al. 2002, FWS 1999).

5.1.1.4.5 Mangroves

Mangrove communities are forested wetlands occurring in intertidal, low-wave-energy, estuarine, and marine environments. 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 psu. Florida Bay experiences salinities in excess of 40 psu 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*).

5.1.1.4.6 Seagrass Beds

Seagrasses are submerged vascular plants that form dense rooted beds in shallow estuarine and marine environments. This community occurs in sub tidal 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 psu, but can tolerate considerable short-term salinity fluctuations. Large-scale seagrass die-off has occurred in Florida Bay since 1987, with over 18 percent 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).

5.1.1.4.7 Rockland Pine Forest

Pine rocklands within the project area occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. Pine rocklands occur on relatively flat terrain with moderately to well-drained soils. Most sites are wet for only short periods following heavy rains (Florida Natural Areas Inventory 1990). Limestone bedrock is close to the surface and the soils are typically shallow accumulations of sand, marl, and organic material. Pine rockland is an open, savanna-like community with a canopy of scattered south Florida slash pine (*Pinus elliottii* var. *densa*) and an open, low-stature understory. This is a fire-maintained community that requires regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson et al. 1997). The overstory is comprised of scattered south Florida slash pines. The shrub layer is comprised of a diverse assemblage of tropical and temperate species. Common shrubs include cabbage palm (*Sabal palmetto*), coco-plum (*Chrysobalanus icaco*), myrsine (*Rapanea punctata*), saw palmetto (*Serenoa repens*), southern sumac (*Rhus copallinum*), strangler fig (*Ficus aurea*), swamp bay (*Persea palustris*), wax myrtle (*Myrica cerifera*), white indigo berry (*Randia aculeata*), and willow-bustic (*Sideroxylon salicifolium*). The herbaceous stratum is comprised of a very diverse assemblage of grasses, sedges, and forbs. Common herbaceous species include crimson bluestem (*Schizachyrium sanguineum*), wire bluestem (*Schizachyrium gracile*), hairy bluestem

(*Andropogon longiberbis*), bushy bluestem (*Andropogon glomeratus* var. *pumilis*), candyweed (*Polygala grandiflora*), creeping morning-glory (*Evolvulus sericeus*), pineland heliotrope (*Heliotropium polyphyllum*), rabbit bells (*Crotolaria rotundifolia*), and thistle (*Cirsium horridulum*) (FWS 1999). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, fragmentation, fire suppression, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rockland (FWS 1999).

5.1.1.4.8 Tropical Hardwood Hammock

Tropical hardwood hammocks occur on upland sites where limestone is near the surface. Tropical hardwood hammocks within the action area occur on the Miami Rock Ridge, along the northern shores of Florida Bay, and on elevated outcrops on the upstream side of tree islands. This community consists of a closed canopy forest dominated by a diverse assemblage of hardwood tree species, a relatively open shrub layer, and a sparse herbaceous stratum. This community is dominated by native south Florida species that represent the northern extension of the ranges of species that occur throughout the West Indies, but nowhere else in the continental United States. Common canopy species include gumbo-limbo (*Bursera simaruba*), paradise tree (*Simarouba glauca*), pigeon-plum (*Coccoloba diversifolia*), strangler fig, wild mastic (*Sideroxylon foetidissimum*), willow-bustic, live oak (*Quercus virginiana*), short-leaf fig (*Ficus citrifolia*), and wild tamarind (*Lysiloma bahamense*). Common understory species include black ironwood (*Krugiodendron ferreum*), inkwood (*Exothea paniculata*), lancewood (*Ocotea coriacea*), marlberry (*Ardisia escallonoides*), poisonwood (*Metopium toxiferum*), satinleaf (*Chrysophyllum oliviforme*), and white stopper (*Eugenia axillaris*). Common species of the sparse shrub/herbaceous layer include shiny-leaf wild-coffee (*Psychotria nervosa*), rouge plant (*Rivinal humilis*), false mint (*Dicliptera sexanguloris*), bamboo grass (*Lasciacis divaricata*), and woods grass (*Oplismenus hirtellus*). This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. Fragmentation of remaining tracts, invasion by exotic species, and alterations of water table elevations have also had negative impacts on this community. Tropical hardwood hammocks on the Miami Rock Ridge have been affected by a lowered water table associated with the reduction of freshwater flow through the Everglades. In contrast, tree islands in the WCAs have been flooded to the extent that many have lost all tropical hardwood hammock trees.

5.1.2 Fish and Wildlife Resources

Aquatic macro invertebrates form a vital link between the algal and detrital food web base of freshwater wetlands and the fishes, amphibians, reptiles, and wading birds that feed upon them. Important macro invertebrates of the freshwater aquatic community include crayfish (*Procambarus alleni*), riverine grass shrimp (*Palaemonetes paludosus*), amphipods (*Hyallela aztecus*), Florida apple snail (*Pomacea paludosa*), Seminole ramshorn (*Planorbella duryi*), and numerous species of aquatic insects (USACE 1999).

Small freshwater marsh fishes are also important processors of algae, plankton, macrophytes, and macro invertebrates. Marsh fishes provide an important food source for wading birds, amphibians, and reptiles. Common small freshwater marsh species include the native and introduced golden topminnow (*Fundulus chrysotus*), least killifish (*Heterandria formosa*), Florida flagfish (*Jordenella floridae*), golden shiner (*Notemigonus crysoleucas*), sailfin molly (*Poecilia latipinna*), bluefin killifish (*Lucania goodei*), oscar (*Astronotus ocellatus*), eastern mosquitofish (*Gambusia holbrookii*), and small sunfishes (*Lepomis* spp.) (USACE 1999). The density and distribution of marsh fish populations fluctuates with seasonal changes in water levels. Populations of marsh fishes increase during extended periods of continuous flooding during the wet season. As marsh surface waters recede during the dry season, marsh fishes become concentrated in areas that hold water through the dry season. Concentrated dry season assemblages of marsh fishes are more susceptible to predation and provide an important food source for wading birds (USACE 1999).

Within the Greater Everglades, numerous sport and larger predatory fishes occur in deeper canals and sloughs. Common species include largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), redear sunfish (*Lepomis microlophus*), black crappie (*Pomoxis nigromaculatus*), Florida gar (*Lepisosteus platyrhincus*), threadfin shad (*Dorosoma petenense*), gizzard shad (*Dorosoma cepedianum*), yellow bullhead (*Ameiurus natilis*), white catfish (*Ameiurus catus*), bowfin (*Amia calva*), and tilapia (*Tilapia* spp.) (USACE 1999). Larger fishes are an important food source for wading birds, alligators, otters, raccoons, and mink.

The freshwater wetland complex supports a diverse assemblage of reptiles and amphibians. Common amphibians include the greater siren (*Siren lacertina*), Everglades dwarf siren (*Pseudobranchus striatus*), two-toed amphiuma (*Amphiuma means*), pig frog (*Rana grylio*), southern leopard frog (*Rana sphenocephala*), Florida cricket frog (*Acris gryllus*), southern chorus frog (*Pseudacris nigrita*), squirrel tree frog (*Hyla squirela*), and green tree frog (*Hyla cinerea*) (USACE 1999). Amphibians represent an important forage base for wading birds, alligators, and larger predatory fishes (USACE 1999).

Common reptiles of freshwater wetlands include the American alligator (*Alligator mississippiensis*), snapping turtle (*Chelydra serpentina*), striped mud turtle (*Kinosternon bauri*), mud turtle (*Kinosternon subrubrum*), cooter (*Chrysemys floridana*), Florida chicken turtle (*Deirochelys reticularia*), Florida softshell turtle (*Trionys ferox*), water snake (*Natrix sipidon*), green water snake (*Natrix cyclopion*), mud snake (*Francia abacura*), and Florida cottonmouth (*Agkistrodon piscivorus*) (USACE 1999).

The alligator was historically most abundant in the peripheral Everglades marshes and freshwater mangrove habitats, but is now most abundant in canals and the deeper slough habitats of the central Everglades. Drainage of peripheral wetlands and increasing salinity in mangrove wetlands as a result of decreased freshwater flows has limited the occurrence of alligators in these habitats (Mazzotti and Brandt 1994).

The freshwater wetlands of the Everglades are noted for their abundance and diversity of colonial wading birds. Common wading birds include the white ibis (*Eudocimus albus*), glossy ibis (*Plegadus falcenellus*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodius*), little blue heron (*Egretta caerulea*), tricolored heron (*Egretta tricolor*), snowy egret (*Egretta thula*), green-backed heron (*Butorides striatus*), cattle egret (*Bubulcus ibis*), black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*Nycticorax violacea*), roseate spoonbill (*Ajaia ajaja*), and wood stork (*Mycteria americana*) (USACE 1999). The number of wading birds nesting in the Everglades has decreased by approximately 90 percent, and the distribution of breeding birds has shifted away from ENP into the WCAs (Bancroft et al. 1994). The WCAs support fewer numbers of breeding pairs with relatively lower reproductive success (USACE 1999). Water management practices and wetland losses are believed to be the primary cause of the declines (Bancroft et al. 1994).

Mammals that are well-adapted to the aquatic and wetland conditions of the freshwater marsh complex include the rice rat (*Oryzomys palustris natator*), round-tailed muskrat, and river otter (*Lutra canadensis*). Additional mammals that may utilize freshwater wetlands on a temporary basis include the white-tailed deer (*Odocoileus virginianus*), Florida panther (*Puma concolor coryi*), bobcat (*Lynx rufus*), and racoon (*Procyon lotor*).

Many of the fish and wildlife resources that inhabit the freshwater aquatic community of the Everglades are also common to Lake Okeechobee, the Northern Estuaries, and the EAA. Native habitat for fish and wildlife does not comprise a significant amount of the EAA as the alteration of the landscape for agricultural uses has resulted in the removal of nearly all historically occurring native vegetation. Although abundant wetland habitat has been replaced by agriculture, the creation of ditches, canals, and the flooding of fallow agricultural fields provides some habitat for fish and wildlife, particularly during the rainy season.

The Northern Estuaries are also home to fish and wildlife species found in estuarine and marine habitats. Sea grasses and other submerged aquatic vegetation within the Northern Estuaries provide important habitat and nursery grounds for several fish species. Many fish species spend part or all of their life in the estuary. Common recreational and commercial fish species include mutton snapper (*Lutjanus analis*), yellowtail snapper (*Ocyurus chrysurus*), lane snapper (*Lutjanus synagris*), yellowtail parrot fish (*Sparisoma rubripinne*), gag grouper (*Mycteroperca microlepis*), pinfish (*Lagodon rhomboids*), tarpon (*Megalops atlanticus*), common snook (*Centropomus undecimalus*), crevalle jack (*Cranx hippos*), spotted sea trout (*Cynoscion nebulosus*), redfish (*Sciaenops acellatus*), mullet (*Mugil spp.*), and sheepshead (*Archosargus probatocephalus*). In addition to finfish, the estuaries support a variety of shellfish. Blue crabs, stone crabs, hard clams, and oysters are important estuarine commercial species. Submerged aquatic vegetation and algal communities are also common foraging areas for the green sea turtle. The Northern Estuaries provides forage for seabords (gulls, terns, pelicans, and others), in addition to a large number of wading birds. The Northern Estuaries are also home to marine mammals such as the Atlantic bottlenose dolphin (*Tursiops truncatus*).

5.2 FEDERALLY LISTED SPECIES

Forty federally listed threatened and endangered species are either known to exist or potentially exist within the project area and, subsequently, may be affected by the proposed project. Many of these species have been previously affected by habitat impacts resulting from wetland drainage, alteration of hydroperiod, wildfire, and water quality degradation. The Corps has coordinated the existence of federally listed species with FWS and with NMFS, as appropriate. Specifically, coordination with NMFS includes listed fish, whales, and sea turtles at sea. Separate coordination with the NMFS has been initiated to assess potential affects to marine species. Coordination with FWS includes other listed plants and animals (**Table 5-2**).

Table 5-2. Status of Threatened and Endangered Species Potentially Affected by CEPP and the Corps' Affect Determination on Federally Listed Species (E: Endangered, T: Threatened, SC: Species of Special Concern, SA: Similarity of Appearance, CH: Critical Habitat; Pr E: Proposed Endangered; Pr CH: Proposed Critical Habitat).

Common Name	Scientific Name	Status	Agency	Determination
Mammals				
Florida bonneted bat	*Eumops floridanus*	Pr E	Federal	No Effect
Florida panther	*Puma concolor coryi*	E	Federal	May Affect
Florida manatee	*Trichechus manatus latirostris*	E, CH	Federal	May Affect
Big Cypress fox squirrel	*Sciurus niger avicennia*	T	State	
Florida black bear	*Ursus americanus floridanus*	T	State	
Everglades mink	*Mustela vison evergladensis*	T	State	

Common Name	Scientific Name	Status	Agency	Determination
Florida mouse	*Podomys floridanus*	SC	State	
Florida mastiff bat	*Eumops glaucinus floridanus*	E	State	
Shermans fox squirrel	*Sciurus niger shermani*	SC	State	
Blue whale*	*Balaenoptera musculus*	E	Federal	No Effect
Finback whale*	*Balaenoptera physalus*	E	Federal	No Effect
Humpback whale*	*Megaptera novaeangliae*	E	Federal	No Effect
Sei whale*	*Balaenoptera borealis*	E	Federal	No Effect
Sperm whale*	*Physeter macrocephalus*	E	Federal	No Effect
Birds				
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	Federal	May Affect
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	Federal	May Affect
Northern crested caracara	*Caracara cheriway*	T	Federal	No Effect
Piping plover	*Charadrius melodus*	T	Federal	No Effect
Red-cockaded woodpecker	*Picoides borealis*	E	Federal	No Effect
Roseate tern	*Sterna dougallii dougallii*	T	Federal	No Effect
Wood stork	*Mycteria americana*	E	Federal	May Affect
American oystercatcher	*Haematopus palliatus*	SC	State	
Black skimmer	*Rynchops niger*	SC	State	
Brown pelican	*Pelecanus occidentalis*	SC	State	
Burrowing owl	*Athene cunicularia*	SC	State	
Florida sandhill crane	*Grus canadensis pratensis*	T	State	
Least tern	*Sterna antillarum*	T	State	
Limpkin	*Aramus guarauna*	SC	State	
Little blue heron	*Egretta caerulea*	SC	State	
Osprey	*Pandion haliaetus*	SC	State	
Reddish egret	*Egretta rufescens*	SC	State	
Roseate spoonbill	*Platalea ajaja*	SC	State	
Snowy egret	*Egretta thula*	SC	State	
Snowy plover	*Charadrius alexandrinus*	T	State	
Southeastern American kestrel	*Falco sparveriuspaulus*	T	State	
Tricolored heron	*Egretta tricolor*	SC	State	
White-crowned pigeon	*Columba leucocephalus*	T	State	
White ibis	*Eudocimus albus*	SC	State	
Reptiles				
American alligator	*Alligator mississippiensis*	T/SA	Federal	May Affect
American crocodile	*Crocodylus acutus*	T, CH	Federal	May Affect
Eastern indigo snake	*Drymarchon corais couperi*	T	Federal	May Affect
Green sea turtle*	*Chelonia mydas*	E, CH**	Federal	May Affect
Hawksbill sea turtle*	*Eretmochelys imbricata*	E, CH**	Federal	May Affect
Kemp's Ridley sea turtle*	*Lepidochelys kempii*	E	Federal	May Affect
Leatherback sea turtle*	*Dermochelys coriacea*	E, CH**	Federal	May Affect
Loggerhead sea turtle*	*Caretta caretta*	T	Federal	May Affect
Gopher tortoise	*Gopherus polyphemus*	SC	State	
Miami black-headed snake	*Tantilla oolitica*	T	State	No Effect
Fish				
Gulf sturgeon*	*Acipenser oxyrinchus desotoi*	T, CH**	Federal	No Effect
Shortnose sturgeon*	*Acipenser brevirostrum*	T	Federal	No Effect
Smalltooth sawfish*	*Pristia pectinata*	E, CH	Federal	May Affect

Mangrove rivulus	*Kryptolebias marmoratus*	SC	State	
Opossum pipefish*	*Microphis brachyurus lineatus*	SC	Federal	No Effect
Mangrove gambusia	*Gambusia rhizophorae*	SC	State	
Common Name	**Scientific Name**	**Status**	**Agency**	**Determination**
Invertebrates				
Bartram's hairstreak butterfly	*Strymon acis bartrami*	C	Federal	No Effect
Elkhorn coral*	*Acropora palmata*	T, CH	Federal	No Effect
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C	Federal	No Effect
Staghorn coral*	*Acropora cervicornis*	T, CH	Federal	No Effect
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	Federal	No Effect
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T	Federal	No Effect
Florida tree snail	*Liguus fasciatus*	SC	State	
Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E	Federal	No Effect
Plants				
Beach jacquemonia	*Jacquemontia reclinata*	E	Federal	No Effect
Cape Sable thoroughwort	*Chromolaena frustrata*	Pr E, Pr CH	Federal	No Effect
Crenulate lead plant	*Amorpha crenulata*	E	Federal	No Effect
Deltoid spurge	*Chamaesyce deltoidea* spp. *deltoidea*	E	Federal	May Affect
Garber's spurge	*Chamaesyce garberi*	T	Federal	May Affect
Johnson's seagrass*	*Halophila johnsonii*	E, CH	Federal	No Effect
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeenis*	E	Federal	No Effect
Small's milkpea	*Galactia smallii*	E	Federal	May Affect
Tiny polygala	*Polygala smallii*	E	Federal	May Affect
Eatons spikemoss	*Selaginella eatonii*	E	State	
Lattace vein fern	*Thelypteris reticulate*	E	State	
Mexican vanilla	*Vanilla mexicana*	E	State	
Pine-pink orchid	*Bletia purpurea*	T	State	
Tropical fern	*Schizaea pennula*	E	State	
Wright's flowering fern	*Anemia wrightii*	E	State	

*Marine species under the purview of NMFS

** Indicates critical habitat for the designated species is not within the action study area

A number of candidate animal species (**Table 5-3**) are also known to exist or potentially exist within the project area and include Bartram's hairstreak butterfly (*Strymon acis bartrami*) and Florida leafwing butterfly (*Anaea troglodyte floridalis*). Effects on these species are not anticipated due to their distribution and habitat requirements. A number of candidate plant species are known to exist or potentially exist in the study area, most of which are also associated with pine rocklands. Adverse effects to federally listed candidate plant species are not anticipated due to implementation of CEPP.

Table 5-3. List of species within CEPP project area that are candidate species for protection under the Endangered Species Act.

Common Name	Scientific Name	Federal Status
Plants		
Big pine partridge pea	*Chamaecrista* var. *keyensis*	C
Blodgett's silverbush	*Argythamnia blodgettii*	C
Carter's small-flowered flax	*Linum carteri* var. *carteri*	C
Everglades bully	*Sideroxylon reclinatum* spp. *austrofloridense*	C

Common Name	Scientific Name	Federal Status
Florida brickell-bush	*Brickellia mosieri*	C
Florida bristle fern	*Trichomane spunctatum* spp. *floridanum*	C
Florida pineland crabgrass	*Digitaria pauciflora*	C
Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	C
Florida semaphore cactus	*Consolea corallicola*	C
Pineland sandmat	*Chamaesyce deltoidea* spp. *pinetorum*	C
Sand flax	*Linum arenicola*	C
Invertebrates		
Bartram's hairstreak butterfly	*Strymon acis bartrami*	C
Florida leafwing butterfly	*Anaea troglodyta floridalis*	C

5.3 STATE LISTED SPECIES

The study area also provides habitat for several state listed species (**Table 5-2**). These species are discussed further in the CEPP Project Implementation Report.

5.4 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, Cape Sable seaside sparrow, Everglade snail kite, and American crocodile. Critical habitat for the smalltooth sawfish, elkhorn coral, staghorn coral, and Johnson's seagrass are covered under the purview of NMFS and therefore are discussed under a separate consultation. Maps of critical habitat locations for these species under FWS purview are depicted within the species effect determination sections of this BA as appropriate.

6.0 EFFECTS DETERMINATIONS

Species were evaluated based on the existing conditions baseline (ECB 2012), which includes ERTP operations, the Future Without Project Conditions (FWO), which includes ERTP operations and the assumption that several other CERP projects would be completed (see Appendix B for more detail on existing conditions and FWO), and Alt 4R2 that is described in **Section 4.0** of this BA.

6.1 "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 in detail below.

6.1.1 Crenulate Lead- Plant and "No Effect" Determination

A perennial, deciduous shrub, the crenulate lead-plant is endemic to Miami-Dade County. Agricultural, urban and commercial development within Miami-Dade County have destroyed approximately 98-99% of the pine rockland communities where this species occurred, prompting the FWS to list the crenulate lead-plant as endangered in 1985 (FWS 1999). Other threats to the continued existence of this species include fire suppression, drainage and exotic plant invasion.

Its present distribution is restricted to eight known locations within a 20-square mile area from Coral Gables to Kendall, Miami-Dade County. Four of the known sites are within public parks managed by the Miami-Dade County Parks Department (FWS 1999). As the crenulate lead-plant is not known to occur within WCA-3A or ENP, the Corps has determined that CEPP will have no effect on this species.

6.1.2 Cape Sable Thoroughwort and "No Effect" Determination

The Cape Sable thoroughwort is endemic to south Florida, an herb that is 8-40 inches tall. It occurs throughout coastal rock barrens and berms and sunny edges of rockland hammock. It was proposed to be listed as endangered in December 2012, along with critical habitat. Alt 4R2 is not expected to affect coastal rock barrens, therefore the Corps has determined that CEPP will have no effect on this species.

6.1.3 Deltoid Spurge, Garber's Spurge, Small's Milkpea, and Tiny Polygala "No Effect" Determinations

Pine rocklands are the primary habitat for deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala. This community occurs on areas of relatively high elevation and consequently, has been subject to intense development pressure. In addition, pine rocklands are a fire-maintained community and require regular burns to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). Fire suppression, fragmentation, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rocklands, prompting the listing of these species under the ESA (FWS 1999).

Within the project area, pine rocklands occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key. These listed plant species have the potential to occur within the rocky glades surrounding the Frog Pond Detention Area. Under CEPP, there may be potential changes to the operations of this seepage reservoir, which could potentially affect hydroperiods within this region. Although these changes are not expected to significantly alter hydroperiods, potential effects on plant species within this region could occur with project implementation. However, these effects are expected to be insignificant. Therefore, the Corps has determined the project will have no effect on deltoid spurge, Garber's spurge, Small's milkpea, or tiny polygala.

6.1.4 Okeechobee Gourd and "No Effect" Determination

The Okeechobee gourd is a climbing annual or perennial vine possessing heart to kidney-shaped leaf blades. The cream-colored flowers are bell-shaped and the light green gourd is globular or slightly oblong. The Okeechobee gourd was locally common in the extensive pond apple forest that once grew south of Lake Okeechobee. Historically, the Okeechobee gourd was found on the southern shore of Lake Okeechobee in Palm Beach County and in the Everglades. Currently this species is limited to two disjunct populations, one along the St. Johns River in Volusia, Seminole, and Lake counties in northern Florida and a second around the shoreline of Lake Okeechobee in south Florida (FWS 1999). The conversion of the pond apple forested swamps and marshes for agricultural purposes as well as water-level regulation within Lake Okeechobee have been the principal causes of the reduction in both range and number of the Okeechobee gourd. Areas around Lake Okeechobee would likely not change due to Alt 4R2, therefore, the Corps determined that the project will have no effect on Okeechobee Gourd.

6.1.5 Miami Blue Butterfly and "No Effect" Determination

The Miami blue is a small butterfly endemic to Florida and is officially listed as endangered under the ESA in April 2012. The Miami blue has a forewing length of 10 to 13 millimeters. Males and females are both bright blue dorsally, but females have an orange eyespot near their hind wing. Both sexes have a gray underside with four black spots. The Miami blue occurs at the edges of tropical hardwood hammocks, beachside scrub, and occasionally in rockland pine forests. Larval host plants include the seed pods of nickerbeans (*Caesalpinia spp.*), blackbeards (*Pithecellobium spp.*), and balloon vine (*Cardiospermum* halicababum), a non-native species. Adults feed on the nectar of Spanish needles (*Bidens pilosa*), cat tongue (*Melanthera aspera*), and other weedy flowers near disturbed hammocks.

Primarily a south Florida coastal species, the Miami blue's historic distribution ranged as far north as Hillsborough County on the Gulf Coast and Volusia County on the Atlantic Coast and extended south to the Florida Keys and the Dry Tortugas (FWC 2013b). The butterfly was thought to be extinct following

Hurricane Andrew in 1992, but was observed in November 1999 at Bahia Honda State Park in the Florida Keys. More than 329 surveys conducted at locations in mainland Florida and the Keys have failed to detect other colonies of this species.

Population declines are primarily a result of loss and degradation of suitable habitat due to residential, recreational, and commercial development. In coastal areas where undeveloped lands remain, the introduction of exotics has led to the direct loss of larval host plants and nectar sources. Other perceived threats include human-caused mortality from pesticide and herbicide use. CEPP project features would not affect rockland pine forests or beachside scrub and would therefore have no affect on this species.

6.1.6 Schaus Swallowtail Butterfly and "No Effect" Determination

The Schaus swallowtail butterfly is a large dark brown and yellow butterfly originally listed as an endangered species because of population declines caused by the destruction of its tropical hardwood hammock habitat, mosquito control practices, and over-harvesting by collectors. Schaus swallowtail butterfly distribution is limited to tropical hardwood hammocks and is concentrated in the insular portions of Miami-Dade and Monroe counties, from Elliott Key in Biscayne National Park and associated smaller Keys to central Key Largo (FWS 1999). It is estimated that remaining suitable habitat for this species is 43% of the historical suitable habitat in Biscayne National Park and 17 percent for north Key Largo. The decline has been attributed primarily to habitat destruction (FWS 1999). Due to the lack of preferred subtropical hardwood hammock habitat in the action area, the Corps has determined that the proposed action would have no effect on the Schaus swallowtail butterfly.

6.1.7 Stock Island Tree Snail and "No Effect" Determination

Measuring approximately 45-55 millimeters in length, the arboreal Stock Island tree snail inhabits hardwood hammocks consisting of tropical trees and shrubs such as gumbo limbo, mahogany, ironwood, poisonwood, marlberry and wild coffee, among others. Population declines, habitat destruction and modification, pesticide use, and over-collecting led to the listing of this species as threatened in 1978 (FWS 1999).

The historic distribution of the Stock Island tree snail was thought to be limited to hardwood hammocks on Stock Island and Key West and possibly other lower Keys hammocks. Recently, the range of this species has been artificially extended through the actions of collectors who have introduced it to Key Largo and the southernmost reaches of the mainland. At present, this snail occupies six sites outside of its historic range including ENP and Big Cypress National Preserve. The Corps has determined that CEPP would not affect the subtropical hardwood hammock habitat in ENP and Big Cypress National Preserve; therefore, Alt 4R2 would not affect the Stock Island tree snail.

6.1.8 Northern Crested Caracara and "No Effect" Determination

The Northern crested caracara is listed as threatened by both FWS and the FWC. This large raptor is a dietary generalist and opportunistic feeder. Prey species include invertebrates such as crayfish, beetles, grasshoppers and small mammals, amphibians, reptiles, fish, and birds (Morrison 1998). In Florida, the caracara historically occupied native prairies, but fire suppression has caused widespread conversion of prairies to open brushland. Currently, the bulk of Florida's caracara population has been found on large cattle ranches with improved pastures and scattered cabbage palms. Dry prairies with wetter areas and scattered cabbage palm comprise typical habitat. Caracaras also occur in some improved pasturelands and even in lightly wooded areas with more limited stretches of open grassland. Within these habitats, caracaras exhibit a propensity for nesting in cabbage palms, followed by live oaks, during a nesting season that typically continues from September through June with a concentration during November to

April (Morrison 1998). Caracaras forage within a variety of habitats including improved pastures, adjacent to dwellings and farm buildings, newly plowed or burned fields, agricultural lands, including sod and cane fields, citrus groves, dairies, and wetland habitats (Morrison 1996). Caracaras are non-migratory and may be found in their home range year round. Home ranges average approximately 1,200 ha (approximately 3,000 acres), corresponding to a radius of two to three kilometers (1.2 to 1.9 miles) surrounding the nest site (Morrison and Humphrey 2001). Foraging typically occurs throughout the home range during nesting and non-nesting seasons. Due to lack of preferred habitat within the project area, the Corps has determined that CEPP will have no effect on this species (**Figure 6-1**).

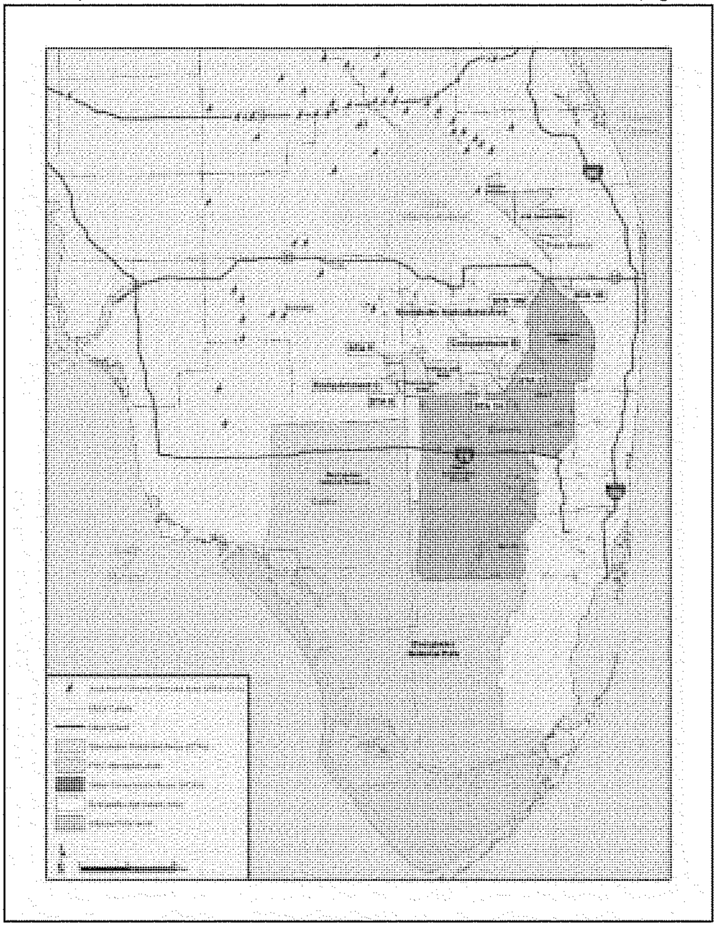


Figure 6-1. Caracara nesting locations from 2003-2013

6.1.9 Piping Plover and "No Effect" Determination

The piping plover is listed by FWS as threatened. The piping plover does not breed in Florida; breeding populations occur near the Great Lakes, the Northern Great Plains, and the Atlantic Coast. Piping plovers regularly winter in the south Florida counties of Broward, Collier, Indian River, Lee, Martin, Miami-Dade, Monroe, Palm Beach, St. Lucie, and Sarasota (Haig 1992). Piping plover nest and feed along coastal sand and gravel beaches throughout North America. Due to lack of preferred wintering habitat within the CEPP project area, the Corps has determined that implementation of CEPP would have no effect on piping plover.

6.1.10 Red-Cockaded Woodpecker and "No Effect" Determination

The red-cockaded woodpecker is identified by its conspicuous white cheek patch, black and white cross-barred back, black cap and nape, white breast and flanks with black spots. In addition, the males have a small bright red spot on each side of the black cap. The bird is approximately 8½ inches in length with a wingspan of 14½ inches. The female is somewhat smaller and resembles the male in coloration, with the exception of a red streak alongside the black cap. The female is approximately 7⅜ inches with a wingspan of 13¼ inches (FWS 1999).

Red-cockaded woodpeckers are a social species and live in groups with a breeding pair and up to four helpers, generally male offspring from the previous year. Approximately 200 acres of mature pine forests are necessary to support each group's nesting and foraging habitat needs. Juvenile females will leave the group prior to the breeding season and establish a breeding pair within a solitary male group. Breeding pairs are monogamous and will raise a single brood each breeding season. Three to four small white eggs will be laid within the roost cavity and incubated by members of the group for a period of ten to twelve days. Chicks are also fed by members of the group and remain within the roost cavity for approximately 26 days. Insects including ants, caterpillars, moths, grasshoppers, spiders, and beetle larvae comprise approximately 85 percent of their diet. The remainder of their diet consists of wild grapes, cherries, poison ivy berries, blueberries, and nuts such as pecans (FWS 1999).

Red-cockaded woodpeckers live in mature pine forests, specifically those with longleaf pines averaging 80 to 120 years old and loblolly pines averaging 70 to 100 years old. Destruction of its preferred long-leaf pine habitat by humans or disease (pines afflicted by fungus or red-ring rot) resulted in the woodpecker becoming listed as endangered in 1970. The current range is from eastern Texas to the southeastern United States and southern Florida. Historically, red-cockaded woodpeckers were found abundantly from Texas to New Jersey and as far inland as Tennessee.

The red-cockaded woodpecker is primarily an upland species, also inhabiting hydric pine flatwoods. Due to lack of lack of appropriate habitat, the Corps has determined that there would be no effect on this species from the implementation of CEPP.

6.1.11 Roseate Tern and "No Effect" Determination

A coastal species, the roseate tern nests on open sandy beaches away from potential predation and human disturbance. This species feeds in nearshore surf on small schooling fishes. In southern Florida, the roseate tern's main nesting areas are located in the Florida Keys and the Dry Tortugas where they nest on isolated islands, rubble islets, and dredge spoils. Although suitable foraging opportunities exist along the shoreline within the project area, the proposed project is not likely to adversely affect their feeding habits or nesting areas. Therefore, the Corps has determined that there would be no effect on this species from the implementation of CEPP.

6.2 "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 quality, quantity, timing, and distribution of flows to the Greater Everglades, including WCA 3A, WCA 3B, ENP, and Florida Bay. The Corps has determined that CEPP may affect federally listed species occurring within the project area including American alligator, American crocodile and its critical habitat, Eastern indigo snake, Florida panther, Florida manatee and its critical habitat, Everglade snail kite and its critical habitat, and wood stork. All standard protection measures for species would be followed during and post construction.

6.2.1 American Alligator and "May Affect" Determination

The American alligator is listed as threatened by the FWS due to similarity of appearance to American crocodile, an endangered species. A keystone species within the Everglades ecosystem, the American alligator (*Alligator mississippiensis*) is dependent on spatial and temporal patterns of water fluctuations that affect courtship and mating, nesting, and habitat use (Brandt and Mazzotti 2000). Historically, American alligators were most abundant in the peripheral Everglades marshes and freshwater mangrove habitats, but are now most abundant in canals and the deeper slough habitats of the central Everglades. Water management practices including drainage of peripheral wetlands and increasing salinity in mangrove wetlands as a result of decreased freshwater flows has limited occurrence of American alligators in these habitats (Craighead 1968, Mazzotti and Brandt 1994). A Habitat Suitability Index (HSI) for alligators was used to predict potential effects of implementation of CEPP Alt 4R2 (South Florida Natural Resources Center 2013a). The HSI measures habitat suitability annually for five components of alligator production: (1) land cover suitability, (2) breeding potential (female growth and survival from April 16 of the previous year - April 15 of the current year), (3) courtship and mating (April 16 – May 31), (4) nest building (June 15 – July 15), and egg incubation (nest flooding from July 01 – September 15).

Results indicate that implementation of Alt 4R2 would improve alligator habitat suitability throughout WCA 3A and ENP as compared with the existing conditions and FWO. The greatest increase in benefits is visible within northern WCA 3A (CEPP Zones 3A-MC, 3A-NE and 3A-NW), with improvements in alligator habitat over existing conditions (**Figure 6-2**) due to additional water deliveries within this region. Gains are smaller in central WCA 3A, WCA 3B, and ENP north and south zones, though they appear to have an increased spatial extent of slightly improved potential habitat in Alt 4R2 **(Figure 6-3).** Changes within southern WCA 3A show potential negative effects to alligator production, however, the effects appear relatively negligible (South Florida Natural Resources Center 2013a). In summary, increasing freshwater flow through the Greater Everglades into ENP under CEPP will provide increased benefits to alligators within these habitats in comparison with the existing conditions. Adverse effects to alligators that utilize the Miami Canal will occur due to backfilling of the Miami Canal. However, these effects are expected to be short-term as alligators will expand into other areas of suitable habitat created as a result of CEPP implementation.

Due to anticipated benefits with CEPP implementation, the Corps has determined that the project may affect American alligator.

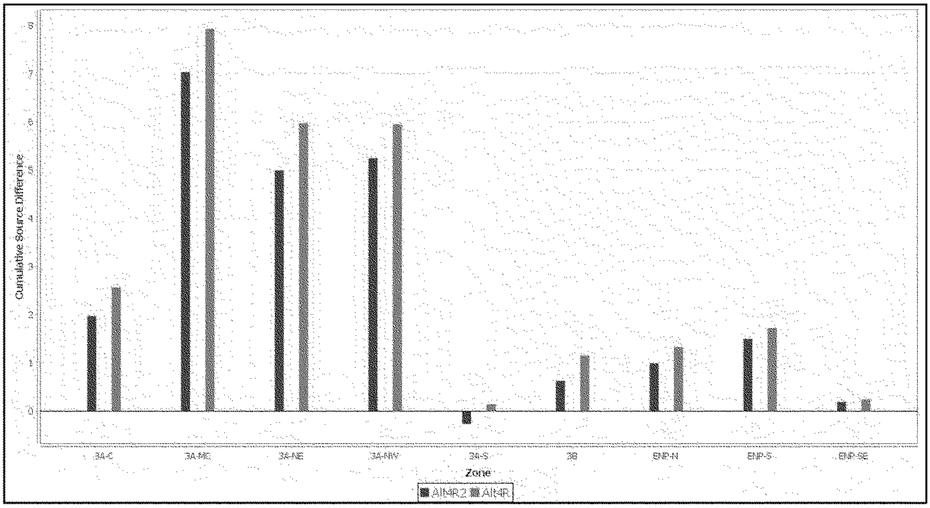


Figure 6-2. Cumulative alligator production habitat suitability (1965-2005) lift from existing conditions (ECB 2012) for Alt4R2 within each CEPP zone. A maximum score of 41 is possible if existing conditions has a suitability score of 0.0 every year and the alternative has a suitability score of 1.0 every year (South Florida Natural Resources Center 2013a).

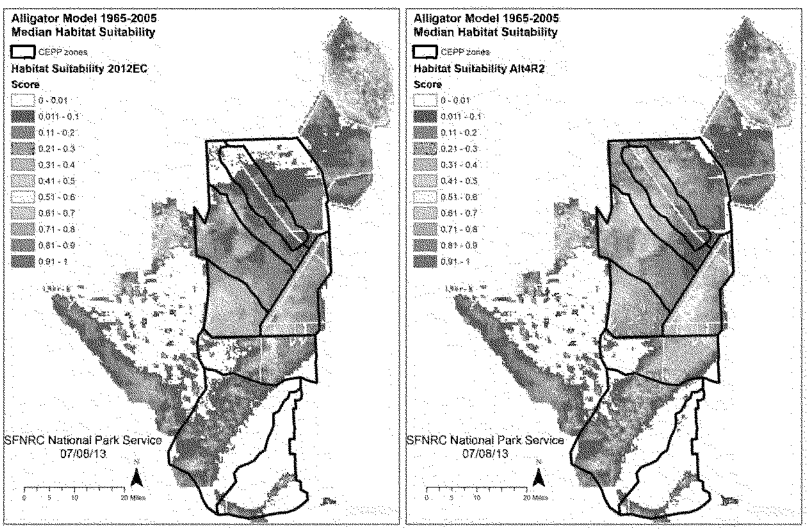


Figure 6-3. Suitable alligator habitat cumulative (1965-2005) lift above the existing conditions for the Alt 4R2 within each water conservation area (WCA) (South Florida Natural Resources Center 2013a)

6.2.2 American Crocodile and "May Affect" Determination

American crocodiles are known to exist throughout the project area, specifically around the coastal fringes from Miami to the bottom of the peninsula and up around Naples (Cherkiss 1999). The cooling canals of Florida Power and Light's Turkey Point Power Plant, which occur within the project boundary, support the most successful crocodile nesting population in south Florida (Mazzotti et al. 2007). These cooling canals offer premium nesting habitat because they satisfy the crocodile's two primary nesting requirements – suitable substrate above the normal high water level and adjacent deep-water refugia. While crocodiles prefer sandy substrates, they will often utilize canal spoil banks (Kushlan and Mazzotti 1989).

A Habitat Suitability Index (HSI) for juvenile American crocodiles was used to predict potential effects of implementation of CEPP Alt 4R2 in Florida Bay. The crocodile growth and survival index used in this analysis is one of the components of a crocodile HSI that characterizes suitable habitat for crocodiles based on habitat, location of known nest sites, salinity, and prey biomass. The growth and survival index is calculated for August through December, the period following hatching when hatchlings are most vulnerable to high salinities (Moler 1992, Mazzotti 1999, Mazzotti et al. 2007). For this analysis, data from salinity monitoring stations at Joe Bay, Trout Cove, Little Madeira Bay (the stations among the available stations closest to where the highest densities of crocodile nests are) and Long Sound, Little Blackwater Sound, Terrapin Bay, and Garfield Bight (generally closer to shoreline stations in areas where crocodiles could occur) are used as input to HSI. Each day between August 1 through December 31 is assigned a score based on the following salinity ranges: salinity <20 practical salinity units (psu) was assigned the highest score of 1 because salinity in this range is considered most favorable for juvenile crocodile growth and survival (Moler 1992, Mazzotti 1999, Mazzotti et al. 2007), salinity $\geq$ 20 and <30 psu was assigned a score of 0.6; $\geq$30 and <40 psu was assigned a score of 0.3, and >40 psu a score of 0. Average yearly and an average overall score were calculated (Brandt 2013).

Results from applying the salinity data into the juvenile crocodile HSI is shown in **Figure 6-4** (Brandt 2013). The plot shows the lift (Alt 4R2 minus existing conditions and FWO) of an index of juvenile crocodile growth and survival at sites along the northern Florida Bay shoreline for all years of the model runs. Sites in the orange box historically have had the most crocodile nesting. Results of the juvenile crocodile HSI performance for an extremely dry (1989) year are shown in **Figure 6-5.** Salinities increase during dry years; therefore, a dry year is representative of a worst case scenario. As indicated by **Figure 6-4** and **Figure 6-5**, implementation of Alt 4R2 will directly benefit juvenile crocodiles within the CEPP project area.

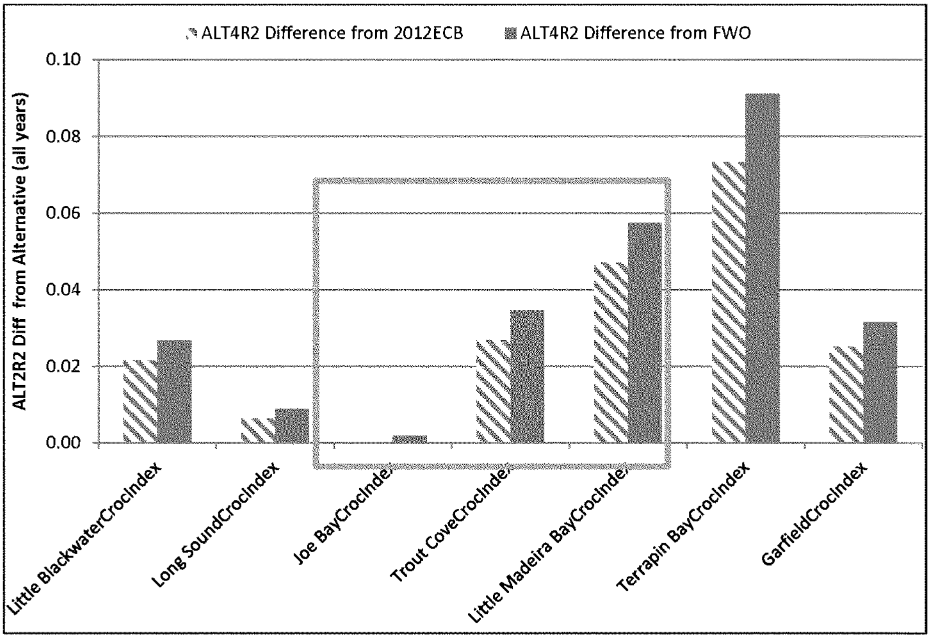


Figure 6-4. Histogram showing the results of the juvenile crocodile HSI for 7 locations of known crocodile occurrence areas across all years within Period of Record (1965-2005). Index values show lift provided by Alt 4R2 as compared with the existing conditions and FWO (Brandt 2013).

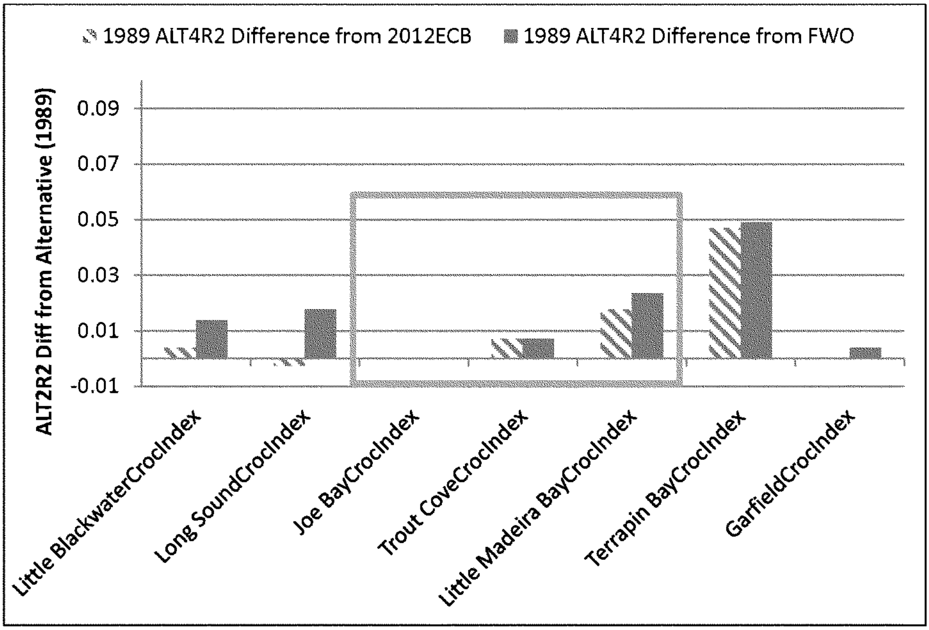


Figure 6-5. Histogram showing the results of the juvenile crocodile HSI for 7 locations of known crocodile occurrence areas for a very dry year (1989). Index values show lift provided by Alt 4R2 as compared with the existing conditions and FWO (Brandt 2013).

An HSI for juvenile American crocodiles was not available to predict potential effects of implementation of CEPP Alt 4R2 in Biscayne Bay; however inferences can be gained from an evaluation in flows along with knowledge of potential suitable habitat within Biscayne Bay. In general, reductions in flows resulting in higher salinities will reduce habitat suitability for crocodiles.

Total flows to Biscayne Bay with Alt 4R2 were increased by an average of 27,000 acre-feet per year (3%) relative to existing conditions. Total flows were decreased by an average of 20,000 acre-feet per year (-2%) relative to FWO. Decreases in freshwater flows occurred in northern portions of Biscayne Bay (i.e. Miami) where there is currently low potential for suitable crocodile habitat due to urban development.

Freshwater flows to the south central portion of Biscayne Bay were increased by an average of 20,000 (8.7%) and 12,000 (5.1%) acre-feet per year relative to existing conditions and FWO, respectively. These increased flows included both wet and dry season increases. Crocodiles are most likely to benefit with implementation of CEPP Alt 4R2 within this area of Biscayne Bay.

Potential effects on crocodiles along the coastline of the southern portion of Biscayne Bay are likely to be minor because the absolute quantity of freshwater discharged to this large area is small for both Alt 4R2 and the existing base conditions. However, implementation of Alt 4R2 decreased flows to the most southern portion of Biscayne Bay (Manatee Bay, Barnes Sound, and Card Sound) during the wet season on average by 8,300 acre feet per year (39%) relative to existing conditions. These decreases were observed in the wet season in association with storm events. Decreases observed during the dry season were less with 800 acre feet per year on average. Alt 4R2 increased flows to this area relative to FWO in both the wet and dry season by 1,200 and 400 acre-feet per year on average, respectively. Most crocodiles within this area have been observed near Card Sound Road, the southeast corner of Florida Power and Light Company's Turkey Point Power Plant, and the Crocodile Lake National Wildlife Refuge on the Key Largo shore of Barnes Sound. Fewer crocodiles have been observed near the S-197 structure (Cherkiss et al. 2001). Salinity changes at these most populated sites would likely be less than 3 ppt based on 8,000 acre feet per year on average decrease in flow and the volume in these water bodies.

6.2.2.1 American Crocodile Effects Determination

Increased freshwater deliveries to ENP, Florida Bay, and Biscayne Bay are predicted to increase suitable habitat for juvenile crocodiles. However, decreased flows to the most southern portion of Biscayne Bay (Manatee Bay, Barnes Sound, and Card Sound) during the wet season may have a negative effect on juvenile crocodiles in this area. Therefore, due to anticipated benefits throughout much of the crocodile's range with CEPP implementation, the Corps has determined that the project may affect, but is not likely to adversely affect, American crocodile.

6.2.2.2 American Crocodile Critical Habitat

As defined in the 50 CFR 17.95 (50 parts 1 to 199, 1 October 2000), the American crocodile's 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. All designated American crocodile critical habitat lies within CEPP study area (**Figure 6-6**).

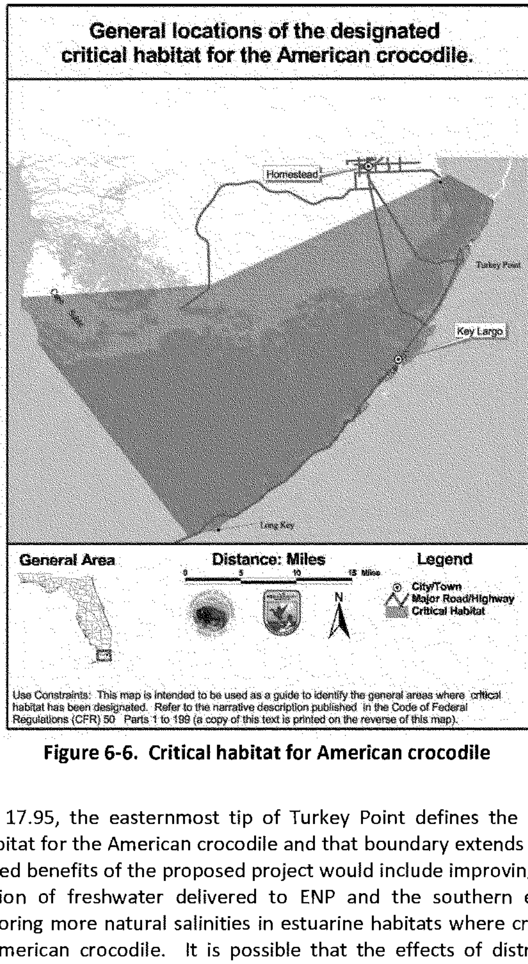


Figure 6-6. Critical habitat for American crocodile

According to 50 CFR 17.95, the easternmost tip of Turkey Point defines the northern boundary of designated critical habitat for the American crocodile and that boundary extends southwest throughout Florida Bay. Anticipated benefits of the proposed project would include improving the quality, quantity, timing, and distribution of freshwater delivered to ENP and the southern estuaries. This could potentially aid in restoring more natural salinities in estuarine habitats where critical habitat has been designated for the American crocodile. It is possible that the effects of distributing overland flow through the wetlands into Florida Bay could have positive effects on tidal wetlands and nearshore salinities that lie within American crocodile critical habitat, but these effects are expected to be minimal. Since the ideal salinity range for American crocodiles is 0 to 20 psu, project implementation has the possibility of enhancing American crocodile habitat within the project area, however, the degree to which this may occur is uncertain. Due to the expected beneficial effects from CEPP implementation, it determined that this project may affect, but is not likely to adversely affect, critical habitat for the American crocodile.

6.2.3 Eastern Indigo Snake and "May Affect" Determination

Eastern indigo snakes were listed as threatened in 1978 due primarily to 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). Declines in Eastern indigo snake populations were also due to over-collection by the pet trade and mortality caused by rattlesnake collectors who gas gopher tortoise burrows to collect snakes (FWS 2013).

The Eastern indigo snake is the largest native non-venomous snake in North America, reaching lengths of up to 8.5 feet (Moler 1992). 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 including pine flatwoods, scrubby flatwoods, floodplain edges, sand ridges, dry glades, tropical hammocks, edges of freshwater marshes, muckland fields, coastal dunes, cabbage palm hammocks, and xeric sandhill communities (Schaefer and Junkin 1990, FWS 1999). Eastern indigo snakes also use agricultural lands and various types of wetlands. Observations over the last 50 years made by maintenance workers in citrus groves in east-central Florida indicate that eastern indigo snakes are most frequently observed near the canals, roads, and wet ditches (FWS 2005). It is anticipated that eastern indigo snakes would be present in sugarcane fields since one of their prey species; the King snake (*Lampropeltis getula floridanus*) has been previously documented in sugarcane fields (Krysko 2002, FWS 2005). Eastern indigo snakes need relatively large areas of undeveloped land to maintain their population. In general, adult males have larger home ranges than females or juveniles. In Florida, Smith (2003) indicated that female and male home ranges extend from 5 to 371 acres and 4 to 805 acres, respectively.

In south Florida, the Eastern indigo snake is thought to be widely distributed. Given their preference for upland habitats (Steiner et al. 1983), Eastern indigo snakes are not commonly found in great numbers in the wetland complexes of the Everglades region, even though they may be found in pinelands, tropical hardwood hammocks, and mangrove forests in extreme south Florida (Duellman and Schwartz 1958, Steiner et al. 1983). They prefer dry, well drained sandy soils, and commonly use burrows and other natural holes as dens. Steiner et al. (1983) also reported that Eastern indigo snakes inhabit abandoned agricultural land and human-altered habitats in south Florida which would include levees within the Water Conservation Areas.

One CEPP project feature to be constructed in the EAA is the A-2 FEB. This would convert approximately 14,000 acres of former agricultural land to a wetland functioning area. The proposed A-2 FEB consists almost exclusively of drained marsh that has been converted to agriculture. Only two soil types occur in the project area: Pahokee Muck and Lauderhill Muck (NRCS 2013). Both types consist of very poorly drained organic materials that commonly occur in broad freshwater marshes. Prior to drainage and agricultural use, the A-2 FEB was characterized as a broad freshwater marsh and with CEPP implementation will likely be converted back to a similar habitat type. Currently, lands that would comprise the A-2 FEB are in agricultural production with sugar cane as the primary crop, although rice has also been observed in some fields. A few areas have become overgrown with exotic Brazilian pepper, willow, dog fennel, and grasses including invasive exotic Napier grass.

No natural standing water features are present in the A-2 FEB project area. Natural sloughs and channels are evident in aerial photographs from the 1940s as well as those taken as recently as 2012. These natural sloughs and channels are much drier due to drainage changes, but are the first areas to be inundated during rains. Man-made drainage features such as ditches and narrow canals traverse the A-2 FEB and are continually being modified and created in response to agricultural needs.

Since Eastern indigo snakes occur primarily in upland areas, their presence within the Greater Everglades is somewhat limited, except within the A-2 FEB and levees throughout the project area. Eastern indigo snakes have a high probability of occurrence within the proposed A-2 FEB site and as a result of construction of the A-2 FEB are likely to be displaced, thereby removing approximately 14,000 acres of potential habitat. Also, due to the secretive nature of the Eastern indigo snake and their tendency to occupy burrows or other underground refugia in vegetative areas where they may not be readily observable by equipment/vehicle operators, some may be taken as a result of construction. Standard construction procedures will be used to avoid Eastern indigo snakes within construction areas following the Standard Protection Measures for the Eastern Indigo Snake (USFWS Dated August 12, 2013). The contractor would be required to keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage of fish and wildlife resources. The contractor would be required to inform the construction team of the potential presence of threatened and endangered species in the work are, the need for construction conservation measures, and any requirements resulting from ESA Section 7 consultation. The hydrologic effects of the proposed project are expected to benefit existing or historic wetlands. Levees along the Miami Canal will be degraded and the spoil used to fill in portions of the Miami Canal. Once the Miami Canal is backfilled, created tree islands will be constructed, potentially providing habitat for Eastern indigo snakes and offsetting the loss of approximately 500 acres of levee habitat. The acreage of levee degrade, canal backfill and tree island creation are listed in **Table 6-1**. In addition, due to increased freshwater flow into Florida Bay and adjacent mangrove communities, CEPP implementation may benefit Eastern indigo snakes within those areas. Due to the loss of upland habitat as a result of CEPP implementation the Corps' has determined that the project may affect Eastern indigo snakes and is therefore requesting formal consultation under ESA for this species.

Table 6-1. Acreage of spoil mounds degraded, spoil mounds retained, levees degraded, and upland areas created.

Project Feature	Upland Acres Lost	Upland Acres Created
A-2 FEB	14,000	
L-4 Degrade	35	
Miami Canal (S-8 to I-75) Spoil Mound Degrade	321	
Miami Canal (S-8 to I-75) Created Tree Islands		49
L-67C Gap Degrade	9	
L-67C Flowway Degrade	64	
L-29 Degrade	46	
Blue Shanty Levee Creation		113
L-67 Extension Levee Degrade	41	
Old Tamiami Trail Road Degrade	31	
Total	14,547	162

6.2.4 Florida Manatee and "May Affect" Determination

The Florida manatee is a large, plant-eating aquatic mammal that can be found in the shallow coastal waters, rivers, and springs of Florida. The 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 ESA in 1973. Because the Florida 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. 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. 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. 1982, 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 July 2013, the FWC reported 672 Florida manatee deaths. Today, poaching is rare, but high mortality rates from human-related sources threaten the future of the species. In general, 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 (Florida Power and Light 1989). However, in 2013, most mortality was related to natural or undetermined causes (FWC 2013).

Florida manatees have been observed in conveyance canals within the project area, specifically in the lower C-111 Canal just downstream of S-197, and adjacent nearshore seagrass beds throughout Florida Bay including all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee and Buttonwood sounds. The extensive acreages of seagrass beds in the bay provide important feeding areas for Florida manatees. Florida manatees also depend upon canals as a source of freshwater and resting sites. 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 6-7** illustrates canals that Florida manatees have access to within the CEPP project area.

Under Alt 4R2, increased freshwater flows to Florida Bay, Biscayne Bay and the southwestern coastal estuaries would improve salinity, therefore reducing stress on sea grasses that are important to foraging manatees. Damaging flows to the Northern Estuaries related to pulse releases would also be reduced, resulting in decreased sedimentation and silt, and increased light penetration, therefore providing better sea grass survival. Alt 4R2 includes backfilling portions of the Miami Canal north of Interstate 75, which manatees do access, however, backfilling could benefit them with less likelihood of becoming stranded in the WCAs. The Corps commits to avoiding and minimizing for adverse effects during construction activities by implementing construction conservation measures as outlined in Standard

Manatee Conditions for In-Water Work (USACE 2011). The Corps' determination is that CEPP may affect, but is not likely to adversely affect, Florida manatee.

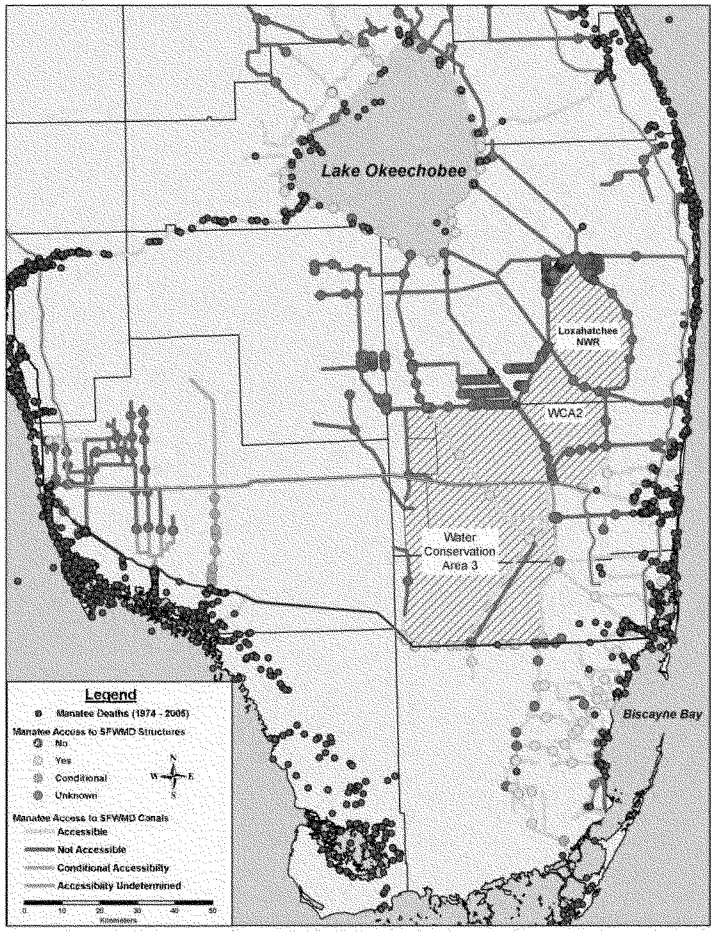


Figure 6-7. Canals that Florida manatees have access to within the Central Everglades Planning Project area

6.2.4.1 Florida Manatee Critical Habitat

Critical habitat for the Florida manatee was designated in 1976 (50 CFR 17.95). The Florida manatee's critical habitat includes all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood sounds between Key Largo, Monroe County, and the mainland of Miami-Dade County (**Figure 6-8**). Another component of designated critical habitat is defined as Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Dade County (CFR 50 Parts 1 to 199; 10-01-00). This was one of the first designations of critical habitat for an endangered species and the first for an endangered marine mammal. Critical habitat for any species is described as the specific area within the geographic area occupied by the species (at the time it is listed under the provisions of section 4 of the Act) on which are found those physical or biological features (i.e. constituent elements) essential to the conservation of the species and which may require special management considerations or protection. No specific primary or secondary constituent elements were included in the critical habitat designation. However, researchers agree that essential habitat features for the Florida manatee include 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 (FWS 2001).

Seagrasses within Florida Bay have long suffered from high salinities due to long-term reductions of freshwater flow. Seagrasses have an optimum salinity range of 24 to 35 psu, but can tolerate considerable short-term salinity fluctuations. Reductions in the number and severity of high volume freshwater discharges to the Northern Estuaries and improvements in seasonal inflow deliveries to Florida Bay and Biscayne Bay under Alt 4R2 has the potential to improve conditions suitable for seagrass survival. In conclusion, the Corps' determination is that CEPP may affect, but is not likely to adversely affect, designated critical habitat for the Florida manatee.

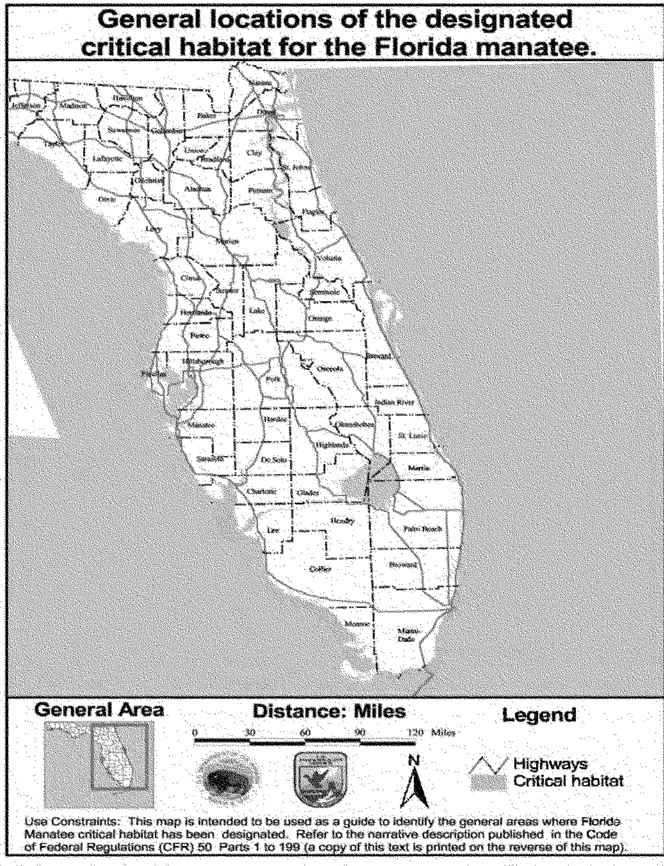


Figure 6-8. Critical habitat for Florida manatee.

6.2.5 Florida Panther and "May Affect" Determination

The 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 has driven the subspecies known as the Florida panther into a small area, where the few remaining animals are highly inbred, causing such genetic flaws as heart defects and sterility. Recently, closely-related panthers from Texas were released in Florida and are successfully breeding with the Florida panthers. Increased genetic variation and protection of habitat may save the subspecies.

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. 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.

Florida panthers presently inhabit lands in the EAA and ENP adjacent to the Southern Glades, and radio tracking studies have shown that they venture into the Southern Glades on occasion during post-breeding dispersion (**Figure 6-9)**. Reference is made to the revised Panther Key and Panther Focus Area Map for use in determining effects to the Florida panther (**Figure 6-10**). CEPP has the potential to affect both the Primary and Secondary Zones for Florida panther habitat (**Figure 6-10**). Construction of the 14,000 acre FEB within the A-2 parcel in EAA would result in conversion of upland habitat that could be potentially used by Florida panther to transverse the area to wetland habitat, thereby eliminating potential habitat within the panther secondary zone in this region (**Table 6-2**). Today, the A-2 FEB contains agricultural fields planted in sugar cane and rice. Some areas are overgrown with Brazilian pepper, willow, and dog fennel; however, most fields are regularly tilled and disked to a standard depth. **Table 6-2** shows other project features that will affect primary and secondary panther habitat either through degradation of levees, backfilling of canals, degradation of spoil mounds and creation of the Blue Shanty levee. Also included are number of acres lost, acres created and the panther habitat unit value. In addition, increased water deliveries to ENP could affect Florida panther habitat. However, as lands within the CEPP project area become restored to their more historic natural values, the improved forage base would result in greater use by the Florida panther utilizing these areas.

Panther prey density, especially deer, is an important factor in evaluating panther habitat. The type of prey available to the panther affects the health and distribution of the panther, as well as its ability to breed and support young. Small mammals including raccoons and river otters would benefit from increased crayfish and small prey fish biomass in rehydrated areas within northern WCA 3A, WCA 3B and ENP as a result of Alt 4R2. Although mammals occurring within the action area are adapted to the naturally fluctuating water levels in the Everglades; there is an increased potential for this vegetation transition to have a moderate adverse effect on the mammals utilizing upland habitat. This is a particular concern for deer populations within northern WCA 3A that utilize tree islands due to increased water depths within this area. However, no adverse effects to tree islands within WCA 3A and ENP are anticipated to occur under CEPP implementation. Deer populations that utilize the lower elevation tree islands within WCA 3B may suffer from habitat loss, having a moderate adverse effect. In addition, deer that utilize levees slated for removal (L-67C, L-29, L-67 Extension) also have the potential to show a moderate adverse effect. Loss of these levees may be offset by the construction of the Blue Shanty Levee in WCA 3B. Deer are highly mobile and will migrate to find suitable habitat.

In summary, the loss of upland habitat within the future A-2 FEB, levee degradation within the WCAs and moderate adverse affects to deer populations may affect Florida panther. Based on this information, and the fact that the Florida panther is a wide-ranging species with the majority of sightings west of the project area, the Corps is requesting formal consultation under ESA for this species. As formally agreed upon for CERP, the Corps will utilize panther credits within CERP Picayune Strand Restoration Project for mitigation of potential adverse affects on panther habitat.

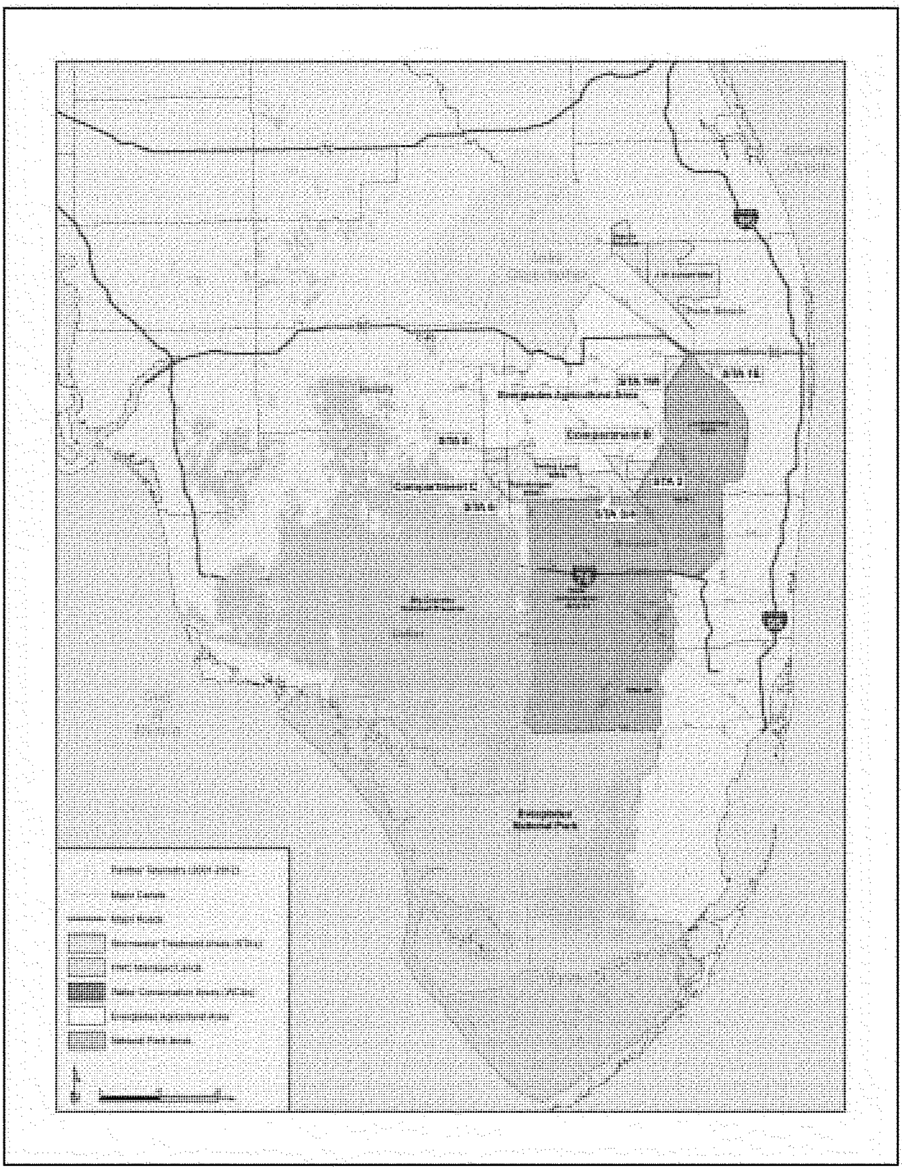


Figure 6-9. Florida panther telemetry information from 2002 – 2012

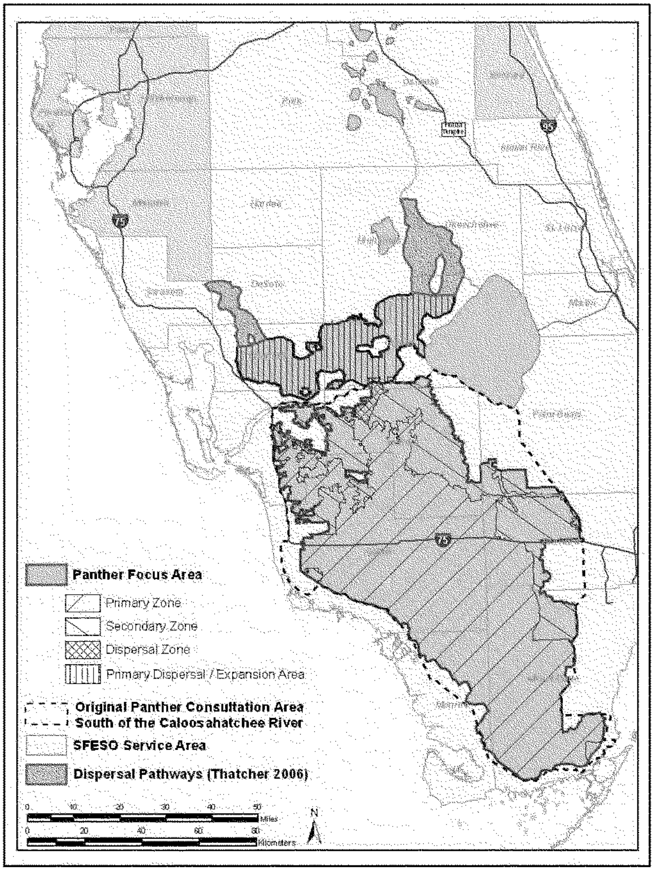


Figure 6-10. Florida panther zones in south Florida (source: Kautz et al. 2006).

Table 6-2. Panther habitat impacts for each CEPP feature based on panther habitat unit values.

Project Feature	Zone of Impacted Lands	Acres Lost	Panther Habitat Unit Value	Acres Created	Panther Habitat Unit Value
A-2 FEB (cropland to FEB)	Secondary	14,000	4.8	14,000	**
L-4 Degrade (barren/disturbed to marsh)	Secondary	35	3	35	4.7
Miami Canal Backfill (water to marsh/wet prairie)	Secondary	417	0	417	4.7
Miami Canal (S-8 to I-75) Spoil Mound Degrade (upland to marsh/wet prairie)	Primary and Secondary	321	9	321	4.7
Miami Canal (S-8 to I-75) Created Tree Islands	Primary and Secondary			49	9.3
L-67C Gap Degrade (barren/disturbed to marsh)	Primary	9	3	9	4.7
L-67C Flowway Degrade (barren/disturbed to marsh)	Primary	64	3	64	4.7
L-29 Degrade (barren/disturbed to marsh)	Primary	46	3	46	4.7
Blue Shanty Levee Creation (marsh/wet prairie to barren/disturbed)	Primary	113	4.7	113	3
L-67 Extension Levee Degrade (barren/disturbed to marsh)	Primary	41	3	41	4.7
L-67 Extension Backfill (water to marsh)	Primary	104	0	104	4.7
Old Tamiami Trail Road Degrade (barren/disturbed to marsh)	Primary	31	3	31	4.7
Total		**15,181**		**15,230**	

**PHU values for storm water treatments areas (FEB may fall under this category) vary depending on design criteria, mode of operation, location in native or non-native habitats and other landscape features. Will need FWS input on this value.

6.2.6 Everglade Snail Kite and "May Affect" Determination

A wide-ranging, New World raptor, the snail kite is found primarily in lowland freshwater marshes in tropical and subtropical America from Florida, Cuba, and Mexico, and south to Argentina and Peru (FWS 1999). The Florida and Cuban subspecies of the Everglade snail kite, *R. sociabilis plumbeus,* was initially listed as endangered in 1967 due to its restricted range and highly specific diet (FWS 1999). Its survival is directly tied to the hydrology, water quality, vegetation composition and structure within the freshwater marshes that it inhabits (Martin et al. 2008, Cattau et al. 2008).

Everglade snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lakes where the apple snail (*Pomacea paludosa*), the Everglade snail kite's main food source, can be found. Snail kite populations in Florida are highly nomadic and mobile; tracking favorable hydrologic conditions and food supplies, and thus avoiding local droughts. Snail kites move widely throughout the primary wetlands of the central and southern portions of the State of Florida. Snail kite is threatened primarily by habitat loss and destruction. Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once Everglade snail kite habitat. In addition to loss of habitat through drainage, large areas of marsh are heavily infested with water hyacinth, which inhibits the Everglade snail kite's ability to see its prey.

The Everglade snail kite has a highly specialized diet typically composed of apple snails, which are found in palustrine, emergent, long-hydroperiod wetlands. As a result, the Everglade snail kite's survival is directly dependent on the hydrology and water quality of its habitat (FWS 1999). Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Suitable foraging habitat for the Everglade snail kite is typically a combination of low profile marsh and a mix of shallow open water. Shallow wetlands with emergent vegetation such as spike rush (*Eleocharis* spp.), maidencane, sawgrass, and other native emergent wetland plant species provide good Everglade snail kite foraging habitat as long as the vegetation is not too dense to locate apple snails. Dense growth of plants reduces the ability of the Everglade snail kite to locate apple snails and their use of these areas is limited even when snails are in relatively high abundance (Bennetts et al. 2006). Areas of sparse emergent vegetation enable apple snails to climb near the surface to feed, breathe, and lay eggs and thus they are easily seen from the air by foraging Everglade snail kites. Suitable foraging habitats are often interspersed with tree islands or small groups of scattered shrubs and trees which serve as perching and nesting sites.

Snail kite nesting primarily occurs from December to July, with a peak in February-June, but can occur year-round. Nesting substrates include small trees such as willow, cypress (*Taxodium* spp.), and pond apple, and herbaceous vegetation such as sawgrass, cattail, bulrush (*Scirpus validus*), and reed (*Phragmites australis*). Snail kites appear to prefer woody vegetation for nesting when water levels are adequate to inundate the site (FWS 1999). Nests are more frequently placed in herbaceous vegetation during periods of low water when dry conditions beneath willow stands (which tend to grow to at higher elevations) prevent Everglade snail kites from nesting in woody vegetation (FWS 1999). Nest collapse is rare in woody vegetation but common in non-woody vegetation, especially on lake margins (FWS 1999). In order to deter predators, nesting almost always occurs over water (Sykes et al. 1995).

Snail kites construct nests using dry plant material and dry sticks, primarily from willow and wax myrtle (Sykes 1987), with a lining of green plant material that aids in incubation (FWS 1999). Courtship includes male displays to attract mates and pair bonds form from late November through early June (FWS 1999). Snail kites will lay between one and five eggs with an average of about three eggs per nest (Sykes 1995, Beissinger 1988). Each egg is laid at about a two-day interval with incubation generally commencing after the second egg is laid (Sykes 1987). Both parents incubate the eggs for a period of 24 to 30 days (Beissenger 1983). Hatching success is variable between years and between watersheds, but averages 2.3 chicks/nest (FWS 1999, Cattau et al. 2008). February, March, and April have been identified as the most successful months for hatching (Sykes 1987). Snail kites may nest more than once within a breeding season and have been documented to renest after both failed and successful nesting attempts (Sykes 1987, Beissinger 1988). Chicks are fed by both parents through the nestling period although ambisexual mate desertion has been documented (FWS 1999). Young fledge at approximately 9 to 11 weeks of age (Beissenger 1988). Adults forage no more than 6 kilometers from the nest, and generally less than a few hundred meters (Beissenger 1988, FWS 1999). When food is scarce or ecological and hydrologic conditions are unfavorable, adults may abandon the nest altogether (Sykes et al. 1995).

The Everglade snail kite occupies the watersheds of the Everglades, Kissimmee River, Caloosahatchee River, the upper St. Johns River, and Lake Okeechobee. According to the FWS (1999), "Each of these watersheds has experienced, and continues to experience, pervasive degradation due to urban development and agricultural activities." The Everglade snail kite's dependence upon each of these watersheds has shifted significantly over the last decade. Lake Okeechobee and WCA 3A, once important Everglade snail kite foraging and nesting areas, no longer support high densities of Everglade snail kites. Lake Okeechobee is of particular importance since it serves as a critical stopover point as Everglade snail kites traverse the network of wetlands within their range. This loss of suitable habitat and refugium, especially during droughts, may have significant demographic consequences (Martin et al. 2006). Once a productive breeding site, Lake Okeechobee has only made minor contributions to the Everglade snail kite population in terms of reproduction since 1996 (Cattau et al. 2008). The loss of suitable Everglade snail kite foraging and nesting areas within Lake Okeechobee have been attributed to shifts in water management regimes (Bennetts et al. 1998), along with habitat degradation due to hurricanes (Cattau et al. 2008).

Historically, WCA 3A has been a critical component within the Everglade snail kites' wetland network for foraging and reproduction. Changes in water management regimes have contributed to the lack of reproduction within this critical habitat area (Mooij et al. 2002, Zweig and Kitchens 2008, Cattau et al. 2008, 2009).

Between 2001 and 2012, Everglade snail kites were predominantly nesting in southern WCA 3A and the southeast corner of WCA 3B (**Figure 6-11**). The high dependence on one area is of concern due to stochastic events, droughts, water management regimes within the Kissimmee Chain of Lakes (KCOL), and the presence of the exotic apple snail (*Pomacea insularum*). Juvenile Everglade snail kites are not efficient at handling the exotic snail, which is larger in size than the native, and thus, their survival may be suppressed (Cattau et al. 2012).

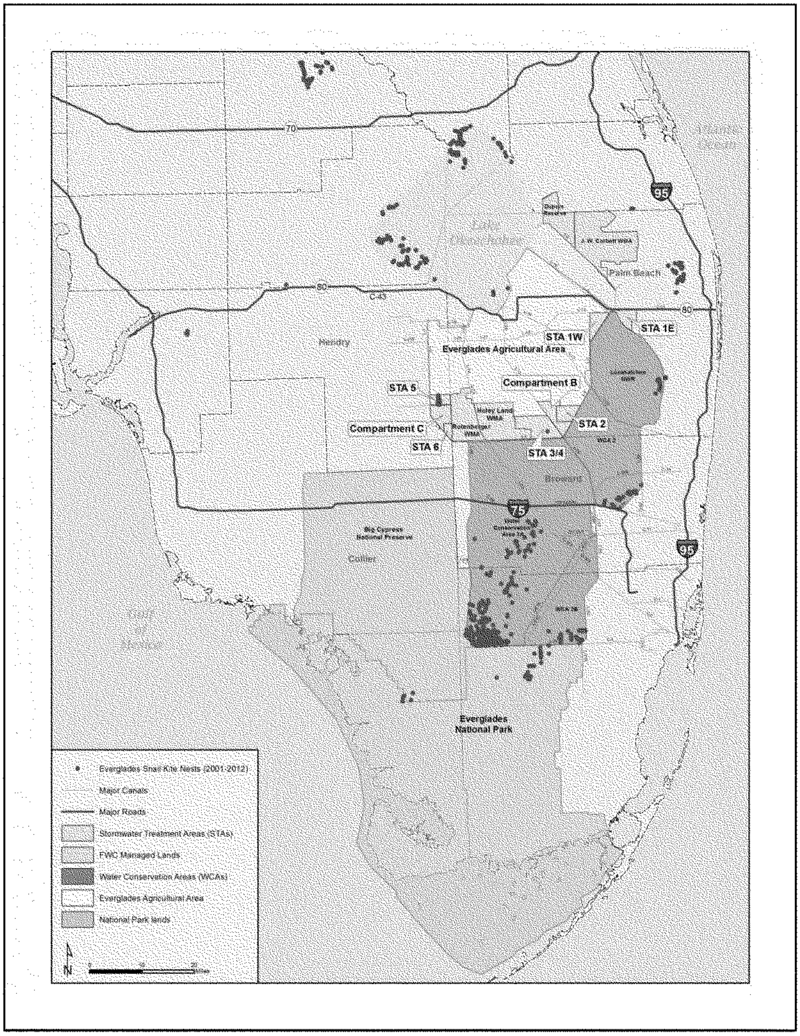


Figure 6-11. Snail kite nesting locations between 2001-2012.

Recent population viability analyses predict a high probability of extinction in the next 50 years, or sooner, if current reproduction, survival, and drought frequency rates remain the same as those of the last ten years (Martin et al. 2007, Cattau et al. 2008, 2009, 2012). It is imperative to manage WCA 3A and Lake Okeechobee so that they once again become functioning components of the Everglade snail kite's network of wetlands within Florida to ensure survival of the Everglade snail kite within Florida.

The persistence of the Everglade snail kite in Florida depends upon maintaining hydrologic conditions that support the specific vegetative communities that compose their habitat along with sufficient apple snail availability across their range each year (Martin et al. 2008). WCA 3A has been previously identified as the most critical component of Everglade snail kite habitat in Florida in terms of its influence on demography (Mooij et al. 2002, Martin 2007, Martin et al. 2007). A principal concern is the lack of reproduction within this area in recent years. The Corps has funded a program to monitor nesting effort and success of the Everglade snail kite in WCA 3 since 1995 with Wiley Kitchens, Ph.D., of USGS, and the University of Florida as principal researcher. The study objectives are to track the numbers and success of Everglade snail kite nesting activities in WCA 3A as part of an on-going demographic study of the kite over its range and to identify the environmental variables related to successful breeding. The Corps is also funding Dr. Kitchens to monitor vegetation responses to altered hydrologic regimes in WCA 3A in areas of traditional Everglade snail kite nesting and foraging habitat, in accordance with recommendations in the 2006 IOP BO.

The Everglade snail kite population in Florida has progressively and dramatically decreased since 1999 (Martin et al. 2006, Cattau et al. 2008, 2009). The population essentially halved between 2000 and 2002 from approximately 3,400 to 1,700 birds; and halved again between 2006 and 2008 from approximately 1,500-1,600 birds in 2006 to approximately 685 birds in 2008. Each decline has coincided, in part, with a severe regional drought throughout the southern portion of the Everglade snail kite's range (Martin et al. 2008, Cattau et al. 2008). Survival of both juveniles and adults rebounded shortly after the 2001 drought, but the number of young produced has not recovered from a sharp decrease that preceded the 2001 drought. While the estimated population size for 2012 (i.e., 1218 is up from 925 individuals in 2011, 826 in 2010 and 662 in 2009) along with the increased number of fledglings counted during the 2011 and 2012 breeding seasons are encouraging trends, it remains unclear whether such trends signify the beginning of a recovery phase. Historically, the WCAs, and WCA 3A in particular, have fledged, proportionally, the large majority of young in the region. However, no young were fledged out of WCA 3A in 2001, 2005, 2007, 2008, or 2010 and only two young successfully fledged in 2012. Nesting activity is summarized in **Table 6-3** for the years 1998-2012, since the Emergency Deviations to the WCA 3A Regulation Schedule for the protection of the CSSS began in 1998. This trend of lowered regional reproduction is a cause of concern regarding the sustainability of the population. In 2010 nesting was observed on Okeechobee for the first time since 2006, which may reflect a slight increase in habitat conditions. Then in both 2011 and 2012, Okeechobee was the third most productive wetland (in terms of kite reproduction) range-wide (Cattau et al. 2012). **Figure 6-12** shows the number of young fledged from 1992-2012, with the Everglades including ENP, Big Cypress National Preserve and all WCAs and STAs.

Table 6-3. Successful Snail Kite Nests and the Number of Young Successfully Fledged within WCA 3A since 1998

Year	Number of Successful Nests	Number of Young Successfully Fledged
1998	84	176
1999	14	19
2000	33	56
2001	0	0
2002	22	32
2003	28	32
2004	19	29
2005	0	0
2006	13	13
2007	0	0
2008	0	0
2009	1	2
2010	0	0
2011	11	11
2012	1	1

*Note: Numbers in Table 6-3 are as reported by annual surveys conducted by Wiley Kitchens, Ph.D. and his research team.

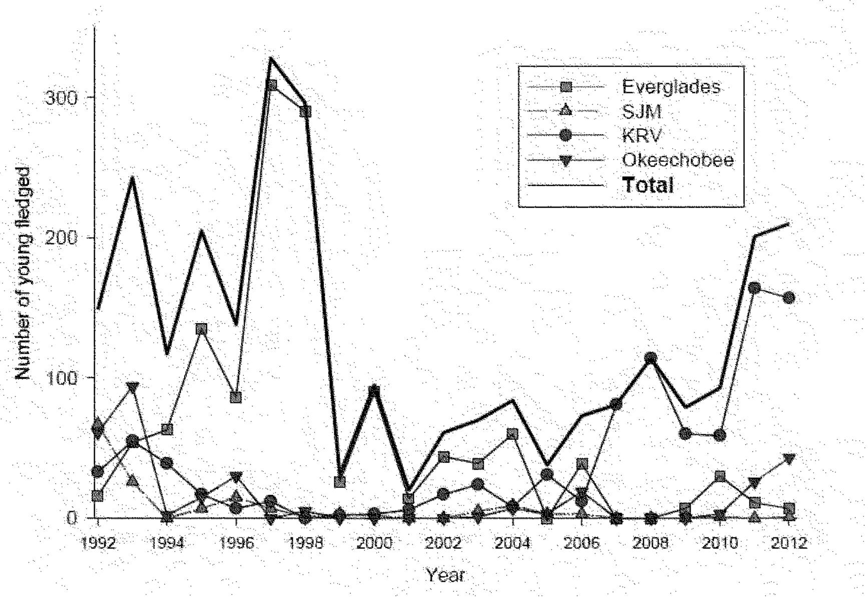


Figure 6-12. Number of young fledged, 1992-2012. Note that these values represent raw counts (uncorrected for detection) of young that reached the minimum fledging age (i.e., 24 days old) in monitored nests. KRV = Kissimmee River Valley; SJM = St. John's Marsh; Everglades includes Everglades National Park, Big Cypress National Preserve and all WCAs and STAs (Cattau et al. 2012).

Both short-term natural disturbances (i.e. drought) and long-term habitat degradation limit the Everglade snail kite's reproductive ability. To date, most concern and interest regarding potential impacts to Everglade snail kites have focused on the higher water levels and hydroperiods, resulting in the conversion of wet prairies to sloughs within WCA 3A (Zweig 2008). The current WCA 3A Regulation Schedule does not mimic the seasonal patterns driven by the natural hydrologic cycle, resulting in water depths in WCA 3A that are too high for the period of September through January (Cattau et al. 2008). In addition, Dr. Kitchens and his research team feel that management activities associated with attempting to mitigate potential high water level impacts may well have potentially amplified those detrimental impacts to Everglade snail kite nesting and foraging activities. For example, in addition to the negative effect on reproduction, the rapid water level recession rates from the elevated stage schedule between February and July, intended to mitigate the extended hydroperiods and excessive depths between September and December, present extreme foraging difficulties to both juvenile and adult Everglade snail kites. In fact, Cattau et al. (2008) demonstrated that the recession rate had significant effects on nest success. Recession rate was defined as the stage difference between that on January 1 and the annual minimum stage divided by the number of days from January 1 to the annual minimum stage (Cattau et al. 2008).

As a result of the on-going research, Dr. Kitchens and his research team have identified three major potentially adverse effects associated with the current WCA 3A Regulation Schedule as: 1) prolonged high water levels in WCA 3A during September through January, 2) prolonged low water levels in WCA 3A during the early spring and summer, and 3) rapid recession rates.

6.2.6.1 Prolonged High Water Levels

Extreme high and low water level stressors can adversely affect snail kites throughout the species' range. Due to the legacy water management infrastructure in the highly managed C&SF system, climatic extremes cannot be entirely controlled to avoid these impacts. However, water management decisions under the current system and with the changes proposed under CEPP, have and will affect the severity and duration of these extremes. From approximately 1993 to present, which coincides with Test 7 of the MWD Experimental Program and subsequent IOP and ERTP operations, WCA 3A stages have shown relatively little annual variation compared to the previous decades, with an annual average stage of approximately 9.5 feet (2.9 meters). In addition, stages in WCA 3A have exceeded 10.5 feet (3.2 meters) in 12 of the past 17 years, while there were only approximately four occurrences of stages exceeding 10.5 feet (3.2 meters) during the 40-year period from 1953 to 1993. Stages in 1994, 1995, 1999, and 2008 also exceeded 11.5 feet (3.5 meters), and are the four highest stages within the period of record (FWS 2006).

Hydrologic modeling of IOP Alternative 7R in 2002 indicated that implementation of IOP would not relieve high water levels within WCA 3A, and in fact, would result in excessive ponding and extended hydroperiods, further contributing to declines in the condition of nesting and foraging habitat in WCA-3A (IOP FSEIS 2006). However, in their 2002 and 2006 IOP BOs, FWS determined that IOP would adversely affect Everglade snail kites and designated Everglade snail kite critical habitat in WCA 3A, but would not likely jeopardize the species. As stated in the 2006 Final IOP BO, FWS anticipated that IOP would result in incidental take in the form of "harm" resulting from reduced ability to forage successfully due to habitat changes that affect prey availability.

High water levels during the wet season are important in maintaining quality wet prairie and emergent slough habitat (FWS 2010). However, high water levels and extended hydroperiods have resulted in vegetation shifts within WCA 3A, degrading Everglade snail kite critical habitat. The extended flooding from September to January resulting either from weather conditions, IOP, or both, appears to be shifting plant communities from wet prairies to open water sloughs (Zweig 2008, Zweig and Kitchens 2008). These shifts from one vegetation type to another may occur in a relatively short time frame (1 to 4 years) following hydrologic alteration (Armentano et al. 2006, Zweig 2008, Zweig and Kitchens 2008, Sah et al. 2008).

This vegetation transition directly affects Everglade snail kites in several ways, most importantly by reducing the amount of suitable foraging and nesting habitat, and reducing prey abundance and availability. Wetter conditions reduce the amount of woody vegetation within the area upon which Everglade snail kites rely for nesting and perch hunting. In addition, prolonged hydroperiods reduce habitat structure in the form of emergent vegetation, which is critical for apple snail aerial respiration and egg deposition (Turner 1996, Darby et al. 1999). Drying events are essential in maintaining the mosaic of vegetation types needed by a variety of wetland fauna (Sklar et al. 2002), including the Everglade snail kite (FWS 2010) and its primary food source, the apple snail (Karunaratne et al. 2006, Darby et al. 2008). However, little annual variation in water depths has occurred within WCA 3A since

1993, virtually eliminating the drying events necessary to maintain this mosaic. This is particularly apparent in southwestern WCA 3A, which has experienced excessive ponding in recent years.

A revised WCA 3A Regulation Schedule was implemented under ERTP in October 2012 to further aid in the reduction of high water levels within WCA-3A, and specifically to address the protracted flooding that occurred between September and January under IOP. The intent of expanding Zones D and E1 is to achieve the ERTP objective of managing water levels within WCA 3A for the protection of multiple species and their habitats (ERTP PM B-I). Through this modification, the Corps will have additional flexibility as compared with IOP in making water releases from WCA 3A in order to better manage recession and ascension rates, as well as to alleviate high water conditions in southern WCA 3A.

As previously discussed, water levels within portions of WCA 3A (i.e. southwestern 3A) have been too high for too long resulting in detrimental effects to vegetation, apple snails and Everglade snail kites. Under ERTP, the WCA 3A Interim Regulation Schedule Zone A has been lowered by 0.25 feet (i.e. 9.75 to 10.75 feet NGVD under IOP versus 9.50 to 10.50 feet NGVD under ERTP), thereby lowering the trigger stage for water releases from WCA 3A. By providing an additional mechanism to reduce high water levels within WCA 3A, modifications to the WCA 3A Regulation Schedule under ERTP have the potential to provide beneficial effects to the Everglade snail kite and its critical habitat within WCA 3A.

Two detrimental impacts associated with the creation of Zone E-1 observed under IOP include rapid recession rates and low water levels during the Everglade snail kite's breeding season. In order to correct these detrimental impacts under ERTP, both a recession rate and a low water level criterion have been developed. ERTP includes a recession rate criterion of 0.05 feet per week between January 1 and June 1 (ERTP PM D) to avoid recession rates that are too rapid and thus detrimental to Everglade snail kites and apple snails. In addition, to avoid water levels that are too low at the end of the dry season, specific water depth criteria have been developed based on the stage at the WCA-3AVG. The criteria include depths favorable for Everglade snail kites, apple snails and wet prairie vegetation and were created in conjunction with the species experts (Dr. Kitchens, Dr. Darby, and Dr. Zweig) and FWS.

6.2.6.2 Prolonged Low Water Levels

Under the IOP WCA 3A Regulation Schedule, there was a high likelihood that the water levels in WCA 3A would fall below a critical threshold (below which Everglade snail kite foraging success and apple snail reproduction is severely reduced) for an extended period of time. Zone E1 was first incorporated into the WCA 3A deviation schedule under the 2000 Interim Structural and Operational Plan (ISOP) and subsequently included in IOP. The 0.5 feet (15 centimeters) reduction in the bottom zone (Zone E) of the WCA 3A Regulation Schedule was intended to help offset the effects of reduced outflows through the S-12 structures that resulted from IOP closures in the dry season and early wet season. This change resulted in a greater reduction in WCA 3A stages prior to the wet season. While this new zone may have helped to achieve the desired result of reducing high water impacts that could result from S-12 closures during the early wet season, it may have contributed to detrimental impacts to Everglade snail kite nesting and foraging within WCA 3A. During the years of ISOP and IOP operations, the low stages (as indicated by gauge 3A-28) that have occurred have reached approximately 8.4 feet (2.6 meters), with the exception of 2003, when the low reached 8.9 feet (2.7 meters). In the six years prior to IOP, the low stages at Gauge 3A-28 (Site 65) had been above approximately 8.9 feet (2.7 meters) at their lowest point. A difference of 0.5 feet (15 centimeters) is not large. However, depending on where Everglade snail kites choose to nest, this difference could have a notable impact on how hydrologic conditions change near Everglade snail kite nests during the spring recession. Snail kites' reliance on the area immediately around the nest for foraging and capturing sufficient prey to feed nestlings during the two months of the nestling period make them vulnerable to rapidly changing hydrologic conditions.

Low water levels have an effect on Everglade snail kite nest success in WCA 3A (Cattau et al. 2008). If water levels become too low and food resources become too scarce, adults will abandon their nest sites and young (Sykes et al. 1995). Predation on nests is also higher when water levels are low. A strong relationship exists between annual minimum stage and juvenile Everglade snail kite survival rate (Martin et al. 2007, Cattau et al. 2008). Estimated juvenile Everglade snail kite survival rates for years when water levels fell below 10 cm was substantially lower compared to years where estimated water depths stayed above 10 cm (Cattau et al. 2008). Due to their inability to move large distances, juvenile Everglade snail kites rely upon the marshes surrounding their nests for foraging. If water levels within these marshes become too low to support foraging (due to low apple snail availability), juvenile survival will be diminished.

Recent scientific information has indicated that apple snail egg production is maximized when dry season low water levels are less than 50 cm (was previously 40 centimeters) but greater than 10 cm (Darby et al. 2002, FWS 2010). Water depths outside this range can significantly affect apple snail recruitment and survival. If water levels are less than 10 cm, apple snails cease movement and may become stranded, hence they are not only unavailable to foraging Everglade snail kites, they are also unable to successfully reproduce. Depending upon the timing and duration of the dry down, apple snail recruitment can be significantly affected by the truncation of annual egg production and stranding of juveniles (Darby et al. 2008). Since apple snails have a 1.0 to 1.5-year life span (Hanning 1979, Ferrer et al. 1990, Darby et al. 2008), they only have one opportunity (i.e. one dry season) for successful reproduction. Egg cluster production may occur from February to November (Odum 1957, Hanning 1979, Darby et al. 1999); however, approximately 77% of all apple snail egg cluster production occurs between April and June (Darby et al. 2008). Dry downs during peak apple snail egg cluster production substantially reduce recruitment (Darby et al. 2008). If possible, dry downs during this critical time frame should be avoided. The length of the dry down, age, and size of the apple snail are all important factors in apple snail recruitment and survival. Larger apple snails can survive dry downs better than smaller apple snails (Kushlan 1975, Darby et al. 2006, 2008). In fact, Darby et al. (2008) found that 70% of pre-reproductive adult-sized apple snails survived a 12-week dry down; while smaller apple snails exhibited significantly lower survival rates (less than 50% after 8 weeks dry).

There is a delicate trade-off between low and high water, and timing seems to be critical. Drying events following managed recessions have the potential to induce mortality of juvenile and adult Everglade snail kites and apple snails, whereas repeated and extended flooding tends to result in long-term degradation of the habitat, which also reduces reproduction and hinders kite recovery.

6.2.6.3 Rapid Recession Rates

Given the high water levels early in the nesting season, birds are initiating nests in upslope shallower sites. Often water managers initiate rapid recession rates to meet the target regulation schedule and avoid impacts of sustained higher water levels. These rapid recession rates have serious implications for Everglade snail kite nesting success. Breeding adults may not be able to raise their young before the water levels reach a critical low, below which apple snail availability to Everglade snail kites is drastically reduced. In addition, when water levels recede below an active Everglade snail kite nest, predation risk increases due to nest exposure to terrestrial predators (Sykes et al. 1995). As a result, nesting success is further reduced in these areas.

Rapid recession rates also result in reduced apple snail productivity. Apple snails may become stranded if water levels fall too rapidly, effectively preventing apple snails from reaching areas of deeper water. Stranded apple snails cease movement and as a result, apple snail reproduction is essentially terminated.

6.2.6.4 Potential Effects of CEPP to Snail Kite

Evaluation of potential effects to Everglade snail kites within the CEPP project area included adaptations of ERTP PMs, including depth and recession rate requirements for Everglade snail kites and apple snails, along with the Apple Snail Population Model (SFNRC 2013d) throughout a 41-year period of record (POR) from 1965 - 2005. Evaluation of critical habitat within Lake Okeechobee was not performed due to CEPP itself remaining within the Lake Okeechobee Regulation Schedule (LORS) 2008. The CEPP PIR will not be the mechanism to propose or conduct the required NEPA or biological evaluation of modifications to the LORS. However, it is expected that a revision to the current LORS 2008 schedule for Lake Okeechobee will be required prior to full utilization of the CEPP A-2 FEB feature and re-direction of the full 210,000 ac-ft/yr south to the Everglades.

Since the apple snail depth ranges within the 2010 FWS MSTS were based upon published literature from several wetland areas throughout Florida (Darby et al. 2002), ERTP PM-C was able to be adapted for use in this analysis to determine potential effects on the Florida apple snail, the primary food source of the endangered Everglade snail kite. However, since the depth ranges for Everglade snail kites within the 2010 FWS MSTS are based on past occurrences of Everglade snail kite nesting within WCA-3A, they are likely more narrow than the species tolerance. Therefore, ERTP PM-B was not used to analyze potential effects of CEPP implementation on this species. The following methodology was used to assess depths within WCA 3A and WCA 3B for apple snails:

- Analysis included Regional Simulation Model (RSM) output for ECB 2012, FWO, and Alt 4R2 for gauges: 3A-NE, 3A-NW, 3A-3, 3A-4, 3A-28, 3A-SW, 3AS3W1, 3A-W2, 3B-71, and3B1W1. (**Figure 6-13**).
- The RSM stage was translated to depth for each of the gauges listed in step 1 using ground surface elevations provided in RSM model output (i.e. RSM stage- RSM ground surface elevation = water depth at gauge).
- The RSM gauge depths were then compared with preferred apple snail depth ranges as reported by Darby et al. 2002 for 2010 FWS MSTS pre-breeding (December 31) and dry season low (May 1-June 1 stages) windows (**Error! Reference source not found.**).
- The number of times throughout the 41-year POR in which the depth were within recommended depth ranges was summed. These graphs can be found in **Table 6-4**.

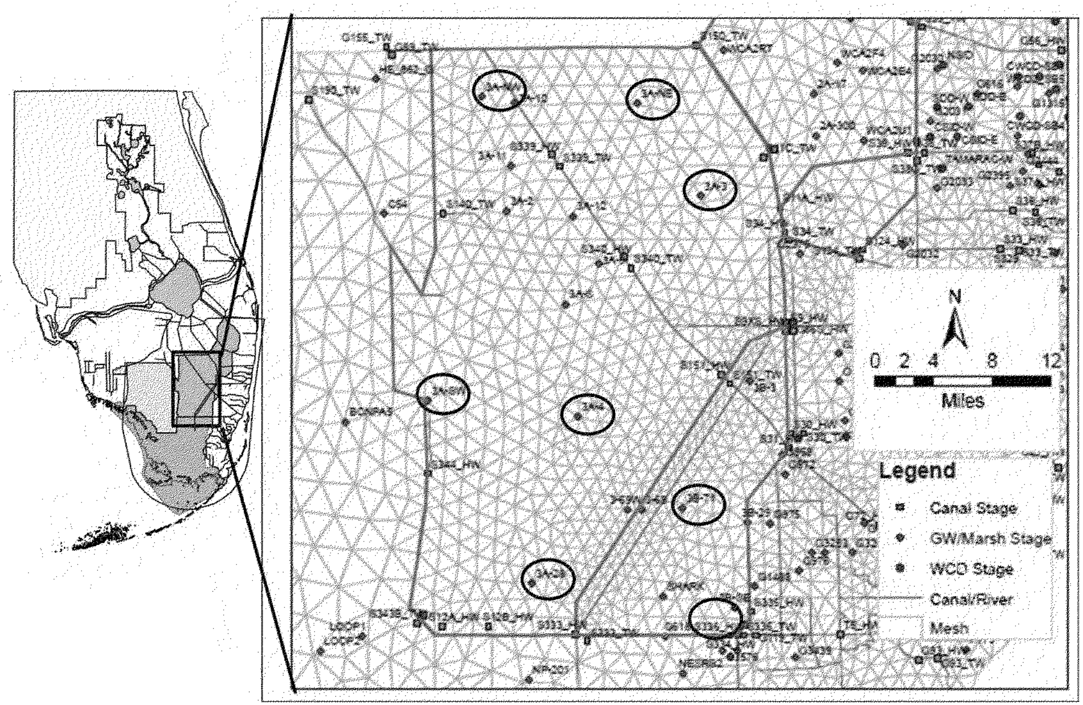


Figure 6-13. WCA 3 Gauge Locations for Snail Kite and Apple Snail Performance Measures.

The number of years in which depths fell within preferred depth ranges for apple snails under existing conditions, FWO, and Alt 4R2 are detailed within **Table 6-4**. Significant improvements to apple snail depth ranges occurred in northern WCA 3A (3A-NE, 3A-NW, 3A-3), with a slight improvement in central WCA 3A (3A-4) and WCA 3B (3B-71 and 3BS1W1). Slight declines from existing conditions occurred in southwestern WCA 3A (3A-28, 3A-SW, 3A-S3W1, and 3A-W2) (**Table 6-4**). As noted in **Table 6-4**, there were a greater number of years across the 41-year POR in which Alt 4R2 provided depths within the recommended depth range for apple snails (i.e. 1 May to 1 June: 173 across all regions for apple snails).Alt 4R2 also increased the number of times that the depth range was within recommended ranges for apple snails within pre-breeding season except at 3A-4 for apple snails where it performed one year differently from existing conditions but the same as FWO (December 31). These pre-breeding water depths are important for a steady recession rate throughout the dry season in order to maintain within suitable depths during the dry season low (refer to 2010 FWS MSTS).

Table 6-4. Number of years in which depths fell within 2010 FWS MSTS recommended depth ranges for apple snails (ERTP PM-C)

	Dec 31			May 1 – June 1		
	ECB 2012	ALT 4R2	FWO	ECB 2012	ALT 4R2	FWO
Gauge	3A-NE					
# years met	0	0	0	2	20	2
Gauge	3A-NW					
# years met	1	16	0	7	19	4
Gauge	3A-3					
# years met	10	10	11	3	20	7
Gauge	3A-4					
# years met	23	22	22	21	23	18
Gauge	3A-28					
# years met	4	4	2	18	15	19
Gauge	3A-SW					
# years met	2	0	2	37	31	37
Gauge	3B-71					
# years met	6	6	5	25	28	5
Gauge	3BS1W1					
# years met	19	21	18	13	17	13
Gauge	3A-S3W1					
# years met	9	11	9	24	18	25
Gauge	3A-W2					
# years met	9	9	9	24	18	26
Total	82	99	81	174	209	156

In addition to the apple snail analysis results presented in Table 6-4 (Note: former 6-5), an apple snail population model developed by Phil Darby (University of West Florida), Don DeAngelis (USGS), and Stephanie Romañach (USGS) was employed as an Ecological Planning Tool for CEPP. The purpose of the model is to describe the dynamics of the apple snail population as a function of hydrology and temperature. The numbers and size distribution of the snails are simulated and can be calculated for any day of a year with input data. Here we present some results from the size-structured population model to simulate the response of apple snails for existing conditions and Alt 4R2 and FWO versus Alt 4R2

(**Figure 6-14** and **Figure 6-15**). Conditions are presented for a dry year for each model run (Alt 4R2 and ECB 2012, and Alt 4R2 and FWO), as dry years are when restoration projects are likely to have the biggest impact, given that the system is largely rainfall driven in the wet season. Results are also shown for adult snails (> 20 mm) during the spring of a dry year, before that years' reproductive period. Adult snails during a given year are a product of egg production, and thus environmental conditions, from the previous year. End of spring results are shown as the population of snails of the size class consumed by the endangered Everglades snail kites. Based upon the results of this analysis, implementation of Alt 4R2 provides better conditions for apple snail populations as compared to existing conditions and FWO, particularly in WCA 3A, WCA 3B, and ENP.

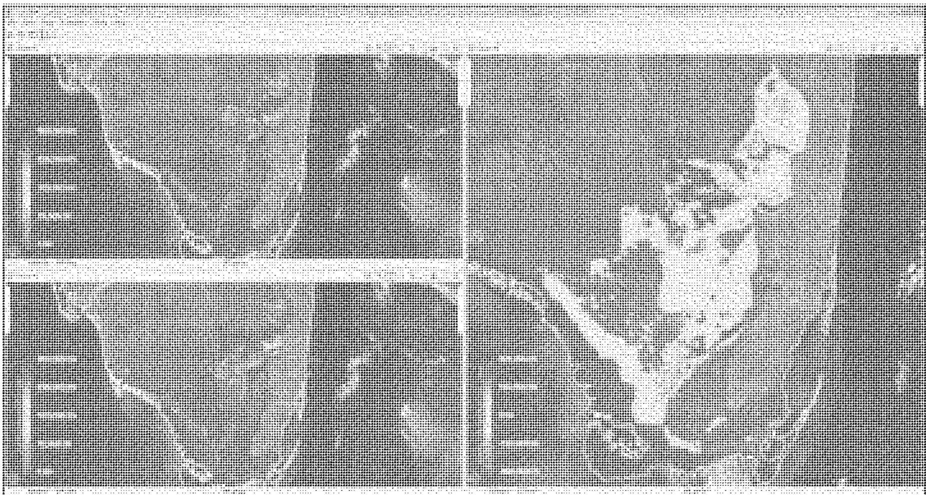
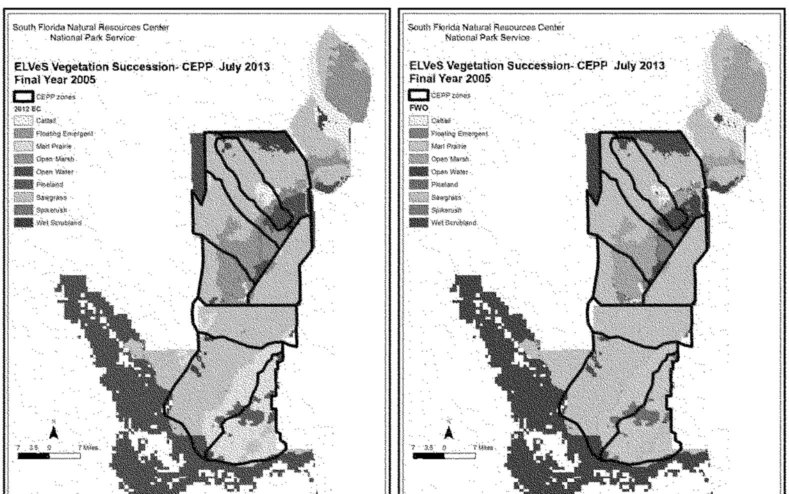


Figure 6-14. Adult snail (> 20 mm) population size as a result of Alt 4R2 (top left) vs. ECB 2012 (bottom left), and a difference map (right map panel) of Alt 4R2 minus ECB 2012.

Figure 6-15. Adult snail (> 20 mm) population size as a result of Alt 4R2 (top left) vs. FWO (bottom left), and a difference map (right map panel) of Alt4R2 minus FWO.

Periphyton is a primary component of invertebrate diets, including apple snails. In addition to the potential for increased foraging opportunities, changes in vegetation resulting in expansion of wet prairie and increases in emergent vegetation would also provide habitat structure critical for apple snail aerial respiration and egg deposition (Turner 1996, Darby et al. 1999). Apple snails tend to avoid areas where water depths are greater than 50 cm (Darby et al. 2002). Avoidance of deeper depths may be related to the type and density of vegetation in deeper water areas, food availability, or energy requirements for aerial respiration (van der Walk et al. 1994, Turner 1996, Darby 1998, Darby et al. 2002). Water-lily sloughs support lower apple snail densities as compared with wet prairies (Karunaratne et al. 2006). Limited food quality and lack of emergent vegetation in sloughs may account for the lower densities. Research indicates that apple snails depend upon periphyton for food (Rich 1990, Browder et al. 1994, Sharfstein and Steinman 2001), which may be limited within deeper water environments. Karunaratne et al. (2006) observed little or no submerged macrophytes and epiphytic periphyton in the sloughs they studied in WCA 3A. In contrast, species commonly encountered within wet prairie habitat (i.e. *Eleocharis spp., Rhynchospora tracyi, Sagittaria spp.*), along with sawgrass that grows within the ecotones between the two vegetative communities, support abundant populations of epiphytic periphyton (Wetzel 1983, Browder et al. 1994, Karunaratne et al. 2006). A reduction in the number of available emergent stems for egg deposition would also contribute to the observed lower snail densities within sloughs. Drying events are needed to maintain the emergent plant species characteristic of typical apple snail habitat (Wood and Tanner 1990, Davis et al. 1994). As shown by Darby et al. (2008), apple snails can survive these events and it is the timing and duration of the dry down event that are critical determinants of apple snail survival and recruitment. CEPP would provide increased opportunities for apple snails within northern WCA 3A, and appropriate conditions for increased apple snail populations in ENP. As compared to the existing conditions and FWO, rehydration and vegetation shifts within northern WCA 3A and increased hydroperiods within WCA 3B and ENP would increase suitable habitat for apple snails, thereby increasing the spatial extent of suitable foraging opportunities for Everglade snail kites (**Table 6-4**).

Suitable foraging habitat for the Everglade snail kite is typically a combination of low profile marsh and a mix of shallow open water. In order to analyze anticipated changes in vegetation that may affect nesting and foraging habitat for Everglade snail kites, the Everglades Landscape Vegetation Succession model (ELVeS) was employed to predict vegetation community change over time in response to changes in environmental conditions (South Florida Natural Resources Center 2013c). The model uses empirically-based probabilistic functions of vegetation community niche space and temporal lags to evaluate expected community response within the model's domain. For this CEPP evaluation, ELVeS was run with nine freshwater marsh/wet prairie communities: (1) open water, (2) open marsh, (3) floating emergent marsh, (4) sawgrass, (5) spikerush, (6) marl prairie, (7) cattail, (8) pineland, and (9) wet scrubland. Results of this analysis are illustrated in **Figure 6-16**. **Figure 6-16** displays the dominant vegetation communities selected by ELVeS at the end of the 41-year POR (2005). At the broad landscape scale there are few large community changes in most of CEPP regions. The largest change is in 3A-NW where increased water deliveries to northern WCA 3A result in a decreased wet scrubland community and subsequent increase in sawgrass. Effects of the Blue Shanty flowway in WCA 3B and NESRS (ENP-N) are evident in the replacement of sawgrass with floating emergent marsh and open marsh. Deeper water vegetation communities area expected to expand in WCA 3A along the L-67 and L-29 canals (South Florida Natural Resources Center 2013c). **Figure 6-17** presents the acreage change between existing conditions, FWO and Alt 4R for each community type. In general, these results show an expansion of sloughs and wet prairies and contraction of sawgrass prairies which would provide increased foraging and nesting habitat for Everglade snail kite and apple snail. Model results for Alt4R2 reveal an expansion of open water habitat within southern WCA-3A where Everglade snail kites are currently known to nest and forage potentially decreasing suitable habitat within this area. However, since the Everglade snail kite is a wide-ranging species, it is anticipated that these effects would be offset by increases in suitable nesting and foraging habitat throughout the CEPP project area.



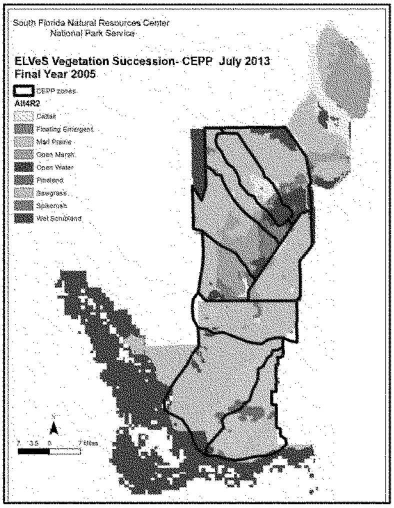


Figure 6-16. Modeled dominant vegetation communities in 2005 as predicted by the Everglades Landscape Vegetation Succession model (ELVeS). The Existing Condition (2012 EC) and the No Action Alternative (FWO) are depicted in the upper panels and Alternative 4R2 in the lower panel. (5outh Florida Natural Resources Center 2013c).

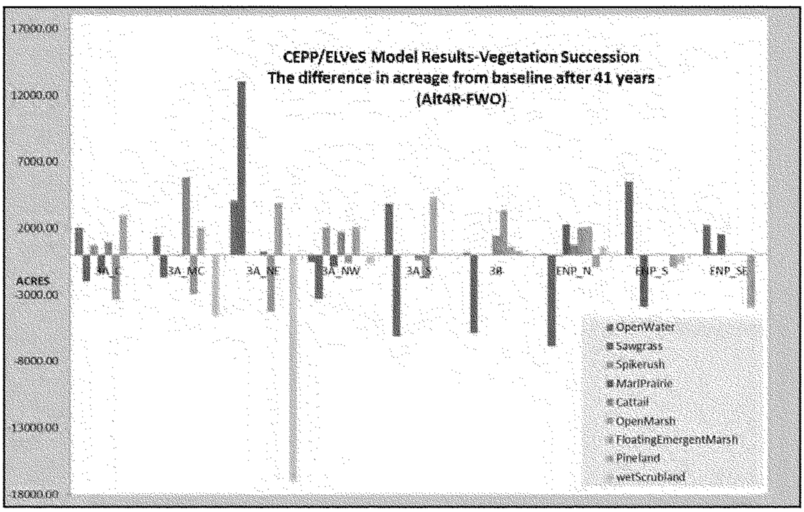


Figure 6-17. Acreage differences (Alternative 4R – No Action Alternative [FWO] for each modeled vegetation community as predicted by Everglades Landscape Vegetation Succession model (ELVeS). Differences between Alts 4R and 4R2 appear relatively negligible. (South Florida Natural Resources Center 2013c).

6.2.6.5 Snail Kite Species Effect Determination

As shown in the ecological planning tool evaluations throughout this Section, Alt 4R2 performs better than both existing conditions and FWO (**Figure 6-14** and **Figure 6-15**). Recession rates less than 0.05 feet/week or more than 0.05 feet but less than 0.10 foot/week are considered acceptable under certain environmental conditions. However, since rapid recession rates were identified as adversely affecting snail kite nesting in WCA 3A, recession rates that are slower than 0.05 feet/week would not have as great of a negative effect as would recession rates more than 0.05 feet but less than 0.10 feet/week. Recession rates for any given week or period of time could be determined based upon recommendations made during the WCA 3A Periodic Scientists Call. The RSM-GL did not contain the ability to model flexibility and adaptive management and thus simply provides a baseline indicator of recession rates. The Corps could utilize the operational flexibility inherent within operations to achieve the recommendation. Operational flexibility is a general term which is supported through specific criteria located within the 2011 ERTP Final EIS, Appendix A-3, Operational Guidance to describe current operational flexibility and the 2013 CEPP Draft Project Operation Plan (CEPP Draft PIR/EIS Annex/Annex C) to describe flexibility within CEPP. One example of operational flexibility is the ability to release up to a certain volume of water through individual structures, allowing flexibility in making low or high volume discharge releases which may act to increase or decrease depths or recession rates.

In conclusion, with the evaluation of ERTP PMs, increased hydroperiods within northern WCA 3A, WCA 3B, and ENP as a result of CEPP implementation would have a beneficial effect on Everglade snail kite and apple snail habitat (**Table 6-3,** and **Table 6-4**). Changes in the quality, quantity, timing, and distribution of water under CEPP provides opportunities for improved vegetation in northern WCA 3A, 3B, and ENP, including expansion of sloughs and wet prairies, and contraction of sawgrass prairies. CEPP would remain below the recommended range ascension rates for apple snails, meet Darby et al (2002) depth recommendations throughout much of WCA 3 and would therefore support successful apple snail oviposition. Increased periphyton would provide for an increased foraging base for the apple snails, in turn providing more foraging opportunities for the Everglade snail kite. Incorporating real-time ground monitoring and using the Periodic Scientist calls could minimize any potential negative effects to the species. The Corps has determined the project may affect Everglade snail kite and is thus requesting formal consultation under ESA for this species.

6.2.6.6 Snail Kite Critical Habitat

Critical habitat for the Everglade snail kite was designated September 22, 1977 (42 FR 47840 47845) and includes areas of land, water, and airspace within portions of the St. Johns Reservoir, Indian River County; Cloud Lake Reservoir, St. Lucie, County; Strazzulla Reservoir, St. Lucie County; western portions of Lake Okeechobee, Glades and Hendry counties; Loxahatchee National Wildlife Refuge (WCA 1), Palm Beach County; WCA 2A, Palm Beach and Broward counties; WCA 2B, Broward County; WCA 3A, Broward and Miami-Dade counties; and ENP to the Miami-Dade/Monroe County line (**Figure 6-18)**. Because this was one of the first critical habitat designations under the ESA, there were no primary constituent elements defined. The designated area encompasses approximately 841,635 acres (340,598 hectares).

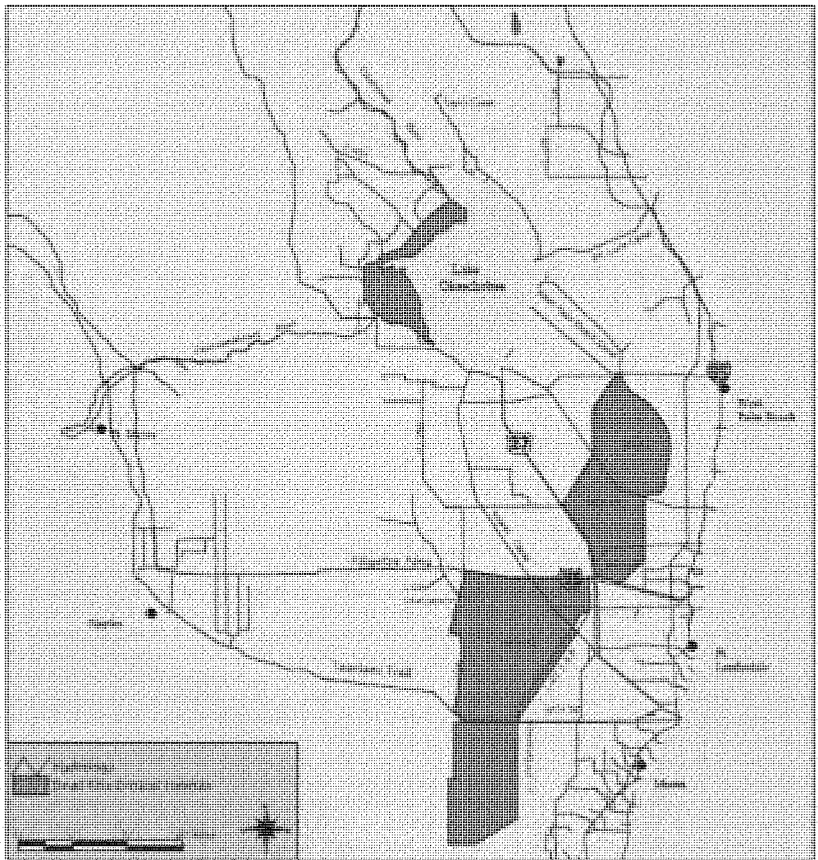


Figure 6-18. Critical habitat for Everglade snail kite.

Since the designation in 1977, FWS has consulted on the loss of 18.66 acres (7.55 hectares) of critical habitat in a construction project. Construction of C&SF infrastructure resulted in impacts to less than 20 acres (8.1 hectares) of critical habitat. A FWS BO addressed the effects of construction of the Miccosukee Tribe's Government Complex Center on critical habitat, which resulted in the loss of 16.88 acres (6.83 hectares) of critical habitat. In addition, the FWS has consulted on impacts to 88,000 acres (35,612 hectares) of critical habitat resulting from prolonged flooding and temporary degradation of critical habitat because of prescribed fire. In addition to these projects, degradation of Everglade snail kite habitat has occurred because of the effects of long-term hydrologic management and eutrophication. While it is not possible to accurately estimate the changes that have occurred within each unit, approximately 40% of the original designation is estimated to be in degraded condition for Everglade snail kite nesting and foraging relative to when it was designated in 1977.

Although previously located in freshwater marshes over considerable areas of peninsular Florida, the range of the Everglade snail kite is currently more limited. This bird is now restricted to peripheral wetlands and several impoundments on the headwaters of the St. John's River, the southwest side of Lake Okeechobee, the eastern and southern portions of WCA 1, 2A, and 3, the southern portion of WCA 2B, the western edge of WCA 3B, and the northern portion of ENP.

Based upon annual surveys from 1970 to 1994, WCA 3A represents the largest and most consistently utilized portion of Everglade snail kite designated critical habitat. Over the past two decades, Everglade snail kites have shifted nesting activities to areas of higher elevation within WCA 3A in response to habitat degradation in traditional nesting areas resulting from prolonged high water levels (Bennetts et al. 1998). Nesting activity has shifted up the elevation gradient to the west, and has also moved south in response to recent increased drying rates, restricting current nesting to the southwest corner of WCA 3A (Zweig and Kitchens 2008).

Sustained high water levels have resulted in the conversion of wet prairies (preferred foraging habitat for Everglade snail kites) to aquatic sloughs in selected sites within WCA 3A, along with losses of interspersed herbaceous and woody species essential for nesting and perch hunting. Concern arose regarding sustained high water levels and their effect on the structure and function of vegetation communities in WCA 3A, portions of which are designated critical habitat for the Everglade snail kite. The principal concern is that the habitat quality, and thus the carrying capacity, of WCA 3A is already seriously degraded. Studies by Zweig (2008) and Zweig and Kitchens (2008) tend to confirm these concerns. Since 1998 and the start of water management regimes for the protection of the CSSS, Everglade snail kite production in WCA 3A has dropped (**Table 6-3**), having produced no Everglade snail kites in 2005, 2007, 2008, 2010, and only two birds in 2009 (Martin 2007, Martin et al. 2007, Cattau et al. 2009, Cattau et al. 2012). In 2011, 11 birds were reported, and in 2012 only 1 was reported. This coincides with successive annual shifts (2002, 2003, 2004, and 2005) in community types within the slough/prairies at sites reported in 2002 to be prime areas of apple snail abundance, and thus Everglade snail kite foraging, in WCA 3A. The conversion trend from emergent prairies/sloughs to deep water sloughs is certainly degradation in habitat quality for the Everglade snail kites. Habitat quality in WCA 3A is changing progressively and dramatically to less desirable habitat in this critical area, and this conversion is rapid, with changes evident in just one year (Zweig and Kitchens 2008). Potential improvements to habitat are expected with CEPP implementation due to rehydration of wetlands within northern WCA 3A and ENP. Slight improvements would be made to vegetation within southern WCA 3A and central WCA 3A is expected to remain under current conditions. The improvements would provide increased foraging and nesting habitat for the Everglade snail kite and apple snail. Water depths are not expected to change in WCA 2 or WCA 1 with implementation of CEPP.

6.2.6.7 Snail Kite Critical Habitat Effect Determination

Implementation of CEPP Alt 4R2 would have no effect on Everglade snail kite designated critical habitat within Lake Okeechobee, WCA 1, or WCA 2 because CEPP is redirecting approximately 210,000 acre feet of additional water that currently flows into the St. Lucie and Caloosahatchee Estuaries to the historical southerly flow path south through FEBs and existing STAs. The goal of CEPP is to increase hydroperiods within WCA 3 and ENP, which coincides with habitat requirements of apple snail and Everglade snail kite within WCA 3 and North East Shark River Slough (NESRS). Results of the ELVeS model show an expansion of sloughs and wet prairies, and contraction of sawgrass prairies which would provide increased foraging and nesting habitat for the Everglade snail kite and apple snail (**Figure 6-16**). Model results for Alt4R2 reveal an expansion of open water habitat within southern WCA-3A where

Everglade snail kites are currently known to nest and forage potentially decreasing suitable habitat within this area. However, since the Everglade snail kite is a wide-ranging species, it is anticipated that these effects would be offset by increases in suitable nesting and foraging habitat throughout the CEPP project area. In addition, implementation of Alt 4R2 substantially increased the number of years in which ERTP PM-C was met at most gauges throughout WCA 3. Based upon this information, the Corps has determined that implementation of CEPP may affect Everglade snail kite critical habitat and is thus requesting formal consultation under ESA for Everglade snail kite critical habitat.

6.2.7 Wood Stork and "May Affect" Determination

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; therefore, none will be affected.

The wood stork is found from northern Argentina, eastern Peru and western Ecuador north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States (AOU 1983). Only the population segment that breeds in the southeastern United States is listed as endangered. 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, Cone and Hall 1970, 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 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. Breeding colonies of wood storks are currently documented in all southern Florida counties except for Okeechobee County.

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 decline in the United States population of the wood stork is thought to be related to one or more of the following factors: 1) reduction in the number of available nesting sites, 2) lack of protection at nesting sites, and 3) loss of an adequate food base during the nesting season (Ogden and Nesbitt 1979). Ogden and Nesbitt (1979) indicate a reduction in nesting sites is not the cause in the population decline, because the number of nesting sites used from year to year is relatively stable. Ogden and Nesbitt suggest loss of an adequate food base is a cause of wood stork declines.

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) 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, Coulter 1987, Gawlik and Crozier 2004, Herring and Gawlik 2007). Calm water, about 5 to 25 cm 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.

Wood storks feed almost entirely on fish between 2 and 25 cm (1 to 10 inches) in length (Kahl 1964, Ogden et al. 1976, Coulter 1987) but may occasionally consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions (Kushlan 1979). Wood storks typically wade through the water with their beaks immersed and open about 7 to 8 centimeters (2.5 to 3.5 inches). When the wood stork encounters prey within its bill, the mandibles snap shut, the head is raised, and the food swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956, Kahl 1964, Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

Studies on fish consumed by wood storks have shown that wood storks are highly selective in their feeding habits with sunfish and four other species of fish comprising the majority of their diet (Ogden et al. 1976). Ogden et al. (1976, 1978) noted that the key species consumed by wood storks included sunfishes (Centrarchidae), yellow bullhead (*Italurus natalis*), marsh killifish (*Fundulus confluentus*), flagfish (*Jordenella floridae*) and sailfin molly (*Poecilia latipinna*).

These species were also observed to be consumed in much greater proportions than they occur at feeding sites, and abundant smaller species (i.e., mosquitofish (*Gambusia* spp.), least killifish (*Heterandria formosa*), bluefin killifish (*Lucania goodei*) are under-represented, which the researchers believed was probably because their small size does not elicit a bill-snapping reflex in these tactile feeders (Coulter et al. 1999). Their studies also showed that in addition to selecting larger species of fish, wood storks consumed individuals that are significantly larger (greater than 3.5 cm) than the mean size available (2.5 centimeters), and many were greater than one-year old (Ogden et al. 1976, Coulter et al. 1999).

Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida. Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over three feet during the wet season (June-September), and then receding gradually during the dry season (October-May). Wood storks nest during the dry season, and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the wood stork nesting period, any one site may only be suitable for wood stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for storks to access the wetlands (Gawlik 2002, Gawlik et al. 2004). Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for wood stork foraging, and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964, Gawlik 2002).

In addition to the concentration of fish due to normal drying, several other factors affect fish abundance in potential foraging habitats. Longer hydroperiod areas generally support more fish and larger fish (Trexler et al. 2000, Turner et al. 1999). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential wood stork foraging sites (Rehage and Trexler 2006), and distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites also affect fish density and biomass. Within the highly modified environments of southern Florida, fish availability varies with respect to hydrologic gradients, nutrient availability gradients, and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a wide variety of hydroperiod classes, nutrient conditions, and spatial variability.

Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high, the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Wood stork prey availability is dependent on a composite variable consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too great (greater than 30 cm) for storks or the tree canopy at the site is too dense for wood storks to land.

Dense submerged and emergent vegetation may reduce foraging suitability by preventing wood storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Some submerged and emergent vegetation does not detrimentally affect wood stork foraging, and may be important to maintaining fish populations. Wood storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993, Coulter et al. 1999). Foraging sites with open canopies are more easily detected from overhead as wood storks are searching for food.

Gawlik (2002) characterized wood storks as "searchers" that employ a foraging strategy of seeking out areas of high density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, but while prey was still sufficiently available that other wading bird species were still foraging in large numbers (Gawlik 2002). Wood stork choice of foraging sites was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Wood storks generally forage in wetlands between 0.5 kilometer and 74.5 kilometer away from the colony site (Bryan and Coulter 1987, Herring and Gawlik 2007), but forage most frequently within 10-20 kilometer (12 miles) of the colony (Coulter and Bryan 1993, Herring and Gawlik 2007). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available, during shifts in seasonal and annual rainfall and surface water patterns, to support wood storks. Adults feed farthest from the nesting site prior to laying eggs, forage in wetlands closer to the colony site during incubation and early stages of raising the young, and then farther away again when the young are able to fly. Wood storks generally use wet prairie ponds early in the dry season then shift to slough ponds later in the dry season thus following water levels as they recede into the ground (Browder 1984).

Wood stork nesting habitat consists of mangroves as low as 1 meter (3 feet), cypress as tall as 30.5 meters (100 feet), and various other live or dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Rodgers et al. 1997, Coulter et al. 1999). Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the large-diameter trees at a colony site (Rodgers et al. 1995). **Figure 6-19** shows the locations of wood stork colonies throughout Florida. The same colony site will be used for many years as long as the colony is undisturbed and sufficient foraging habitat remains in the surrounding wetlands. However, not all wood storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1995). In response to this type of change to nest site hydrology, wood storks may abandon that site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrologic conditions may re-nest in other nearby areas (Borkhataria et al. 2004, Crozier and Cook 2004).

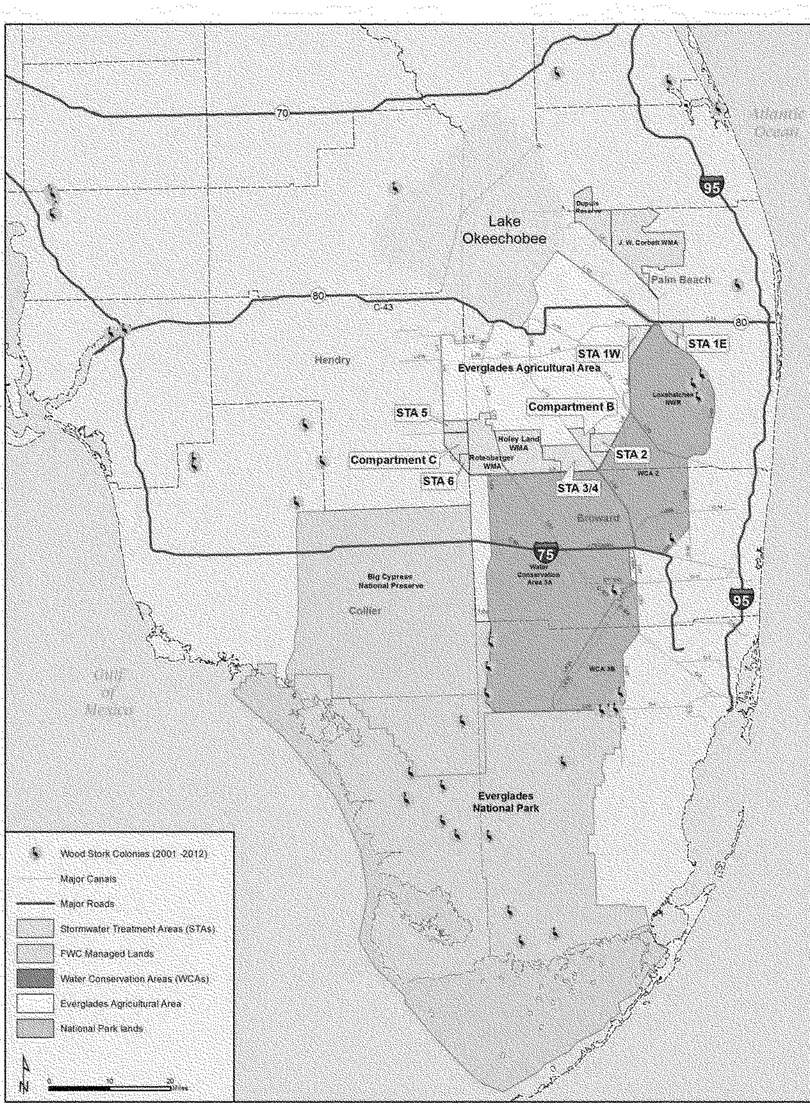


Figure 6-19. Location of wood stork colonies in Florida between 2001-2012.

The wood stork life history strategy has been characterized as a "bet-hedging" strategy (Hylton et al. 2006) in which high adult survival rates and the capability of relatively high reproductive output under favorable conditions allow the species to persist during poor conditions and capitalize on favorable environmental conditions. This life-history strategy may be adapted to variable environments (Hylton et al. 2006) such as the wetland systems of southern Florida. Nest initiation date, colony size, nest abandonment, and fledging success of a wood stork colony vary from year to year based on availability of suitable wetland foraging areas, which can be affected by local rainfall patterns, regional weather patterns, and anthropogenic hydrologic management (Frederick and Ogden 2001). While the majority of wood stork nesting occurs within traditional wood stork rookeries, a handful of new wood stork nesting colonies are discovered each year (Meyer and Frederick 2004, SFWMD 2004, 2009). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Breeding wood storks are believed to form new pair bonds every season. First age of breeding has been documented in 3- to 4-year-old birds but the average first age of breeding is unknown. Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990, FWS 1999). A single clutch of two to five (average three) eggs is laid per breeding season but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation among years in the clutch sizes, and clutch size does not appear to be related to longitude, nest data, nesting density, or nesting numbers, and may be related to habitat conditions at the time of laying (Frederick 2009, Frederick et al. 2009). Egg laying is staggered and incubation, which lasts approximately 30 days, begins after the first egg is laid. Therefore, the eggs hatch at different times and the nestlings vary in size (Coulter et al. 1999). In the event of diminished foraging conditions, the youngest birds generally do not survive.

The young fledge in approximately eight weeks but will stay at the nest for three to four more weeks to be fed. Adults feed the young by regurgitating whole fish into the bottom of the nest about three to ten times per day. Feedings are more frequent when the birds are young (Coulter et al. 1999). When wood storks are forced to fly great distances to locate food, feedings are less frequent (Bryan et al. 1995). The total nesting period from courtship and nest-building through independence of young, lasts approximately 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous, and consequently, a colony may contain active breeding wood storks for a period significantly longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site for a relatively short period following the completion of breeding. Appropriate water depths for successful foraging are particularly important for newly fledged juveniles (Borkhataria et al. 2008).

Wood storks produce an average of 1.29 fledglings per nest and 0.42 fledglings per egg which is a probability of survivorship from egg laying to fledgling of 42 percent (Rodgers and Schwikert 1997). However, in 2009, which was a banner year for nesting, over 2.6 young fledged from successful nests (Frederick et al. 2009). The greatest losses occur from egg laying to hatching with a 30 percent loss of the nest productivity. From hatching to nestlings of two weeks of age, nest productivity loss is an additional 8%. Corresponding losses for the remainder of the nesting cycles are on the average of a 6% per two week increase in age of the nestling (Rodgers and Schwikert 1997).

Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964, Kushlan et al. 1975) to sustain successful wood stork nesting. During the period when a nesting colony is active, wood storks are dependent on consistent foraging opportunities in wetlands within their core foraging area (30 kilometer radius, FWS 2010) surrounding a nest site. The greatest energy demands occur during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 201 kilograms (443 pounds) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for wood storks during colony establishment, courtship and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.* 30 percent and 8%, respectively from egg laying to hatching and from hatching to nestling survival to two weeks) (Rodgers and Schwikert 1997).

The annual climatological pattern that appears to stimulate the heaviest nesting efforts by wood storks is a combination of the average or above-average rainfall during the summer rainy season prior to colony formation and an absence of unusually rainy or cold weather during the following winter-spring nesting season. This pattern produces widespread and prolonged flooding of summer marshes that maximizes production of freshwater fishes, followed by steady drying that concentrates fish during the dry season when storks nest (Kahl 1964, Frederick et al. 2009). However, frequent heavy rains during nesting can cause water levels to increase rapidly. The abrupt increases in water levels during nesting, termed reversals (Crozier and Gawlik 2004), may cause nest abandonment, re-nesting, late nest initiation, and poor fledging success. Abandonment and poor fledging success was reported to have affected most wading bird colonies in southern Florida during 2004, 2005 and 2008 (Crozier and Cook 2004, Cook and Call 2005, SFWMD 2008).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first six months following fledging, most likely as a result of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006, Borkhataria et al. 2008). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects wood storks and their ability to forage (Hylton et al. 2006, Borkhataria et al. 2008).

In southern Florida, both adult and juvenile wood storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Wood storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile wood storks from southern Florida move far beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999, Borkhataria et al. 2004, Borkhataria et al. 2006). Some flocks of juvenile wood storks have also been reported to move well beyond the breeding range of wood storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Both adult and juvenile wood storks return southward in the late fall and early winter months. In a study using satellite telemetry, Borkhataria et al. (2006) reported that nearly all wood storks that had been tagged in the southeastern United States moved into Florida near the beginning of the dry season, including all sub-adult storks that fledged from Florida and Georgia colonies. Adult wood storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006). Preliminary analyses of the range-wide occurrence of wood storks in December, recorded during the annual Christmas bird surveys, suggest that the vast majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of wood storks in this region was 10 to 100 times higher than in northern Florida and Georgia (FWS, unpublished data). As a result of these general population-level movement patterns, during the earlier period of the wood stork breeding season in southern Florida, the wetlands upon which nesting wood storks depend are also being heavily used by a large portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and sub-adult storks from throughout the wood stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

The original Everglades ecosystem, including the WCAs, provided abundant primary and secondary wading bird production during the summer and fall months (Holling et al. 1994). This productivity was concentrated during the dry season when water levels receded. The concentrations of food provided ideal foraging habitat for numerous wetlands species, especially large flocks of wading birds (Bancroft 1989, Ogden 1994). However, the hydrology of the Everglades ecosystem and WCA-3A has been severely altered by extensive drainage and the construction of canals and levees (Abbott and Nath 1996). The resulting system is not only spatially smaller, but also drier than historical levels (Walters et al. 1992). Breeding populations of wading birds have responded negatively to the altered hydrology (Ogden 1994, Kushlan and Fohring 1986, Bancroft 1989).

In most years within the vicinity of NESRS, IOP resulted in reduced stages during the dry season because of constraints on inflows. This may have caused increased recession rates in this area resulting in a reduction in the amount of suitable foraging habitat available near the end of wood stork nesting in the late dry season when stages in that area reached their lowest levels. In addition, reduced flows had the potential to result in the risk of drying below the Tamiami West wood stork colony potentially increasing nest depredation rates and risk of nest abandonment, particularly in drier-than-average years. The close proximity of the colony to the L-29 Canal helped to reduce the risk of drying below the colony because canal stages were maintained at a relatively stable level throughout the dry season. Modeling also indicated that IOP would occasionally result in increased water levels in NESRS during the spring dry season (2006 IOP FSEIS). These conditions presumably occurred when stages were sufficiently low that the G-3273 constraint did not restrict inflows, and water from WCA 3A was diverted into NESRS through the S-333 structure. In these cases, water levels within NESRS, in the immediate vicinity of the Tamiami West wood stork colony, would rise by up to one foot during the period when wood storks were nesting and when water levels were generally receding throughout the system. This results in an artificial reversal and would cause a reduction in wood stork foraging conditions in areas near the colony, and may be significant enough to cause colony abandonment. Because the foraging radius of the Tamiami West colony includes parts of WCA 3A and WCA 3B, ENP, the Pennsuco Wetlands, and urban areas, sufficient foraging opportunities remained in other areas to offset the poor foraging conditions that result from IOP in NESRS, but some reduction in foraging opportunities was expected.

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Historically, the short hydroperiod wetlands within ENP have been important for wood stork foraging during the pre-breeding season with the storks shifting to longer hydroperiod wetlands as the dry season progresses. ERTP ET-2 provides for a hydroperiod requirement between 90-210 days within CSSS habitat and thus would help to produce a mosaic of wetlands of varying hydroperiods within ENP. Hydrologic patterns that produce a maximum number of patches with high prey availability (i.e. high water levels at the end of the wet season and low water levels at the end of the dry season) are necessary for high reproductive outputs (Gawlik 2002, Gawlik et al. 2004). Depending upon the elevation and microtopography throughout the WCAs and ENP, implementation of CEPP will produce a variety of wetland habitats that would support prey densities conducive to successful wood stork foraging and nesting.

6.2.7.1 Potential Effects to the Wood Stork

Wood storks rely upon short hydroperiod wetlands (i.e. marl prairies) for pre-breeding foraging. Short hydroperiod wetlands would help increase body condition and would allow for wood storks and other wading birds to initiate nesting earlier than they do now (November versus February). This will improve nesting success by reducing potential for nest abandonment, increasing juvenile survival by ensuring prey are available within CFA and allowing juveniles to fledge prior to end of dry season/start of wet season when food availability decreases around nests.

Several models of wading birds were used to assess potential affects to wading birds within the Greater Everglades as a result of implementation of CEPP Alt 4R2 including: 1) Wood Stork Foraging Probability Index model (ENP 2012, 2013) 2) wading bird species distribution (Beerens 2013), and 3) wading bird nesting success (Beerens 2013). ERTP PMs are captured within the Beerens models.

A Wood Stork Foraging Probability Index model (ENP 2013) was used to assess potential affects to wading birds within the Greater Everglades as a result of CEPP implementation. An analysis of wood stork foraging potential was performed to predict how foraging habitat with CEPP implementation would be affected (ENP 2013). The Wood Stork Foraging Probability Index (STORKI v. 1.0) was developed to provide rapid simulations of wood stork foraging conditions in response to modeled CERP scenarios (LoGalbo et al. 2012).

Figure 6-20 and **Figure 6-21** indicate that Alt 4R2 provides the greatest benefit within northeastern WCA 3, areas adjacent to the Miami Canal, and throughout southern ENP relative to the existing conditions. Not many wood stork colonies are currently found in northeastern WCA 3 or adjacent to the Miami Canal, however, if foraging conditions improve in these areas, wood storks could colonize there. As compared to benefits gained in northern WCA 3A, less benefits occur within northwest WCA 3A (CEPP zone 3A-NW), and southeast Everglades National Park (CEPP zone ENP-S), however, 4R2 is still an improvement over the existing conditions and FWO. Benefits generally result from the increased water deliveries to these regions which result in more suitable water depths for wood stork foraging as compared to existing conditions and the FWO.

Declines in stork foraging suitability occur within northern ENP (CEPP Zone ENP-N) with Alt4R2 relative to existing conditions or FWO. The effects of increasing flow deliveries to ENP through the Blue Shanty flowway results in downstream water depths in ENP-N substantially less suitable for wood stork foraging. As compared to Zone ENP-N, less negative effects to foraging occur in central and southern WCA 3A central (CEPP Zones 3A-C and 3A-S) with Alt4R2 as compared to existing conditions or FWO.

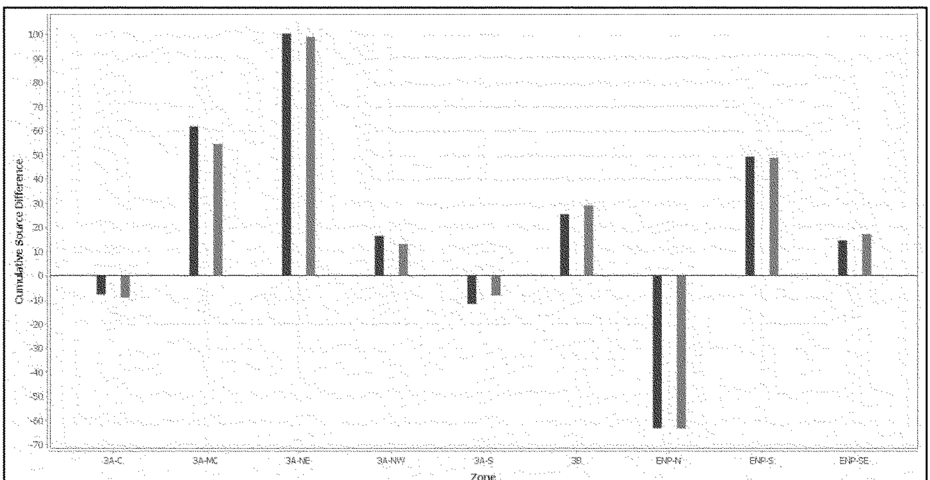


Figure 6-20. Suitable wood stork habitat cumulative (1965-2005) lift above existing conditions for Alt 4R2 within each CEPP zone. A maximum score of 1327 is possible if ECB 2012 has a suitability score of 0.0 every week and the alternative has a suitability score of 1.0 every week of the 41 year hydrologic model runs (SFNRC 2013c)

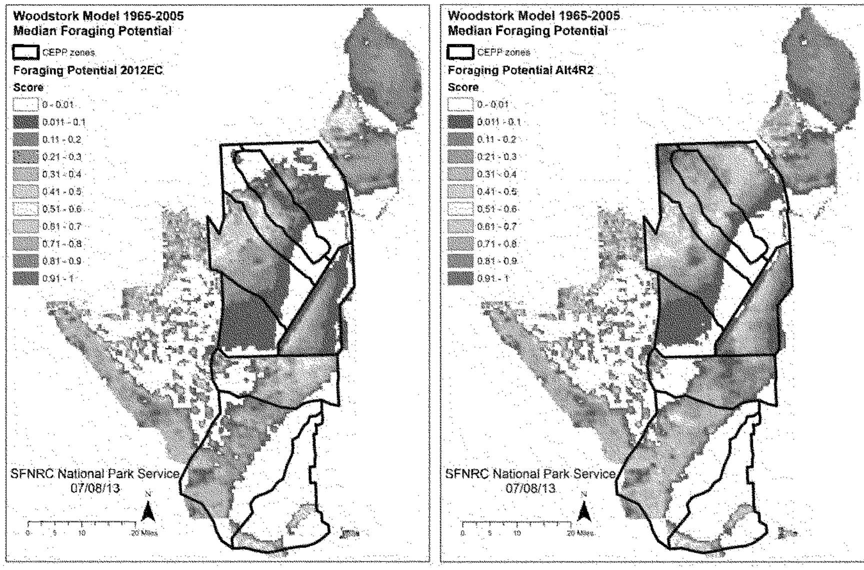


Figure 6-21. Median wood stork foraging potential suitability scores for 1965-2005. Scores vary from 0.0 (not suitable) to 1.0 (optimal foraging). Existing conditions is shown in the left panel and Alt 4R2 in the right panel (SFNRC 2013a)

Wood stork species distribution was modeled by Beerens 2013 in support of the RECOVER Greater Everglades ecological evaluation. The objectives of the spatial foraging conditions model (SFC) are to determine the average hydrological and spatial characteristics of a cell that predict the species-specific *frequency* of cell use over the study period. Results from Beerens 2013 indicate that wood storks would more frequently use areas of northern WCA 3A, WCA 3B, and southern ENP under Alt 4R2 compared to the existing conditions and FWO (**Figure 6-22** and **Figure 6-23**). The location of wood stork colonies between 2001 and 2012 from WCA 2, WCA 3, and ENP has been included in **Figure 6-22** and **Figure 6-23** for reference. Wading bird use is predicted to increase for wood stork colonies previously and/or currently located within WCA 3B (3B Mud East), along Tamiami Trail (Tamiami Trail East 1, Tamiami Trail East 2, and Tamiami Trail West), and for several colonies located in ENP (Grossman West, Rookery Branch) for Alt 4R2 relative to existing conditions and FWO. Wading bird use is predicted to remain stable or decrease for several colonies located in southern WCA 3A adjacent to L-28 (Crossover, Jetport, Jetport South, Hidden) for Alt 4R2 relative to existing conditions and FWO; however there is potential for these wood stork colonies to utilize adjacent areas where foraging and habitat suitability are increasing.

Historically, the short hydroperiod wetlands within ENP have been important for wood stork foraging during the pre-breeding season with the storks shifting to longer hydroperiod wetlands as the dry season progresses. Hydrologic patterns that produce a maximum number of patches with high prey availability (i.e. high water levels at the end of the wet season and low water levels at the end of the dry season) are necessary for high reproductive outputs (Gawlik 2002, Gawlik et al. 2004). Depending upon the elevation and microtopography throughout the WCAs and ENP, implementation of CEPP would produce a variety of wetland habitats that would support prey densities conducive to successful wading bird foraging and nesting.

Water depth and recession rate are the two most important hydrologic variables for wood storks (Gawlik et al. 2004) and wading birds. In their analysis of habitat suitability, Gawlik et al. (2004) identified feeding sites where the weekly average water depths from November to April (pre-breeding and breeding season) were between 0.0 and 0.5 feet as the most suitable. Suitability drops to 0.0 when water depths are -0.3 feet below marsh surface or greater than 0.8 feet. Wood storks and other wading birds require recession to condense their prey items into shallow pools for more effective foraging. The ERTP PM F (Strive to maintain a recession rate of 0.07 feet per week, with an optimal range of 0.06 to 0.07 feet per week, from January 1 to June 1) was moderated more often in Alt 4R2 as compared to existing conditions and FWO (**Figure 6-24**). Recession rates > -0.05 but < 0.06 feet/week and >0.07 but < 0.17 feet/week should be viewed with caution and are considered to be slower than recommended and faster than recommended, respectively. Alt 4R2 fell within these respective ranges more frequently in WCA 3A than existing conditions and FWO, indicating a potential effect on wood stork foraging. Recession rates > 0.17 feet/week or < -0.05 feet/week are considered too rapid or too slow, respectively. Alt 4R2 fell within these respective ranges less frequently in WCA 3A than existing conditions and the FWO. Recession rates for any given week or period of time could be determined based upon recommendations made during the WCA 3A Periodic Scientists Call. The RSM-GL did not contain the ability to model flexibility and adaptive management and thus simply provides a baseline indicator of recession rates. The Corps could utilize the operational flexibility inherent within operations to achieve the recommendation. One example of operational flexibility is the ability to release up to a certain volume of water through individual structures, allowing flexibility in making low or high volume discharge releases which may act to increase or decrease depths or recession rates. It is recognized that areas of suitable foraging habitat will vary both within and between years due to microtopography, antecedent conditions, hydrologic and meteorological conditions, and water management actions. It is anticipated that these provisions within CEPP will help to improve foraging conditions within WCA 3A and ENP to provide a direct benefit to the wood stork and other wading bird species.

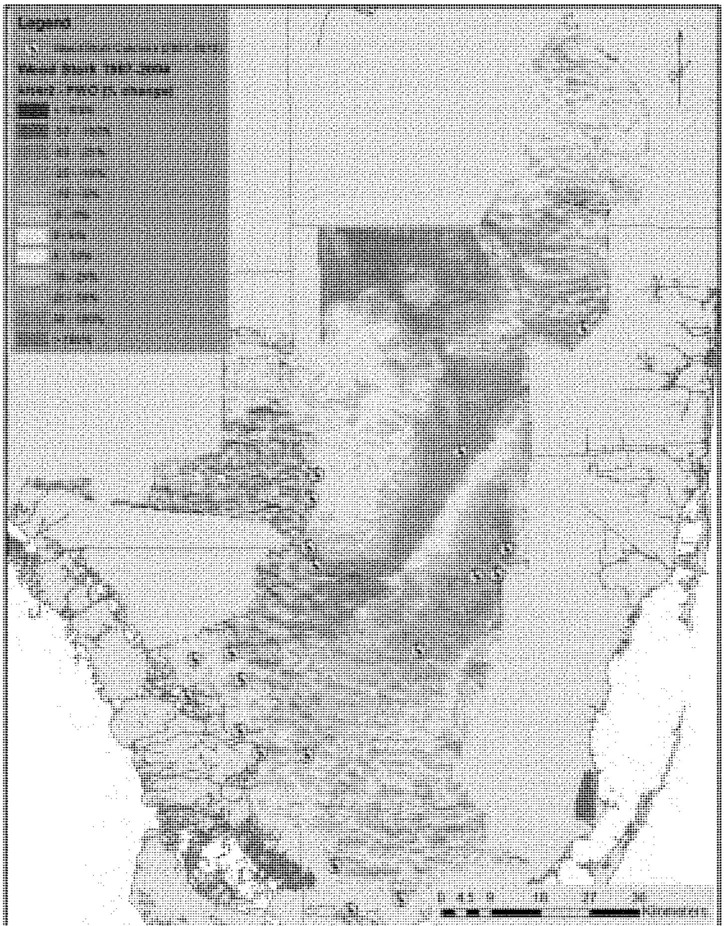


Figure 6-22. The coloration in this map represents the mean percent change in wading bird cell use (Jan – May, 1967-2004) for Alt4R2 relative to Future Without (FWO) for wood storks. The graphic also depicts the location of wood stork colonies in Florida between 2001 and 2012 within WCA 2, WCA 3, and ENP.

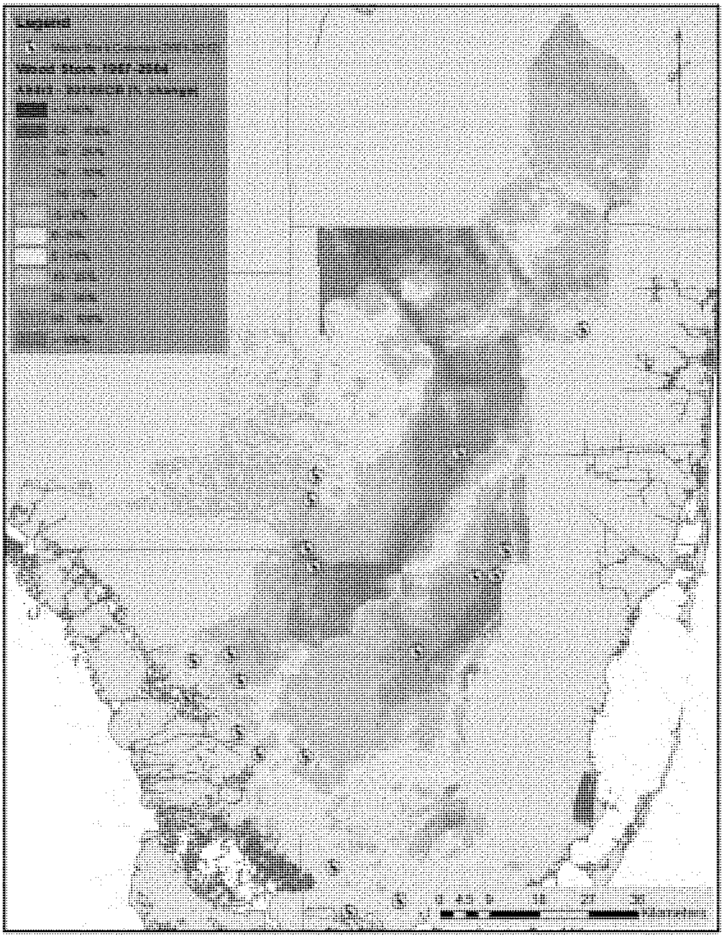


Figure 6-23. The coloration in this map represents the mean percent change in wading bird cell use (Jan – May, 1967-2004) for Alt 4R2 relative to existing conditions for wood storks. The graphic also depicts the location of wood stork colonies in Florida between 2001 and 2012 within WCA 2, WCA 3, and ENP.

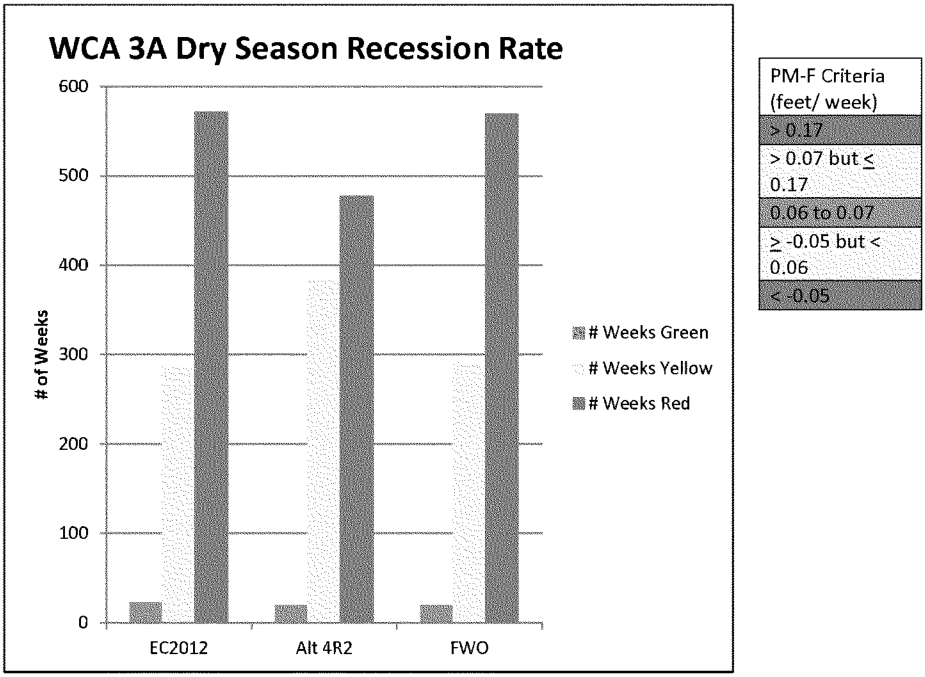


Figure 6-24. WCA 3A Dry Season Recession Rates (PM-F).

6.2.7.2 Wood Stork Species Effect Determination

Restoration of hydroperiods and hydropatterns closer to a pre-drainage condition (Pre-drainage conditions are defined as those conditions that occurred in the late 1800s, prior to the wide-scale drainage, urbanization, and compartmentalization of the Everglades) is a focal Everglades restoration objective for CERP. A related CERP restoration goal is to restore historic wading bird foraging and colonial nesting habitats in the mainland estuary zones of ENP. Therefore, the general transitioning of wood stork foraging habitat (under most climatic conditions) from Shark River Slough, which historically was a deep water white-water lily-dominated slough habitat, back into southern ENP, is considered a progressive step toward ecosystem restoration. It should be noted, however, that with Alt 4R2, a levee will be constructed within WCA 3B that will result in permanent loss of wood stork foraging habitat as well as habitat connectivity. Construction of the Blue Shanty levee will result in the loss of approximately 113 acres of wetland habitat within WCA 3B. However, the construction of other project features, including the degradation of existing levees (i.e. L-4, L-57, L-29, and Old Tamiami Trail Road) and the backfilling of canals (i.e. Miami Canal, L-67 Extension) will result in an increase of 625 acres of wetland habitat within WCA 3A, WCA 3B, and ENP; resulting in wetlands that may be suitable for foraging. Approximately 14,000 acres of existing land within the footprint of the A-2 parcel currently classified as agricultural will also be improved to a higher quality wetland with construction of the A-2 FEB.

Hydrologic changes associated with implementation of the project are expected to alter and provide an overall net benefit for wood stork foraging suitability throughout WCA 3 and ENP. Although wood stork colonies are not currently in all of the areas where foraging and habitat suitability are increasing, the potential for wood storks to colonize these areas highly increases due to the increase in foraging and habitat suitability. However, declines in foraging suitability occur in northern ENP due to increased flow deliveries through the Blue Shanty flowway. Declines in foraging suitability were also observed in southern WCA 3A. Wood stork colonies have been identified to occur within these areas and may be affected by decreased foraging opportunities and habitat suitability within these locations. Metrics would need to be developed prior to CEPP implementation to account for any changes in the system due to construction and operation of other features, such as Modified Water Deliveries to ENP. Based upon the current information, the Corps' determination is that CEPP may affect wood stork and is thus requesting formal consultation under ESA for this species.

6.2.8 Cape Sable Seaside Sparrow and "May affect" Determination

Measuring 13-14 centimeters in length, the CSSS is one of nine subspecies of seaside sparrows (Werner 1975). CSSS are non-migratory residents of freshwater to brackish marshes and their range is restricted to the lower Florida peninsula. They were originally listed as endangered in 1969 due to their restricted range (FWS 1999). Subsequent changes in their habitat have further reduced their range and continue to threaten this subspecies with extinction.

CSSS prefer mixed marl prairie communities that include muhly grass (*Muhlenbergia filipes*) for nesting (Stevenson and Anderson 1994). Marl prairie communities have short-hydroperiods (the period of time during which a wetland is covered by water) and contain a mosaic of moderately dense, clumped grasses, interspersed with open space that permit ground movements by the sparrows (FWS 1999). CSSS are generally not found in communities dominated by dense sawgrass, cattail (*Typha* spp.) monocultures, long-hydroperiod wetlands with tall, dense vegetative cover, spike rush marshes, and sites supporting woody vegetation (Werner 1975, Kushlan and Bass 1983). CSSS also avoid sites with permanent water cover (Curnutt and Pimm 1993). The combination of hydroperiod and periodic fire events are critical in the maintenance of suitable mixed marl prairie communities for the CSSS (Kushlan and Bass 1983).

CSSS nest in the spring when the marl prairies are dry. While the majority of nesting activities have been observed between March 1 and July 15 when Everglades marl prairies are dry, (Lockwood et al. 1997, 2001), nesting has been reported as early as late February (Werner 1975), and as late as early August (Dean and Morrison 2001). Males will establish breeding territories in early February (Balent et al. 1998) and defend these territories throughout the breeding season (FWS 1999). Male sparrows vocalize to attract females and this particular breeding activity has been shown to decrease with increased surface water conditions (Nott et al. 1998, Curnutt and Pimm 1993).

Successful CSSS breeding requires that breeding season water levels remain at or below ground level in the breeding habitat. Nott et al. (1998) cited a "10-centimeter (cm)" rule for maximum water depth over which the CSSS will initiate nesting. This conclusion was based upon observations within the ENP range-wide survey in which no singing males were heard when water depths exceeded that level. However, Dean and Morrison (1998) demonstrated that nesting may occur when average water depths exceed this rule. CSSS construct their nests relatively close to the ground in clumps of grasses composed primarily of muhly, beakrushes (*Rhynchospora* spp.), and Florida little bluestem (*Schizachyrium rhizomatum*) (Pimm et al. 2002). The average early season nest height is 17 cm (6.7 inches) above ground, while the average late season nest height is 21 cm (8.3inches) above ground (Lockwood et al. 2001). The shift in average nest height after the onset of the wet season rainfall pattern, which typically begins in early June (Lockwood et al. 2001), appears to be an adaptive response to rising surface water conditions. In general, the CSSS will raise one or two broods within a season; however, if weather conditions permit, a third brood is possible (Kushlan et al. 1982, FWS 1983). A new nest is constructed for each successive brood. The end of the breeding season is triggered by the onset of the rainy season when ground water levels rise above the height of the nest off the ground (Lockwood et al. 1997).

CSSS will lay three to four eggs per clutch (Werner 1978, Pimm et al. 2002) with a hatching rate ranging between 0.66 and 1.00 (Boulton et al. 2009b). The nest cycle lasts between 34 and 44 days in length and includes a 12-13 day incubation period, 9-11 day nestling period and 10-20 days of post-fledgling care by both parents (Sprunt 1968, Trost 1968, Woolfenden 1968, Lockwood et al. 1997, Pimm et al. 2002). Nest success rate varies between 21 and 60 percent, depending upon timing of nest initiation within the breeding season (Baiser et al. 2008, Boulton et al. 2009a). Substantially higher nest success rates occur within the early portion of the breeding season (approximately 60 percent prior to June 1) followed by a decline in success as the breeding season progresses to a low of approximately 21% after June 1 (Baiser et al. 2008, Boulton et al. 2009a, Virzi et al. 2009). In most years, June 1 is a good division between the early high success period and the later, lower success period (Dr. Julie Lockwood email correspondence to FWS, October 15, 2009). Nearly all nests that fail appear to fail due to predation, and predation rates appear to increase as water level increases (Lockwood et al. 1997, 2001, Baiser et al. 2008). A complete array of nest predators has not been determined. However, raccoons *(Procyon lotor*), rice rats *(Oryzomys palustris*), and snakes may be the chief predators (Lockwood et al. 1997, Dean and Morrison 1998, Post 2007).

A dietary generalist, CSSS feed by gleaning food items from low-lying vegetation (Ehrlich et al. 1992, Pimm et al. 2002). Common components of their diet include soft-bodied insects such as grasshoppers, spiders, moths, caterpillars, beetles, dragonflies, wasps, marine worms, shrimp, grass, and sedge seeds (Stevenson and Anderson 1994). The importance of individual food items appear to shift in response to their availability (Pimm et al. 1996, 2002).

CSSS are non-migratory with males displaying high site fidelity, defending the same territory for two to three years (Werner 1975). CSSS are capable of both short-distance and longer-range movements, but appear to be restricted to short hydroperiod prairie habitat (Dean and Morrison 1998). Large expanses of deep water or wooded habitat act as barriers to long-range movements (Dean and Morrison 1998). Recent research by Julie Lockwood, Ph.D. of Rutgers University and her students have revealed substantial movements between subpopulations east of Shark River Slough (Lockwood et al. 2008, Virzi et al. 2009), suggesting that the CSSS may have the capacity to colonize unoccupied suitable habitat if it is available (Sustainable Ecosystems Institute 2007).

In the 1930s, Cape Sable was the only known breeding range for the CSSS (Nicholson 1928). Areas on Cape Sable that were occupied by the CSSS in the 1930s have experienced a shift in vegetative communities from freshwater vegetation to mangroves, bare mud flats, and salt-tolerant plants, such as turtleweed (*Batis maritima*) and bushy seaside tansy (*Borrichia frutescens*) (Kushlan and Bass 1983). As a result, CSSS no longer use this area. More recently, continued alterations of CSSS habitat have occurred as a result of changes in the distribution, timing, and quantity of water flows in south Florida. Water flow changes and associated shifts in vegetation appear to be the leading contributor to the decline in CSSS population, which subsequently threaten the subspecies with extinction. Competition and predation also threatens the CSSS.

Presently, the known distribution of the CSSS is restricted to two areas of marl prairies east and west of Shark River Slough in the Everglades region (within ENP and BCNP) and the edge of Taylor Slough in the Southern Glades Wildlife and Environmental Area in Miami-Dade County. ENP staff first undertook a comprehensive survey of the CSSS in 1981 to identify all areas where sparrows were present. This survey, hereafter referred to as the range-wide survey, resulted in the first complete range map for the CSSS (Bass and Kushlan 1982, Kushlan and Bass 1983). The survey design consisted of a one-kilometer survey grid over any suspected CSSS habitat. As much of CSSS habitat is inaccessible, a helicopter was used and landed at the intersection of each grid line (i.e. every 1 kilometer). At each site, the researchers would record every CSSS seen or heard (singing males) within an approximate 200 meter radius of their landing location (Curnutt et al. 1998). From the resulting range map, Curnutt et al. (1998) divided the CSSS into six separate subpopulations, labeled as A through F (**Figure 6-25**) with subpopulation A (CSSS-A) as the only subpopulation west of Shark River Slough (SRS).

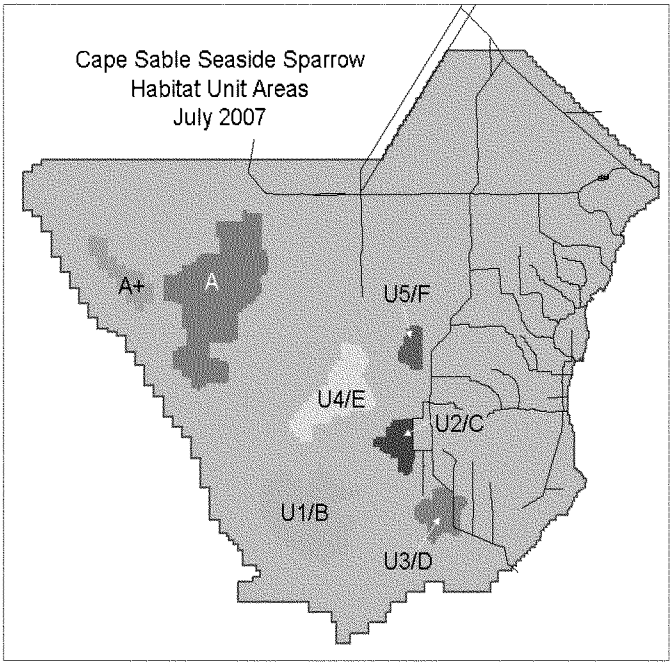


Figure 6-25. Cape Sable Seaside Sparrow Subpopulations (A-F) and Designated Critical Habitat Units (U1-U5).

After the 1981 survey, the population was not surveyed again until 1992. The range-wide survey has been performed annually since 1992, although the number of survey locations has changed from a high of over 850 sites in 1992 to a low of 250 sites in 1995 (Cassey et al. 2007).

Bass and Kushlan (1982) also devised a methodology of translating the range-wide survey results into an estimate of population size. To account for females (only males sing) and CSSS outside the audio detection range, the number of birds counted is multiplied by a factor of sixteen (15.87 rounded to 16). In order to confirm the validity of this estimation factor, Curnutt et al. (1998) compared the bird counts from the range-wide survey with actual mapped territories on intensive study plots and found it to be adequate given normal population fluctuations. More recent research indicates that this estimation factor may be overestimating population abundance within the smaller CSSS subpopulations (*i.e.* CSSS-A, C, D, F) due to the presence of floater males and a male-biased sex ratio (Boulton et al. 2009a).

Based on the range-wide surveys, total CSSS populations have declined from approximately 6,600 individuals during the period from 1981-1992, to approximately 1,456 in 2012 (**Table 6-5**). Although populations decreased significantly during the early part of that time period, they have remained relatively constant since 1993 **(Table 6-5, Figure 6-26).** Recognizing the limitations of the range-wide survey in detecting fine-scale changes in population abundance related to management actions (Walters et al. 2000, Lockwood et al. 2006), Cassey et al. (2007) translated the results of the range-wide survey into presence/absence data and then converted it into a measure of occupancy. In their study, occupancy was defined as the fraction of the area occupied by the species in any one year as used by MacKenzie et al. (2002). Their results show that the proportion of CSSS range occupied decreased between 1981 and 1992, particularly in CSSS-C, D and F, with a second period of decline between 1992 and 1996, most notably within CSSS-A. After 1996, overall occupancy has remained relatively constant (Cassey et al. 2007).

Table 6-5. Cape Sable Seaside Sparrow Bird Count and Population Estimates by Year as Recorded by the Everglades National Park Range-Wide Survey (BC: Bird Count, EST: Estimate, NS: Not Surveyed)

Population/ Year	CSSS-A		CSSS-B		CSSS-C		CSSS-D		CSSS-E		CSSS-F		Total	
	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST	BC	EST
1981	168	2,688	147	2,352	27	432	25	400	42	672	7	112	416	6,656
1992	163	2,608	199	3,184	3	48	7	112	37	592	2	32	411	6,576
1993	27	432	154	2,464	0	0	6	96	20	320	0	0	207	3,312
1994	5	80	139	2,224	NS	NS	NS	NS	7	112	NS	NS	151	2,416
1995	15	240	133	2,128	0	0	0	0	22	352	0	0	170	2,720
1996	24	384	118	1,888	3	48	5	80	13	208	1	16	164	2,624
1997	17	272	177	2,832	3	48	3	48	52	832	1	16	253	4,048
1998	12	192	113	1,808	5	80	3	48	57	912	1	16	191	3,056
1999a	25	400	128	2,048	9	144	11	176	48	768	1	16	222	3,552
1999b	12	192	171	2,736	4	64	NS	NS	60	960	0	0	247	3,952
2000a	28	448	114	1,824	7	112	4	64	65	1,040	0	0	218	3,488
2000b	25	400	153	2,448	4	64	1	16	44	704	7	112	234	3,744
2001	8	128	133	2,128	6	96	2	32	53	848	2	32	204	3,264
2002	6	96	119	1,904	7	112	0	0	36	576	1	16	169	2,704
2003	8	128	148	2,368	6	96	0	0	37	592	2	32	201	3,216
2004	1	16	174	2,784	8	128	0	0	40	640	1	16	224	3,584
2005	5	80	142	2,272	5	80	3	48	36	576	2	32	193	3,088
2006	7	112	130	2,080	10	160	0	0	44	704	2	32	193	3,088
2007	4	64	157	2,512	3	48	0	0	35	560	0	0	199	3,184
2008	7	112	NS	NS	3	48	1	16	23	368	0	0	34	544*
2009	6	96	NS	NS	3	48	2	32	27	432	0	0	38	608*
2010	8	128	119	1904	2	32	4	64	57	912	1	16	191	3,056
2011	11	176	NS	NS	11	176	1	16	37	592	2	32	62	992*
2012	21	336	NS	NS	6	96	14	224	46	736	4	64	91	1456

*Note: These numbers do not reflect a significant decline in CSSS population. CSSS-B, the largest and most stable subpopulation, was not surveyed in 2008, 2009, or 2011. Adding the 2007 CSSS-B population estimate of 2,512 birds to those of the other subpopulations, the estimated total CSSS population size is 3,056 and 3,120 birds for 2008 and 2009, respectively. Adding the 2010 CSSS-B population estimate of

1,904 birds to those of the other subpopulations, the estimated total CSSS population size is 2,896 birds and 3,360 for 2011 and 2012, respectively

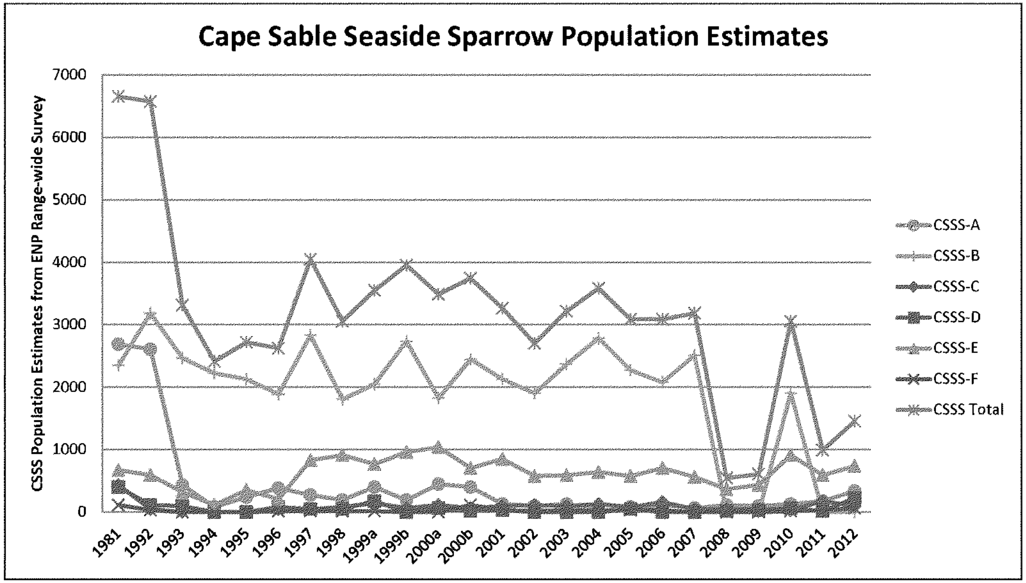


Figure 6-26. Cape Sable Seaside Sparrow Population Estimates within Each Subpopulation as Reported from the Everglades National Park Range-Wide Surveys

CSSS-A is located in western SRS immediately in the path of water discharges out of WCA 3A through the S-12 structures. Unusually intense and unseasonable rainy periods during the winter of 1992/93, along with Hurricane Andrew, and again in 1993/94 and 1994/95 caused prolonged flooding in CSSS-A, sufficient enough that the high water levels may have nearly precluded breeding in 1993 and 1995 (Walters et al. 2000). In addition, little or no breeding was possible during the 1994 and 1996 breeding seasons, due to the limited availability of suitable dry habitat. The flooding of the habitat by direct rainfall was compounded by discharges of water through the S-12 structures needed to meet the regulation schedule for WCA 3A. With an average life-span of two to three years, several consecutive years with little or no reproduction, could significantly affect population size. This is reflected in the dramatic reduction of sparrows detected in subsequent surveys in CSSS-A, in addition to the reduction in occupancy reported by Cassey et al. (2007) for the time period between 1992 and 1996. As a consequence, the FWS issued a BO in 1999 providing recommendations to the Corps on how water levels should be controlled within CSSS-A nesting habitat so that the existence of the CSSS would not be jeopardized. The Corps responded by developing changes in water management operations through emergency deviations in 1998 and 1999, two iterations of the Interim Structural and Operational Plan (ISOP) for Protection of the Cape Sable Seaside Sparrow in 2000 and 2001, culminating in the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow in 2002, which has been in effect until December of 2012 when the Everglades Restoration Transition Plan went into effect. The ISOP/IOP goals were to keep subpopulations (particularly CSSS-A) dry during the breeding season and to also keep the habitat for sub-populations B, C, D, E, and F (CSSS-B, CSSS-C, CSSS-D, CSSS-E, and CSSS-F) from excessive drying in order to prevent adverse habitat change from unseasonable fire frequencies.

The primary objective in implementing IOP was to reduce damaging high water levels within CSSS habitat west of SRS (i.e. CSSS-A). IOP was designed to protect the CSSS to the maximum extent possible through water management operations. The purpose of IOP was to provide an improved opportunity for nesting by maintaining water levels below ground level for a minimum of 60 consecutive days between March 1 and July 15, corresponding to the CSSS breeding season. In addition, a secondary purpose of IOP was to allow CSSS habitat to recover from prolonged flooding during the mid-1990s. It is recognized in the 1999 FWS BO that there could be times when unseasonable rainfall events could overwhelm the ability of the water management system to provide the necessary dry conditions. Since implementation of IOP, the FWS recommendations for protection of the CSSS in CSSS-A were met in 2002, 2004, 2006, 2008 and 2009. Direct rainfall on CSSS-A prevented meeting the RPA requirements for 2003, 2005 and 2007, contributing to the lack of recovery of CSSS-A. As reported from the range-wide survey (**Table 6-5**), the estimated total CSSS population during IOP has remained between 2,704 bird (2002) and 3,584 birds (2004). CSSS-A population estimates during IOP ranged from a low of 16 (1 bird counted) in 2004 to a high of 128 (8 birds counted) in 2003. The population estimates for CSSS-A may be inflated due to the potential inaccuracy of the estimation factor in smaller subpopulations as suggested by recent research (Boulton et al. 2009a). In addition, it should also be noted that the estimates for a particular year have relevance for potential breeding that year, but this would not be reflected in the population estimates until the following year. Under the 2006 IOP, the S12A-C, S343A-B and S344 structures were closed during portions of the year in order to meet the FWS RPA of 60 consecutive dry days at gauge NP-205 between March 1 and July 15. Under ERTP, the S-12A-B, S343A-B and S344 closure dates remain as identified under IOP. However, under ERTP, S-12C would not have any associated closure dates designed to meet the FWS RPA for the CSSS. Due to its more eastern location, S-12C is farther removed from CSSS-A as compared with the S12A-B structures and thus has less of an impact on hydrological conditions within CSSS-A (refer to 2006 IOP FSEIS). In addition, Department of the Interior will maintain sandbags within the culverts along the Tram Road within ENP to prevent westward flow of water from S-12C into the western marl prairies and CSSS-A. These stoppers will help to prevent S-12C flows west of the Tram Road and maintain shorter hydroperiods within the western marl prairies. Also, S-346 will be open when S-12D is open to further facilitate the movement of water into central Shark River Slough. As ERTP was implemented in October 2012, sufficient data is not available to understand if ERTP operations are having the intended effect within CSSS habitat.

Another factor in lack of recovery is change in vegetative structure resulting from physical damage during the high water events of 1993 through 1995 and a shift in the vegetative community dominants away from previous species. This phenomenon was studied by Michael Ross, Ph.D. and Jay Sah, Ph.D. of Florida International University, along with James Snyder of the United States Geological Survey (USGS) in a 2003-2009 monitoring study funded by the Corps (Ross et al. 2003, 2004, 2006, Sah et al. 2007, 2008, 2009). Based upon several years of vegetation studies within CSSS habitat, the researchers concluded that the direction and magnitude of short-term vegetation change within marl prairie is dependent upon the position of the habitat within the landscape. Efforts to regulate the S-12 structures under ISOP/IOP to protect CSSS-A and its habitat west of SRS, as well as drought, have resulted in lower water depths during the sparrow breeding season as measured at gauge NP-205. However, the persistence of wetter vegetation within the vicinity of gauge P-34 may have limited the recovery of CSSS-A within this part of its habitat. This suggests water flow from the northwest resulting in deeper water levels and longer hydroperiods within this portion of CSSS-A habitat. As shown in **Table 6-5**, CSSS-A has not recovered under IOP operations, but has remained relatively stable since its implementation. Recent research suggests that sparrow populations are slow to recover, or cannot recover, once they reach very small population sizes due to low adult and juvenile recruitment, many unmated males, biased sex ratios, lower hatch rates and other adverse effects associated with small population size (i.e. the Allee effect) (Boulton et al. 2009a, Virzi et al. 2009).

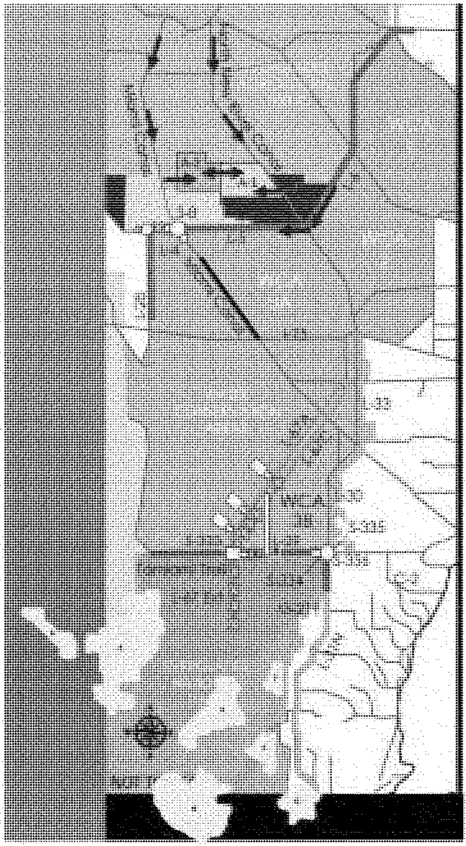
Vegetation change is mediated by the interaction of fire and hydrology. Studies by Sah et al. (2009) revealed that not only did post-fire flooding delay the vegetation recovery process, but also caused it to follow a different trajectory in terms of species composition. This in turn, could potentially impede recolonization by the CSSS (Sah et al. 2009). The transition from one vegetation type to another (i.e. prairie to marsh) in response to hydrology may take place in as little as three to four years (Armentano et al. 2006), however, the transition from marsh to prairie may take longer (Ross et al. 2006, Sah et al. 2009). Vegetation studies within CSSS habitat (Ross et al. 2004) have shown that CSSS occupy prairies with a hydroperiod ranging between 90 and 240 days. However, solely attaining this hydroperiod requirement may not be enough to promote a transition from marsh to prairie habitat, as this likely requires the process of fire (Ross et al. 2006, Sah et al. 2009).

6.2.8.1 Potential Effects on CSSS

Presently, the known distribution of the CSSS is restricted to two areas of marl prairies east and west of SRS in the Everglades region (within ENP and BCNP) and the edge of Taylor Slough in the Southern Glades Wildlife and Environmental Area in Miami-Dade County. CSSS surveys resulted in a range map that divided the CSSS into six separate subpopulations, labeled as A through F (**Figure 6-27** and **Figure 6-28**), with CSSS-A as the only subpopulation west of SRS (Curnutt et al. 1998). The following analysis of Alt 4R2 compared to existing conditions and FWO is arranged by ERTP PM and ET with potential effects to each subpopulation described in greater detail.

PM-A: Number of years a minimum of 60 consecutive days at NP-205 below 6.0 feet, NGVD beginning no later than March 15 is met out of the 40 year period of record.

In order to compare alternatives in relation to PM-A, the RSM-GL simulated NP-205 daily stage was used. From this data, the annual discontinuous hydroperiod (number of days inundated), was calculated and the number of consecutive dry days within the CSSS nesting window of March 1 through July 15 was counted. For CSSS-B, CSSS-C, and CSSS-F, Alt 4R2 performs similarly to existing conditions and FWO. One region (IR-A2 and one gauge (TMC) in CSSS-A and two regions (E-1 and E-2) and one gauge (NE of NPA) in CSSS-E performed worse than the existing conditions by 8, 2, 4, 4 and 4 years respectively (**Table 6-6** and **Figure 6-29** through **Figure 6-40**). Since 1999, through deviations, IOP and ERTP, FWS has always maintained that moving water to the east through the historical flowpath into NESRS was the solution to improve nesting and habitat conditions for CSSS. However, RSM-GL model results indicates that although CEPP acts to restore the historical flowpath through WCA-3A to WCA-3B and shifts water flow into NESRS, there are still adverse effects on portions of the areas occupied by the eastern and western sparrow subpopulations. CSSS-A, E-1 and E-2 continue to not meet the minimum 60-day dry period criterion during the nesting season. The continued low number of years meeting the criterion make it hard for these sub populations to recover, especially since these sub populations, as well as sub population D (no change from existing condition, but only meeting the criteria 20 years) have the smallest estimated populations (**Figure 6-24**). Since sparrow populations are slow to recover, or cannot recover once they reach very small population size, continued years of not meeting the criterion may inhibit the recovery of these sub populations in some portion of the areas currently occupied by CSSS.



**Not to scale and 100% georeferenced

Figure 6-27. CEPP TSP with CSSS sub populations overlaid.

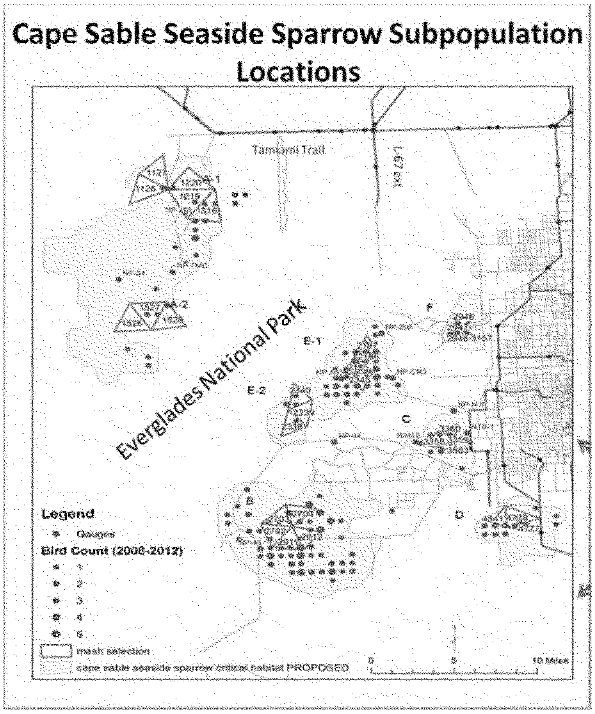


Figure 6-28. Extent of CSSS sub populations.

Table 6-6. PM-A: Number of years there is a minimum of 60 consecutive days at NP-205 below 6.0 feet, NGVD beginning no later than March 15. Comparison of ECB 2012, FWO, and Alt 4R2 for each subpopulation of CSSS out of the 41 year POR.

Subpop	Gauge	ECB2012	Alt 4R2	FWO
A	IR-A1 (region)	20	22	20
	IR-A2 (region)	33	25	33
	P34	29	29	29
	TMC	31	29	32
B	CY3	40	40	40
C	R3110	39	39	39
	E112	38	38	38
D	EVER4	20	20	22
E	NE of NPA13 (E-1)	37	33	36
	E-1	38	34	37
	E-2	28	24	28
F	NE of RG2	33	33	33

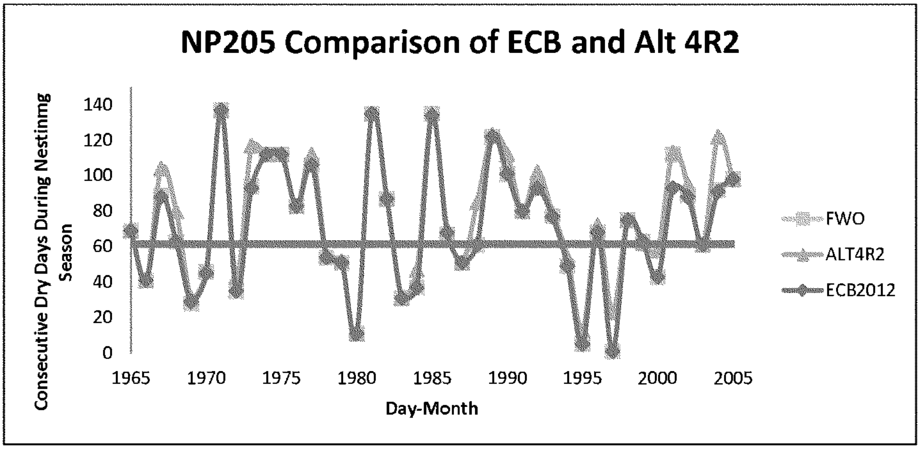


Figure 6-29. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A

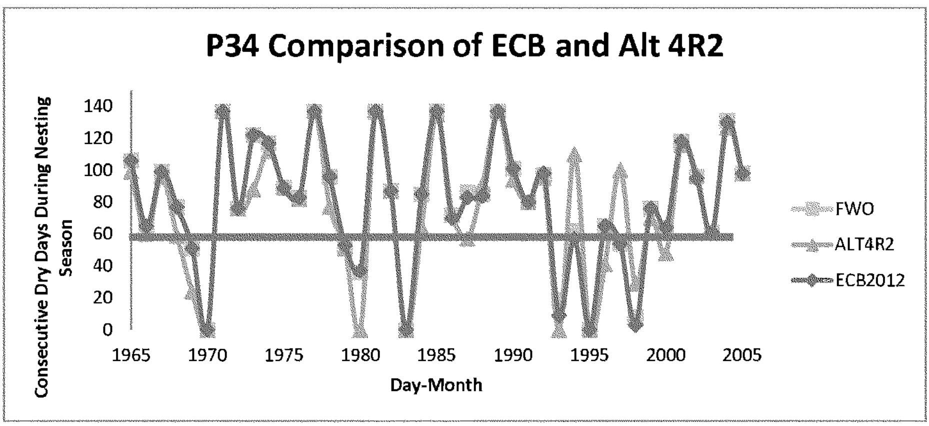


Figure 6-30. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A

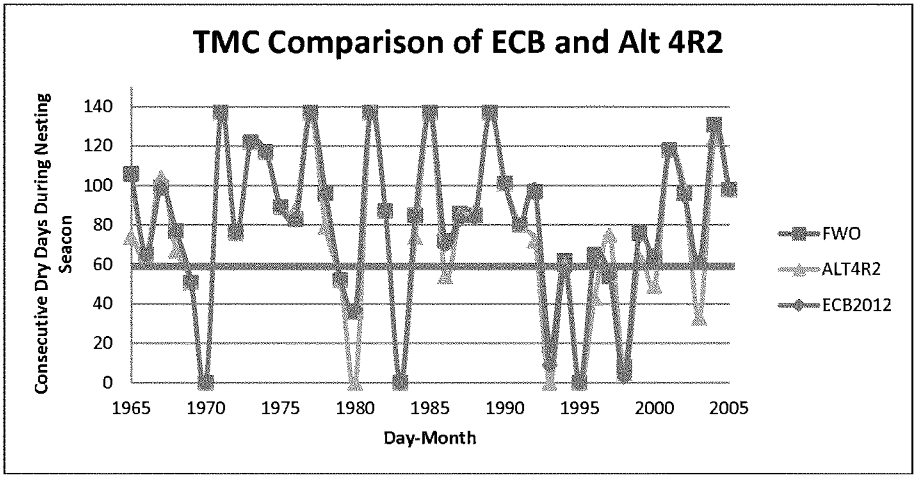


Figure 6-31. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A

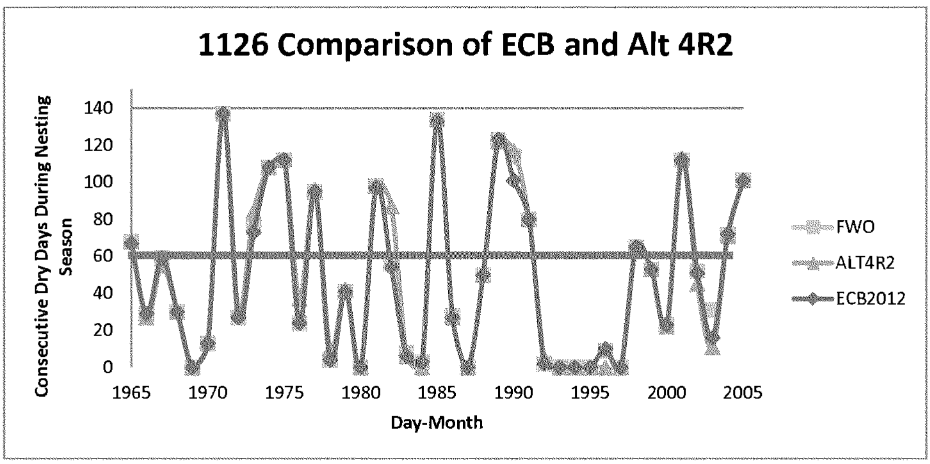


Figure 6-32. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

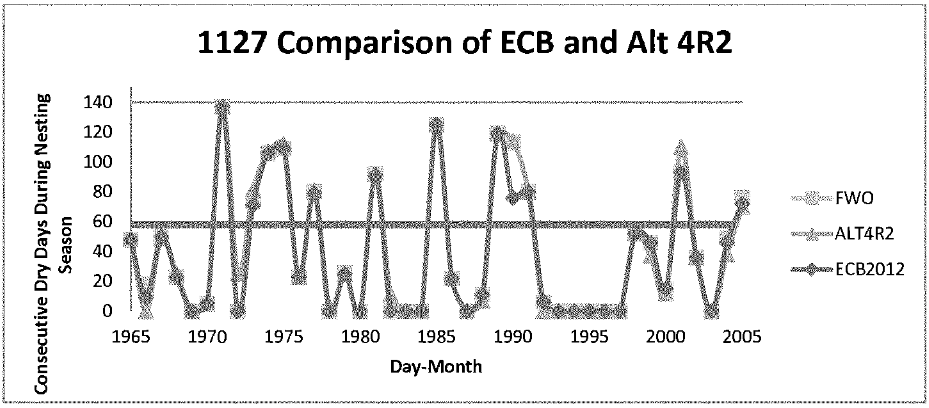


Figure 6-33. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

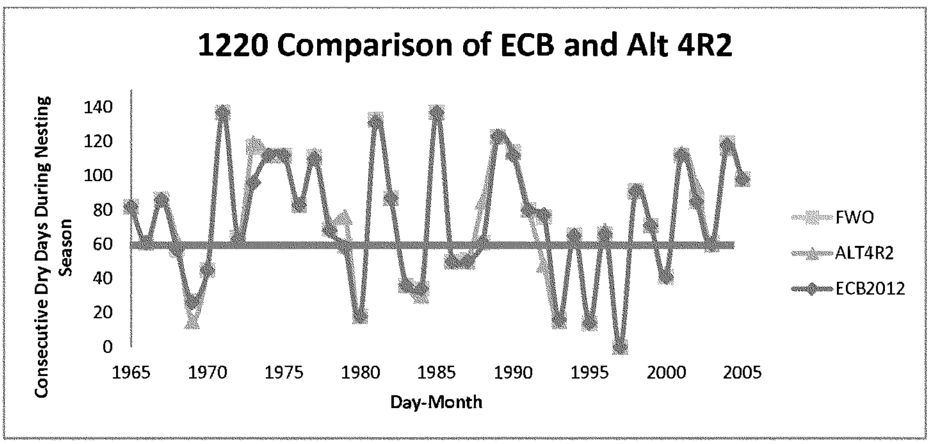


Figure 6-34. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-A-1

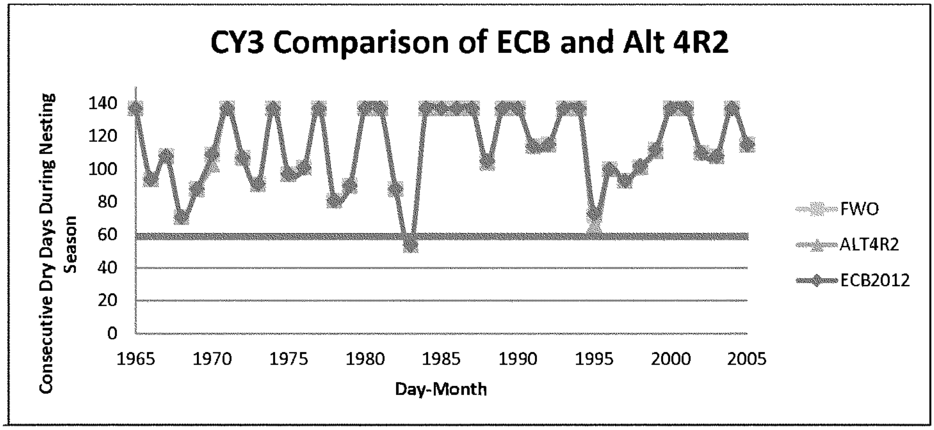


Figure 6-35. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-B

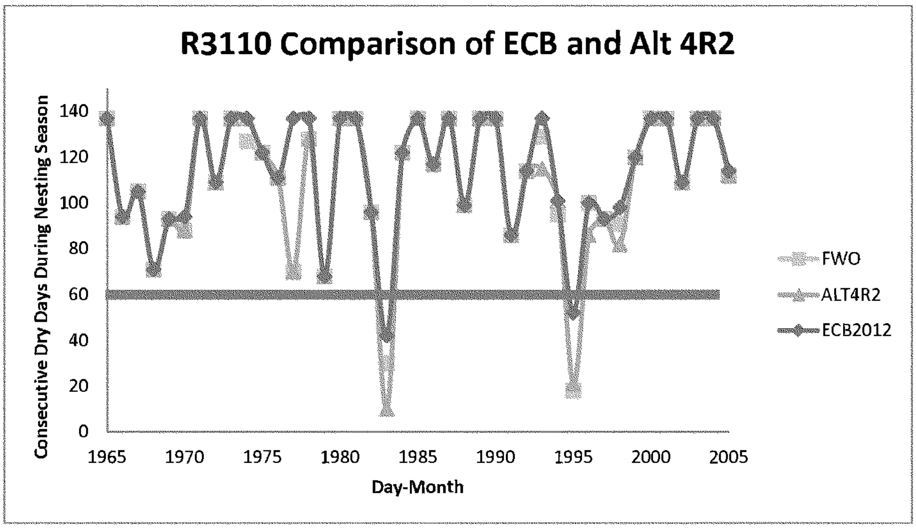


Figure 6-36. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-C

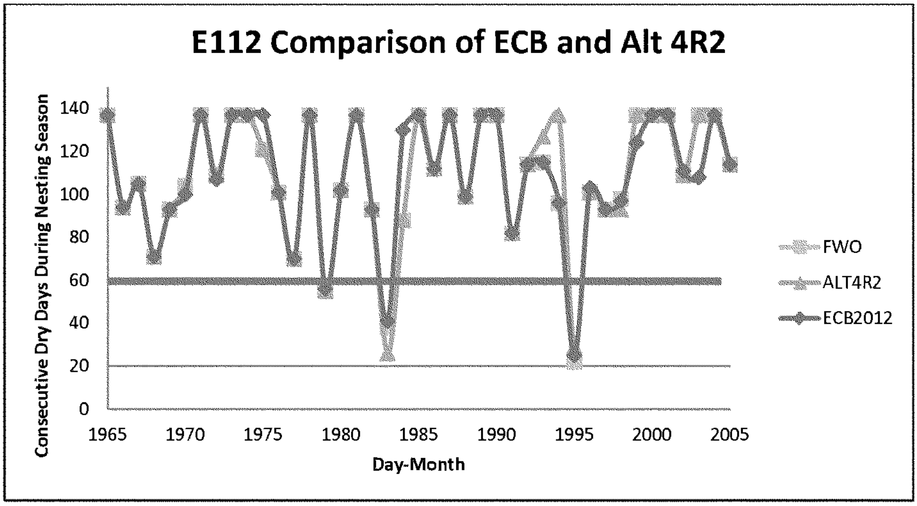


Figure 6-37. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-C

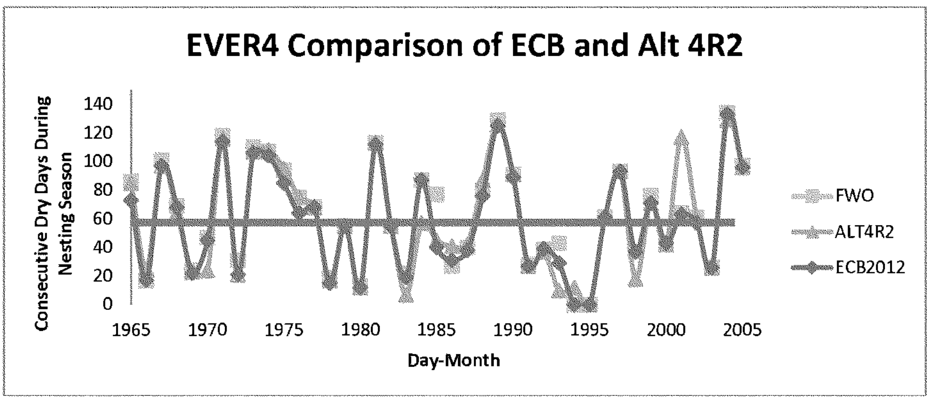


Figure 6-38. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-D

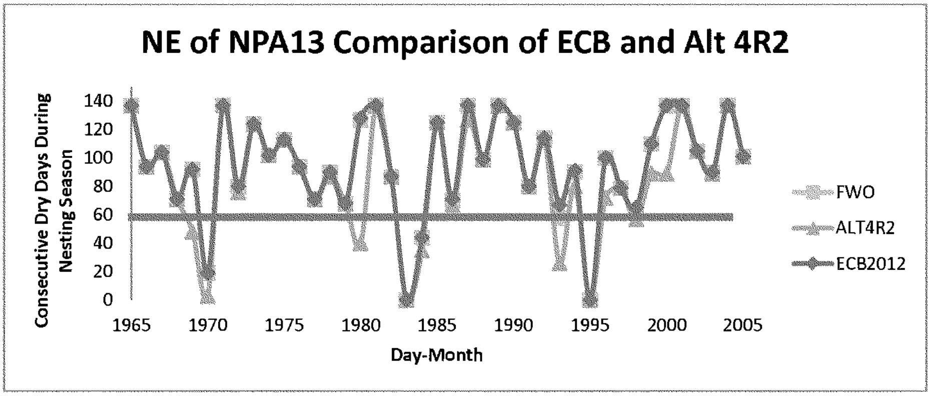


Figure 6-39. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-E

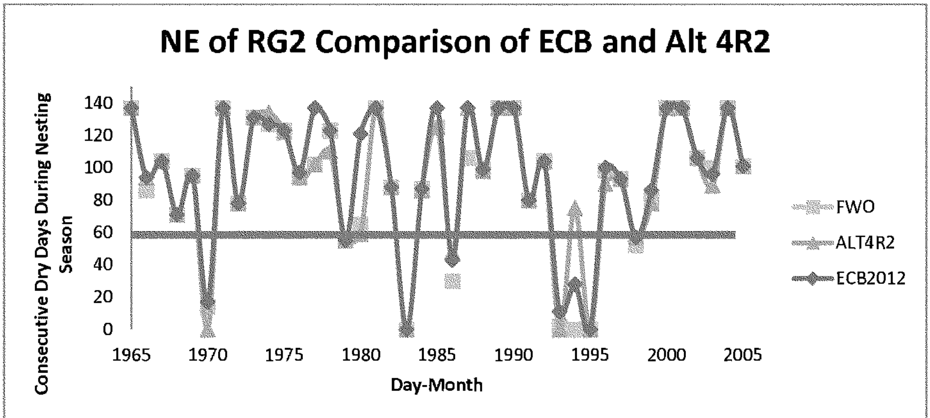


Figure 6-40. PM-A comparison of existing conditions, Alt 4R2, and FWO for CSSS-F

CSSS-A population has remained stable, but has not increased since the implementation of CSSS protective measures in 1999. Critical habitat for CSSS was revised in 2007 and CSSS-A is the only subpopulation that does not reside within designated critical habitat. The biggest difference in CSSS-A where existing conditions performed better than Alt 4R2 is 8 years at IR-A2 and 2 years at TMC. In the 2008-2012 survey, the IR-A1 had more birds present than in IR-A2 (**Figure 6-41**), and the IR-A1 increased meeting PM-A by 2 years over existing conditions and FWO. P34 had the same number of years met between all comparisons, however, only a few birds were found present in the area (**Figure 6-41**).

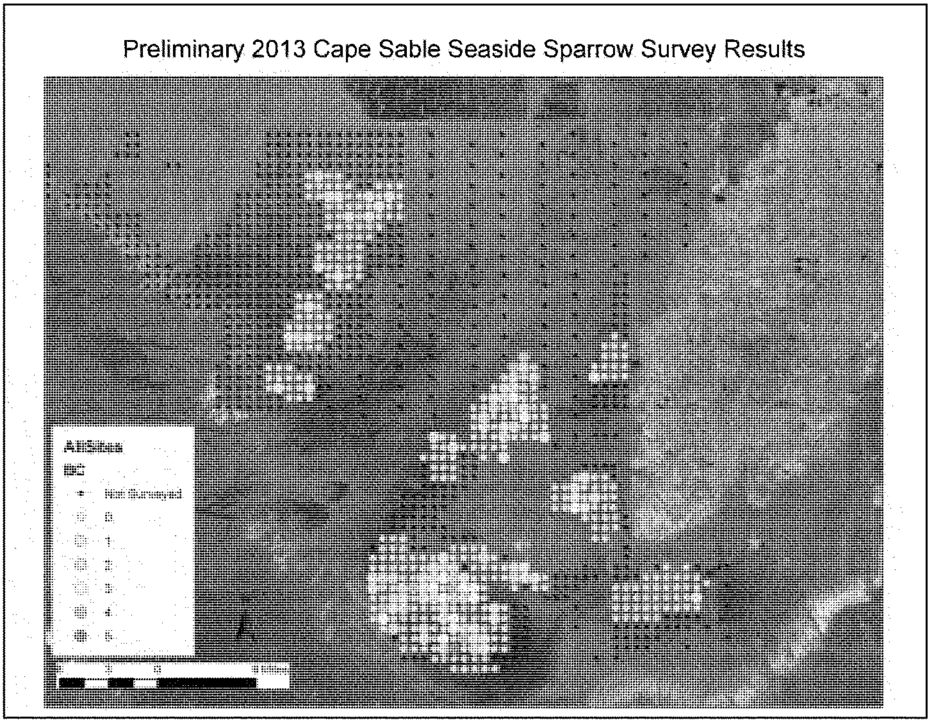


Figure 6-41. 2013 CSSS ENP survey results

CSSS-E is the second largest subpopulation, and Alt 4R2 met the criteria 4 years less than existing conditions and 3 years less than FWO. CSSS-D met the criteria the same as existing conditions but 2 years less than the FWO. In CSSS-B Alt 4R2 meets the 60 day requirement below 6 ft of water every year. CSSS-C also meets the PM-A requirement often (38 years), as did CSSS-F (33 years). Hydrologic restoration resulting from implementation of Alt 4R2 in areas that are currently too dry should increase habitat suitability for CSSS, therefore these areas could potentially provide habitat for translocation of birds as the area of suitability within current populated locations decreases.

CSSS are largely sedentary, occupy the prairie habitats year-round and are completely dependent on the condition of the prairies. The CSSS have a short life expectancy of two to three years. This short life expectancy range identifies that for the population to sustain itself, there must not be three or more years in a row where water depths are not suitable for nesting. Favorable nesting habitat requires short hydroperiod vegetation characteristic of mixed marl prairie communities. A measure of the potential for CSSS nesting success is the number of consecutive days between March 1 and July 15 that water levels are below ground surface. Preferable discontinuous hydroperiod durations range from 60 to 180 days, although a 40 to 80 consecutive day period is considered favorable (Pimm et al. 2002). In order to maintain suitable vegetative composition conducive for successful nesting, it is important that water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 centimeters) more than 30 days during the period from March 15 to June 30 at a frequency of more than two out of every ten years. Water depths greater than 7.9 inches (20 centimeters) during this period will result in elevated nest failure rates (Lockwood et al. 2001; Pimm et al. 2002). If these water depths occur for short periods during nesting season, CSSS may be able to re-nest within the same season. These depths, if they occur for sustained periods (more than 30 days) within CSSS nesting season, will reduce successful nesting to a level that will be insufficient to support a population if they occur more frequently than two out of every ten years. This has occurred within portions of the CSSS range. This means that there should not be three consecutive years in a row where the minimum of 60 consecutive dry days during the nesting season is not met. It is important to note that the 60-day dry period criterion is a minimum FWS requirement based upon the 1999 FWS Jeopardy Opinion RPA.

Further analysis of gauges specific to where nesting occurred in 2013 of the PM-A data looked at the durations and timing of the total number of consecutive dry days during the nesting season for each year of POR. **Table 6-7** through **Table 6-12** presenting this data show that some areas exceed the greater than 60 day nesting period between March 1 and July 15, potentially allowing for multiple nests in one year. Preferable discontinuous hydroperiod durations range from 60 to 180 days, although a 40 to 80 consecutive day period is considered favorable (Pimm et al. 2002). Some of the consecutive day counts are close to 60, and may have been a day or a few days where the water level is just above the ground surface. In these cases, the cells were coded as yellow in that they may provide a suitable nesting season. Cells that are green met the 60 consecutive dry days and cells that are red did not meet the 60 consecutive dry days or even a total of 60 dry days during the nesting season. This analysis shows that for the northern CSSS-AA (Label A-1), while there is still no difference between Alt 4R2, existing conditions, and FWO, 1984 was a year in which there were a total of 115 dry days for 4R2 and 57 dry days for existing conditions and FWO that has the possibility of producing a successful nest (**Table 6-7**). Results from grids 1126 and 1127 in CSSS-A (Label A-1) show 4 to 5 times over the period of record that there are 3 or more consecutive years where the minimum of 60 dry days is not met, this also occurred in the case of ECB and FWO. In 1982, Alt 4R2 met the met the minimum day criteria, so there was only 2 years in a row instead of the 3 that were in ECB and FWO conditions. **Table 6-7** shows that in the southern CSSS-A (Label A-2), while Alt 4R2 perform worse than existing conditions and FWO for more years and more consecutive years where there are less than 60 dry days during the nesting season, the breakdown of the days show that in 1979, there are 60 total dry days during the nesting season. Unusually intense and unseasonable rainy periods during the winter of 1992/93, along with Hurricane Andrew, and again in 1993/94 and 1994/95 caused prolonged flooding in CSSS-A, sufficient enough that the high water levels may have nearly precluded breeding in 1993 and 1995 (Walters et al. 2000). In addition, little or no breeding was possible during the 1994 and 1996 breeding seasons, due to the limited availability of suitable dry habitat. **Table 6-8** and **Table 6-9** show no difference between Alt 4R2, existing conditions, and FWO in CSSS-B and CSSS-C, respectively. **Table 6-10** shows that while Alt 4R2 perform slightly worse than existing conditions and FWO for CSSS-D, there are 7 potential years where the total number of days adds up to greater than 60, therefore having the possibility of producing a successful nest. **Table 6-11** shows that while Alt 4R2 perform slightly worse than existing conditions and FWO for CSSS-E (Label E-1), there are 3 more potential years that have a total of greater than 60 days. In the southern CSSS-E (Label E-2), **Table 6-11** shows while Alt 4R2 perform worse than FWO there are a few years such as 1972, 2000, and 2003 where the alternatives do not meet the 60 consecutive dry day target, but they do have at least 60 dry days during the nesting season. Depending upon water depth at the nesting location, CSSS nesting may or may not have been affected. The average early season nest height is 17 cm (6.7 inches) above ground, while the average late season nest height is 21 cm (8.3inches) above ground (Lockwood et al. 2001). Increases in water depth below these thresholds would not flood nests, but may inhibit nesting activity (Nott et al. 1998, Dean and Morrison 1998). **Table 6-12** also shows that Alt 4R2 performs better than the FWO in CSSS sub population F and that there are a few years such as 1980 and 1986 where the alternatives do not meet the 60 consecutive dry day target, but they do have at least 60 dry days during the nesting season.

The average continuous dry period (days) over the period of record was calculated for gauges and grid cells in each CSSS sub population for existing condition, Alt 4R2 and FWO (**Table 6-13**). The average continuous dry period was greater than the minimum of 60 days for gauges and grid cells in CSSS-A (Label A-1) in the eastern grids, A-2, B, C, D, E-1, E-2 and F. The A-1, A-2, E-1 and E-2 indicator regions were not post processed by SFWMD modeling team and thus the individual grid cells have been analyzed. The western grid cells in CSSS-A (Label A-1) did not meet the minimum number of dry days over the period of record in the existing condition, FWO or Alt 4R2. In addition, there is no significant difference between existing condition, FWO and Alt 4R2 with 50 average continuous dry days for grid cell 1126 and 40 average continuous dry days for grid cell 1127 (**Table 6-13**). CSSS-D is just at the minimum with 66 days for Alt 4R2 compared to 70 days for FWO. CSSS-E (Label E-1) shows a decrease from 95 days to 89 days from FWO to Alt 4R2 and CSSS-E (Label E-2) shows a decrease from 80 days to 73 days from FWO to Alt 4R2.

Table 6-7. Total number of consecutive dry days during March 1 – July 15 for the northern CSSS-A (Label A-1) and CSSS-A (Label A-2). Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

NP-205 (A-1)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	65, 1, 17	65, 1, 17	65, 1, 17
1966	14, 41	14, 41	14, 41
1967	88	104	88
1968	1, 1, 61	60	1, 1, 61
1969	5, 29, 14	1, 5, 31, 15	5, 29, 14
1970	45	45	45
1971	117	117	117
1972	8, 3, 35	14, 43	8, 3, 35
1973	11, 93	117	11, 93
1974	112	112	112
1975	112	112	112
1976	84, 2	81, 6	84, 2
1977	106, 11	111, 12	106, 11
1978	54	2, 55	54
1979	51, 2, 6, 6, 6, 13, 1	52, 3, 4, 29, 3	51, 2, 6, 6, 6, 13, 1
1980	33	33	33
1981	135	135	135
1982	87	87	87
1983	33	33	33
1984	22, 22	6, 9, 1, 47, 23	22, 22
1985	134	135, 1	135
1986	1, 69	1, 2, 1, 70	1, 67
1987	15, 51	15, 51	15, 51
1988	17, 65, 1	85, 2	17, 65, 1
1989	122, 9	121, 11	122, 9
1990	101, 10	112, 1	101, 10
1991	80	80	80
1992	91	102	91
1993	77	74	77
1994	2, 45	58	2, 45
1995	5, 2	53, 2, 3	5, 2, 3
1996	2, 1, 68	4, 72	2, 1, 68
1997	52, 1	35, 10, 3	52, 1
1998	1, 75	1, 75	1, 75
1999	81	82	81
2000	37, 41, 10	44, 58	38, 41, 10
2001	95, 18	115	112
2002	88	95	88
2003	61, 25	61, 34	61, 25
2004	12, 91	122	12, 92
2005	98, 1	98, 1	98, 1

P34 (A)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	81	81	81
1966	12, 35	30	12, 35
1967	88	2, 96	88
1968	2, 64	53	2, 2, 62
1969	3, 26, 14	31, 5, 1	3, 26, 14
1970	8	8	8
1971	117	117	117
1972	76	76	76
1973	18, 64	13, 68	18, 68
1974	112	112	112
1975	89	88	89
1976	82	82	82
1977	152	157	152
1978	75	77	75
1979	50, 10, 2, 3	51, 12, 2, 3	51, 12, 2, 3
1980	3, 12, 5	8	8, 12
1981	117	137	137
1982	87	87	87
1983	8	8	8
1984	83	44, 6, 2	83
1985	135	135	135
1986	6, 2, 71	1, 13, 71	2, 13, 71
1987	5, 10, 58	5, 11, 2, 2, 57	5, 11, 2, 2, 57
1988	77	81	1, 76
1989	157	157	157
1990	94, 2, 1	94, 1, 2, 1	94, 2, 1
1991	82	82	82
1992	87	92	92
1993	33	8	33
1994	110	110	1, 111
1995	8	8	8
1996	65, 8	5, 35, 3	65, 8
1997	13, 1, 78	103	13, 1, 78
1998	35	5, 25, 2	4, 35, 3
1999	1, 74	82	1, 74
2000	32, 49, 15, 10, 5	30, 48, 10, 6, 4	32, 49, 15, 10, 5
2001	116	116	116
2002	90	97	92
2003	27, 33, 21	61, 25	27, 33, 21
2004	116	127	121
2005	98	98	98

TMC (A)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	106	74, 26	106
1966	85, 1, 1	85, 1	85, 1, 2
1967	1, 93	104	1, 93
1968	77	1, 67	77
1969	5, 12, 51	4, 12, 52	5, 12, 53
1970	0	0	0
1971	137	137	137
1972	76	76	76
1973	122	122	122
1974	117	117	117
1975	90, 1	90, 1	90, 1
1976	81, 4	81	81, 4
1977	137	137	137
1978	3, 98	1, 2, 1, 75	3, 96
1979	53, 12, 7, 1, 8, 2	52, 2, 8, 7, 8	52, 2, 8, 7, 7, 2
1980	16, 21, 17, 5	0	16, 20, 36, 4
1981	137	137	137
1982	87	87	87
1983	0	0	0
1984	85, 1, 2	74	85, 1, 2
1985	137	137	137
1986	2, 5, 2, 70	54	4, 14, 72
1987	5, 83	5, 85	5, 86
1988	84	87	85
1989	137	137	137
1990	101, 11	101, 11	101, 11
1991	80	80	80
1992	61	13, 72, 1	67
1993	8, 7, 6	0	11, 15, 3
1994	52	80	62
1995	0	0	0
1996	65, 1	16, 43	65, 1
1997	13, 1, 2, 54, 18	14, 10, 75	13, 1, 1, 2, 54, 17
1998	3	3	1, 8
1999	76	53	76
2000	12, 64, 16	14, 40, 12, 9, 6	12, 64, 16
2001	118, 2	118, 2	118, 3
2002	56	58	56
2003	67, 23	27, 11, 23	61, 23
2004	130	124	131
2005	98	98, 1	98, 1

1126 (A-1)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	67, 7	66, 10	66, 10
1966	2, 59, 1	1, 27	2, 59, 5
1967	53	55	53
1968	93, 3	93, 3	93, 3
1969	5	0	0
1970	53	54	53
1971	137	137	137
1972	27	8, 15	27
1973	73	4, 34	76
1974	106, 1	106, 3	106, 1
1975	112	112	112
1976	5, 24, 55, 1	5, 37, 2	5, 24, 18
1977	95	94, 1	95
1978	4	55, 2	6
1979	41	42	41
1980	0	0	0
1981	97	98	98
1982	54	57	55
1983	2, 2	5, 1	3
1984	3, 1, 2	0	3, 1, 3
1985	133	134	134
1986	25	27	25, 7
1987	0	0	0
1988	56	58	56
1989	113, 4	113, 4	113, 4
1990	101, 12, 2	117	114, 2
1991	80	82	82
1992	2	2	2
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	3, 55	0	3
1997	0	0	0
1998	85	85	85
1999	53	53	58
2000	22, 5	22, 5	26, 5
2001	112	113	112
2002	53	55, 3	53
2003	13, 5, 16	15, 3	15, 6, 31
2004	4, 10, 72	4, 9, 71	5, 10, 72
2005	101	101	101

1127 (A-1)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	11, 48	11, 49, 2	11, 48, 1
1966	5, 9	8	16
1967	52	49	51
1968	23	25, 1	23
1969	0	0	0
1970	5	8	5
1971	157	157	157
1972	8	26	8
1973	21	31	21
1974	106	107	106
1975	109	111	109
1976	8, 23, 10	8, 23, 10	8, 23, 10
1977	55, 5	31, 6	55, 5
1978	0	2	0
1979	25	25	25
1980	0	0	0
1981	91, 1	93, 1	92, 1
1982	0	11, 8, 22, 2, 2	0
1983	0	0	0
1984	0	0	0
1985	125	125	125
1986	22	22	22
1987	0	0	5
1988	2, 33	2	2, 33
1989	119	119	119
1990	2, 74, 5, 7, 1	114, 1	113
1991	80	80	80
1992	6	6	6
1993	0	0	0
1994	0	0	0
1995	0	6	0
1996	6	0	6
1997	0	5	0
1998	52	52	52
1999	46, 2	27, 5	46, 2
2000	56, 2	32	56, 2
2001	33, 4, 6	110	33, 5, 6
2002	35	35	35, 1
2003	0	0	1
2004	32, 2	35	55, 5
2005	1, 3, 1, 72	1, 2, 75	17, 56

1220 (A-1)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	64, 13, 3	64, 15, 3	64, 15, 3
1966	61	61	61
1967	88	88	88
1968	57	1, 1, 62	57
1969	2, 5, 25	2, 5, 3, 25	2, 5, 25
1970	45, 2, 2	57, 3	45, 2, 2
1971	157	157	157
1972	64	65	64
1973	3, 17, 96	119	117
1974	112	113	112
1975	112	112	112
1976	81, 1	81, 1	81, 1
1977	110, 23	117, 23	111, 23
1978	68	72	69
1979	58, 12, 1	56, 1	58, 13, 2
1980	28, 2	28, 2	28, 2
1981	131, 1	131, 1	131, 1
1982	87	87	87
1983	35	35	35
1984	33, 3	37	33, 3
1985	137	137	137
1986	2, 56	5, 1, 56	2, 56
1987	20, 50	21, 50	20, 51
1988	15, 61	81	15, 61
1989	123, 11	123, 12	123, 11
1990	112, 1	114, 1	114
1991	80	87	80
1992	16, 77	13, 24, 44	17, 76
1993	5, 55	5, 55	5, 55
1994	83	81	83
1995	54	56	54
1996	5, 66	4, 66	5, 66
1997	5	5	5
1998	91	91	91
1999	71	71	71
2000	41, 34	43, 30	41, 34
2001	112	113	112
2002	85	89	85
2003	65, 8, 1, 3	48, 8, 2	61, 21
2004	116	116	119
2005	58, 1	58, 1	59, 1

1527 (A-2)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	105	105	105
1966	83	83, 1, 2	70
1967	2, 95	2, 101	2, 95
1968	1, 71	58	1, 71
1969	5, 46	5, 34	5, 46
1970	8	8	8
1971	157	157	157
1972	76	76	76
1973	120, 1	119, 1	120, 1
1974	117	117	117
1975	83	83	83
1976	41, 2	41, 2	41, 2
1977	157	157	157
1978	9, 67	3, 59	9, 67
1979	71, 8, 2	48, 1, 8, 5	71, 8
1980	15, 23, 44	6	15, 21, 37, 5
1981	157	157	157
1982	87	87	87
1983	8	6	8
1984	41	31	51
1985	157	157	157
1986	21, 77	58	101
1987	5, 78	5, 81	5, 82
1988	36	36	36
1989	157	157	157
1990	98, 4, 2	98, 4, 2	98, 4, 2
1991	80	80	80
1992	41	5, 64	45
1993	12	8	12
1994	70, 1, 2, 1, 5, 1	82, 1	76, 1
1995	8	8	8
1996	64, 8	5, 37, 5	66, 8
1997	15, 1, 39	15, 63	15, 62
1998	5	5	5
1999	58	30	58
2000	12, 48, 10, 1	12, 45, 9	12, 48, 10, 1
2001	116, 1	116, 1	116, 1
2002	57	59	58
2003	89	61, 24	88
2004	127	116	127
2005	38	36	36

Table 6-8. Total number of consecutive dry days during March 1 – July 15 for the CSSS-B. Cells that are green have 60 or greater dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

CY3 (B)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	94
1967	108	108	108
1968	71	71	71
1969	88	88	88
1970	108, 2, 3	4, 103, 1, 2	108, 2, 3
1971	137	137	137
1972	107, 1	107, 1	107, 1
1973	3, 15, 1, 91	3, 15, 1, 91	3, 15, 1, 91
1974	137	137	137
1975	97, 2, 1	97, 1, 1	97, 1, 1
1976	101	101	101
1977	137	137	137
1978	81	81	81
1979	90, 13, 2, 28	90, 13, 2, 28	90, 13, 2, 28
1980	137	137	137
1981	137	137	137
1982	88	88	88
1983	54	54	54
1984	137	137	137
1985	137	137	137
1986	137	137	137
1987	137	137	137
1988	105	104	105
1989	137	137	137
1990	137	137	137
1991	114, 1, 3	114, 1, 3	114, 1, 3
1992	115	115	115
1993	137	137	137
1994	137	137	137
1995	73	66	73
1996	100	100	100
1997	91	91	91
1998	101	101	101
1999	112, 1	111	112, 1
2000	137	137	137
2001	137	137	137
2002	110	110	110
2003	108, 11	108, 11	108, 11
2004	137	137	137
2005	115, 1, 4	115, 1, 4	115, 1, 4

2704 (B)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	94
1967	107	107	107
1968	71	71	71
1969	91	91	91
1970	115, 1	111, 1	115, 1
1971	137	137	137
1972	107	107	107
1973	121	121	121
1974	137	137	137
1975	107	97, 1, 4	107
1976	101	101	101
1977	137	137	137
1978	94	94	94
1979	137	137	137
1980	137	137	137
1981	137	137	137
1982	88	88	88
1983	53	53	53
1984	114	114	114
1985	137	137	137
1986	119, 17	118, 17	137
1987	137	137	137
1988	98, 2	98, 2	98, 2
1989	137	137	137
1990	137	137	137
1991	110	110	110
1992	115	115	115
1993	105	97, 18, 17	105
1994	137	137	137
1995	73	65	73
1996	100	100	100
1997	91	91	91
1998	101	101	102
1999	112	110	112
2000	137	137	137
2001	137	137	137
2002	109	109	109
2003	107, 4, 11	103, 4, 12	107, 4, 11
2004	137	137	137
2005	114, 1, 5	114, 1, 5	114, 1, 5

Table 6-9. Total number of consecutive dry days during March 1 – July 15 for the CSSS-C. Cells that are green have 60 or greater dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

[illegible] (C)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94, 1	96	96
1967	105	105	105
1968	71	71	71
1969	93, 2	93, 2	93, 2
1970	96, 20	96	96, 11
1971	137	137	137
1972	108, 10	109, 8	109, 4
1973	137	137	137
1974	137	137	127, 9
1975	122, 1, 8, 1	122, 6	122, 6
1976	111, 1	111	111
1977	137	91, 58	91, 58
1978	137	8, 128	8, 128
1979	68, 66	68, 65	68, 65
1980	137	137	137
1981	137	137	137
1982	98, 40	98, 40	98, 40
1983	4, 14, 1, 42, 1	58, 7	58
1984	122, 4, 7	122, 4, 7	122, 2, 2
1985	137	137	137
1986	117, 18	117, 19	117, 8, 10
1987	137	137	137
1988	98, 2, 1, 1	98, 1	98, 1
1989	137	137	137
1990	137	137	137
1991	66, 8	66, 7	66, 6
1992	118	118	118
1993	137	115, 11	129
1994	101, 34	101, 34	95, 4, 33
1995	52, 2	24	5, 1, 38
1996	101, 9	96, 13, 6	100, 6
1997	95	95	95
1998	1, 5, 56	62	58
1999	130, 2, 12	130, 1, 10	130, 2, 11
2000	137	137	137
2001	137	137	137
2002	109	109	109
2003	137	137	131
2004	137	137	137
2005	114, 12	112, 1, 10	112, 1, 11

E112 (C)	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94, 2	94, 1	96
1967	105	105, 2	105
1968	71	71	71
1969	93, 2	93, 2	93, 2
1970	108	5, 103, 2	108
1971	137	137	137
1972	107, 8	108, 16	109, 8
1973	137	137	137
1974	137	137	137
1975	137	121, 1, 8, 1	121, 9
1976	101, 9	101, 13, 1, 1, 6	101, 8
1977	91, 58	55, 21, 41	55, 15, 41
1978	137	137	137
1979	55, 4, 56	55, 4, 5, 16, 30	55, 1, 2, 14, 30
1980	101, 26, 7	101, 26, 7	101, 26, 7
1981	137	137	137
1982	93, 34	93, 37	93, 35
1983	2, 2, 5, 3, 47, 5	58, 5	38, 18, 5
1984	130, 1	88, 47	88, 45
1985	137	137	137
1986	112, 4, 4, 1, 4	112, 24	112, 4, 12, 4
1987	137	137	137
1988	96, 1	96, 1	96, 1
1989	137	137	137
1990	137	137	137
1991	82, 2	82, 1, 5	82, 1
1992	114	114	114
1993	115, 6	137	115, 11
1994	94, 40	137	95, 39
1995	16, 6, 25	12, 8, 25, 11	15, 6, 22, 2
1996	101, 1	101, 1, 4, 1	101, 1, 1
1997	95, 2	95, 1	95
1998	57	61	58
1999	124, 9	137	137
2000	137	137	137
2001	137	137	137
2002	111	109, 1	109
2003	108, 1, 17	137	137
2004	137	137	137
2005	114, 11	114, 15	114, 14

335B (C)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	94
1967	105	105	105
1968	71	71	71
1969	51	51	51
1970	46, 10, 1, 1	46	46, 7, 1
1971	137	137	137
1972	109, 3	109, 3	109
1973	125, 11	125, 3, 4	125, 3, 4
1974	136, 1	136, 1	136
1975	118	118	118
1976	101	96, 5	96, 5
1977	83, 62	83, 11, 26	83, 11, 27
1978	8, 125	2, 5, 123	8, 124
1979	68, 56	68, 56	68, 56
1980	137	1, 135	137
1981	137	137	137
1982	90, 1, 1, 36	90, 34	90, 34
1983	3, 92	13, 2, 8	92
1984	122	44, 77	44, 77
1985	124, 10	124, 4, 4	124, 9
1986	112, 4	112, 1, 1, 4	112, 4
1987	137	137	137
1988	98	98	98
1989	137	137	137
1990	137	137	121, 13
1991	92	92	92
1992	114	114	114
1993	95, 10, 8, 1, 1, 1	93, 1, 17, 7	93, 1, 17, 7
1994	95, 28	1, 93, 1, 31	1, 93, 12, 12
1995	16, 1, 27	3, 38	3, 3, 38
1996	95, 1, 4	95, 5	96, 7
1997	93	82, 10	82, 10
1998	87	82	92
1999	101, 6	111, 2, 3	111, 2, 4
2000	137	137	137
2001	137	137	137
2002	107, 1	106	106
2003	109, 1, 17	109, 1, 18	106, 4, 2, 18
2004	137	137	137
2005	111, 3	101, 8	101, 8

Table 6-10. Total number of consecutive dry days during March 1 – July 15 for the CSSS-D. Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

[illegible]	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	1, 91, 5, 4, 4	111, 5, 14	111, 5, 18
1966	[illegible]	3, 25, 27, 16	[illegible]
1967	[illegible]	101	101
1968	[illegible]	[illegible]	[illegible]
1969	[illegible]	[illegible]	[illegible]
1970	[illegible]	[illegible]	[illegible]
1971	116	116, 4, 2, 4	119, 5, 7
1972	[illegible]	21, 3, 12, 16	31, 3, 12, 17
1973	107	118	118
1974	102, 7	119	110
1975	90	[illegible]	91, 7, 2, 10
1976	62, 12, 1	75, 4, 2	75, 5, 2
1977	65, 2, 1, 6	68, 1, 1, 6	68, 1, 1, 6
1978	[illegible]	[illegible]	[illegible]
1979	[illegible]	[illegible]	[illegible]
1980	[illegible]	[illegible]	[illegible]
1981	116	119	119
1982	[illegible]	[illegible]	[illegible]
1983	[illegible]	[illegible]	[illegible]
1984	22, 62	22, 61	[illegible]
1985	20, 50, 2, 6, 27	[illegible]	117
1986	[illegible]	20, 49	[illegible]
1987	5, 28, 41	5, 6, 49, 51	6, 13, 47, 47
1988	[illegible]	91	91
1989	126	126, 7	[illegible]
1990	87, 6	87, 6, 20	87, 6, 16
1991	1, 4, 33, 28	1, 45, 29	1, 44, 29
1992	[illegible]	[illegible]	22, 75
1993	[illegible]	[illegible]	[illegible]
1994	[illegible]	[illegible]	[illegible]
1995	[illegible]	[illegible]	[illegible]
1996	43, 22	46, 23	2, 47, 23
1997	91	91	91
1998	[illegible]	[illegible]	[illegible]
1999	[illegible]	[illegible]	1, 108
2000	40, 47	42, 54, 1	[illegible]
2001	[illegible]	[illegible]	[illegible]
2002	[illegible]	[illegible]	[illegible]
2003	[illegible]	[illegible]	[illegible]
2004	[illegible]	[illegible]	[illegible]
2005	[illegible]	101	101

Table 6-11. Total number of consecutive dry days during March 1 – July 15 for the northern CSSS-E (Label E-1, left) and southern CSSS-E (Label E-2, right). Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

NE of NPA13 (E-1)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	94	94	94
1967	104	104	104
1968	71	71	71
1969	92	15, 48, 12, 1	92
1970	[illegible]	[illegible]	[illegible]
1971	137	137	137
1972	85, 1, 5	76, 1	80, 4
1973	124	124	124
1974	102	102	102
1975	113, 2	113, 1	113, 2
1976	94	94	94
1977	71, 35, 4, 18	71, 34, 2, 2, 6	71, 34, 3, 6, 6
1978	90	87	90
1979	68, 37	68, 5	68, 13, 3, 5, 1
1980	1, 136	14, 19, 40, 4	1, 137
1981	137	137	137
1982	87	87	87
1983	3	3	3
1984	44, 19, 10, 7	32, 5, 35, 4, 2, 1	44, 11, 3, 7
1985	125	125	125
1986	26, 72	25, 87	26, 72
1987	137	5, 127	137
1988	88	88	88
1989	137	137	137
1990	126, 1, 1	126, 1, 1	126, 1, 1
1991	80	80	80
1992	114	113	114
1993	67, 1, 17	28	58, 13
1994	91, 1, 36, 1, 53	80, 5, 8	80, 5, 5
1995	9	9	9
1996	108	2, 73, 30	108
1997	78, 1	78	78, 1
1998	62	52	62
1999	110	88	110
2000	137	48, 101	137
2001	137	137	137
2002	105	105	105
2003	90, 5, 3	85, 6	90, 5, 3
2004	137	137	137
2005	101	101	101

2399 (E-2)	EC2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	81	1, 78	81
1967	104	104	104
1968	71	71	71
1969	3, 8, 10, 33	3, 3, 5, 28	3, 2, 3, 32
1970	3	3	3
1971	137	137	137
1972	76	24, 1, 36	25, 1, 40
1973	3, 2, 1, 74	3, 1, 75	3, 2, 76
1974	106	106	106
1975	90, 1	90	90
1976	88	88	88
1977	71, 34, 1, 14	71, 53, 2, 8, 6	71, 53, 2, 7, 6
1978	74	71	74
1979	56, 1, 8	33	35, 2, 1
1980	24, 44, 46	33	24, 41, 2, 43, 5
1981	131	2, 128	131
1982	57	57	57
1983	3	3	3
1984	22, 59	[illegible]	22, 58
1985	124	124	124
1986	103	15, 71	103
1987	5, 108	5, 98	5, 103
1988	88	88	88
1989	137	137	137
1990	117	117	117
1991	92	92	92
1992	87	22, 72	87
1993	64, 1, 1	[illegible]	64, 1, 1
1994	68	[illegible]	68
1995	3	3	3
1996	4, 73, 1, 2, 1	[illegible]	5, 73, 1
1997	74	74	74
1998	45	35	45
1999	108	53	108
2000	44, 49, 1, 3	56, 43	44, 49, 1, 2
2001	137	137	137
2002	91, 5	91, 1	91, 5
2003	26, 21, 29	16, 8, 21, 39	25, 21, 39
2004	137	135	137
2005	94	94	94

Table 6-12. Total number of consecutive dry days during March 1 – July 15 for the CSSS-F. Cells that are green have 60 or greater dry days during the nesting season. Cells that are yellow do not have 60 or more consecutive dry days during the nesting season, but do have a total of 60 or more dry days during the nesting season. Cells that are red do not have 60 dry days during the nesting season.

[illegible]	ECB2012	Alt 4R2	FWO
Year	# consecutive days	# consecutive days	# consecutive days
1965	137	137	137
1966	95	94	95
1967	104	104	104
1968	71	71	71
1969	95	95	95
1970	[illegible]	[illegible]	[illegible]
1971	137	137	137
1972	78	78	78
1973	101	101	101
1974	127, 6, 2	134, 2	127, 5, 1
1975	115	112	115
1976	97	98	95, 1
1977	137	102, 11	102, 14
1978	133	5, 110	133
1979	55, 17	[illegible]	[illegible]
1980	101	3, 58	1, 55, 2, 65
1981	137	137	137
1982	88	88	88
1983	[illegible]	[illegible]	[illegible]
1984	97	98	97
1985	137	125, 1	125, 7
1986	35, 43	35, 48	[illegible]
1987	137	137	81, 104
1988	99	98	98
1989	137	137	137
1990	137	137	137
1991	90	90	90
1992	104	104	104
1993	[illegible]	[illegible]	[illegible]
1994	[illegible]	75, 34	[illegible]
1995	[illegible]	[illegible]	[illegible]
1996	100	95	75
1997	91, 4	91	93, 2
1998	57	57	57
1999	86, 4, 7	77, 6, 5	91, 4, 6
2000	137	137	137
2001	137	137	137
2002	106	106	106
2003	95	89	107
2004	137	137	137
2005	101	101	101

Table 6-13. Average continuous dry period (days) over the POR. In the case of multiple days per year with continuous dry days, the largest number of contiguous days were used.

Sub Population	Gauge/Grid Cell	EC2012	Alt 4R2	FWO
A	NP-205 (A-1)	73	78	73
	P34 (A)	75	76	75
	TMC (A)	80	75	81
	1126 (A-1)	49	50	50
	1127 (A-1)	38	40	40
	1220 (A-1)	74	75	75
	1527 (A-2)	82	74	83
B	CY3 (B)	114	113	113
	2704 (B)	115	113	115
C	R3110 (C)	114	109	110
	E112 (C)	109	110	109
	3358 (C)	107	103	103
D	4541 (D)	61	66	70
E	NE of NPA13 (E-1)	95	89	95
	2339 (E-2)	81	73	80
F	NE of RG2 (F)	96	93	91

Ecological Target 1

ET-1 (NP-205, CSSS-A): Strive to reach a water level of < 7.0 feet, NGVD at NP-205 by December 31 far nesting season water levels to reach 6.0 feet, NGVD by mid-March.

Alt 4R2 performed the same as the FWO for ET-1; with both meeting the requirement 1 extra year than the existing conditions (**Table 6-14**).

Table 6-14. Comparison of ECB 2012, Alt 4R2 and FWO: Number of years ET-1 was met.

ET-1	ECB 2012	Alt 4R2	FWO
# years met	38	39	39

Ecological Target 2

ET-2 (CSSS): Strive to maintain a hydroperiod between 90 and 210 days (three to seven months) per year throughout sparrow habitat to maintain marl prairie vegetation.

RSM-GL results for each CSSS subpopulation are depicted in **Table 6-15** and **Figure 6-42**. Alt 4R2, existing conditions, and FWO were compared to understand how many years out of the 41 year POR the hydroperiod between 90 and 210 days (three to seven months) were met to maintain marl prairie vegetation. Alt 4R2 only performed better than the FWO in CSSS-A (Label A-1) by meeting the ET-2 criteria 6 more years than the existing conditions and 4 more years than FWO. Alt 4R2 performed worse than the existing conditions and FWO in CSSS-A (Label A-2) and CSSS-B (1 year), CSSS-C (3 and 4 years), CSSS-D (1 and 4 years), CSSS-E1 (6 years), CSSS-E2 (2 years), and CSSS-F (3 and 4 years). **Table 6-16** shows the average annual hydroperiod (days) for each CSSS sub population for Alt 4R2 compared to existing and future without conditions. Sub populations CSSS-A (Label A-1 andA-2), CSSS-D and CSSS-E (Label E-2) are above the target hydroperiod of 90-210 days in the existing conditions and well as in FWO condition indicating that the system is already is too wet and will remain too wet without the implementation of CEPP. However, the implementation of CEPP would reduce the average annual hydroperiod by 9 days for CSSS-A (Label A-1) compared to FWO. The implementation of CEPP would increase the average annual hydroperiod for sub populations CSSS-A (Label A-2), CSSS-D, and CSSS-E (Label E-2) by 14, 12 and 18 days, respectively. For CSSS-E (Label E-1), the average annual hydroperiod falls within the target of 90-210 days for the existing condition and future without condition. With the implementation of CEPP, the average annual hydroperiod increases to 211 days, just above the target range within this area. There is no significant change in the average annual hydroperiod in CSSS-B. While there is an increase in the average annual hydroperiod for CSSS-C and CSSS-F (8 and 37 days, respectively), the hydroperiod remains within the target range. **Figure 6-43** through **Figure 6-52** show average annual hydroperiod over the entire POR comparing existing conditions, Alt 4R2, and FWO. The long-term ramifications of not meeting the hydroperiod target for a majority of the POR in CSSS-A (Label A-1 and A-2), CSSS-D, CSSS-E (Label E-1 and E-2) is a reduction of suitable habitat for CSSS recovery for portions of these areas (i.e. CSSS-A, CSSS-D, CSSS-E) currently occupied by CSSS.

Table 6-15. Number of years out of the period of record that the hydroperiod was between 90 and 210 days each year throughout sparrow habitat in order to maintain marl prairie vegetation (ET-2)

CSSS Sub Population	ECB 2012	Alt 4R2	FWO
A-1	4	10	6
A-2	9	8	9
B	25	24	25
C	18	15	19
D	11	10	16
E-1	24	18	24
E-2	12	10	12
F	17	14	18

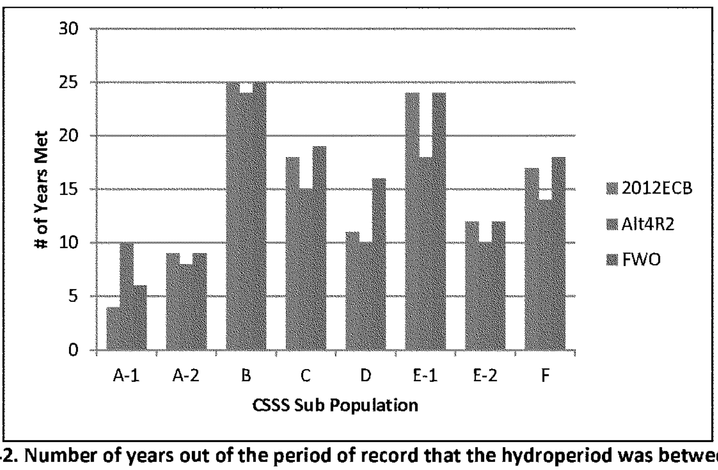


Figure 6-42. Number of years out of the period of record that the hydroperiod was between 90 and 210 days each year throughout sparrow habitat in order to maintain marl prairie vegetation

Table 6-16. CSSS average annual hydroperiod (days) over the period of record, 1965-2005. The target hydroperiod is 90-210 days.

CSSS Sub Population	ECB 2012	Alt 4R2	FWO
A-1	277	262	275
A-2	251	262	248
B	145	147	145
C	107	129	121
D	258	249	237
E-1	179	211	182
E-2	248	266	248
F	138	180	143

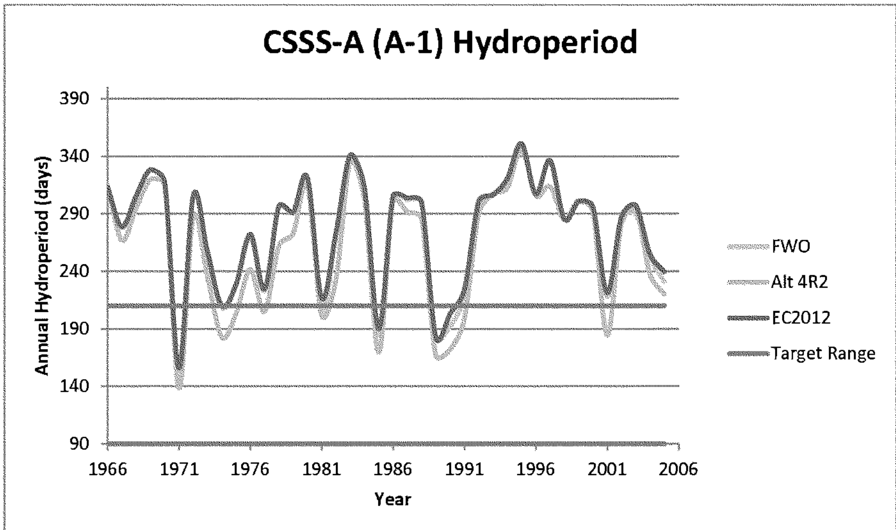


Figure 6-43. CSSS-A (A-1) comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

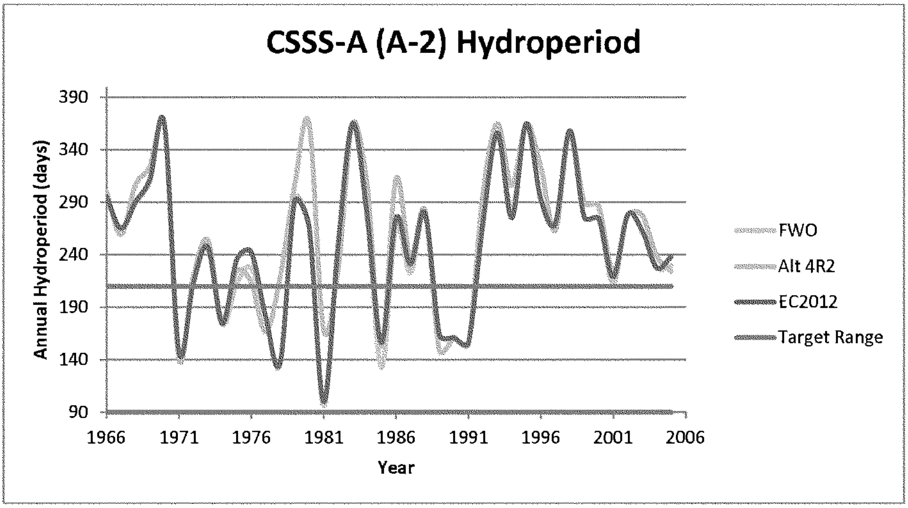


Figure 6-44. CSSS-A (A-2) comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

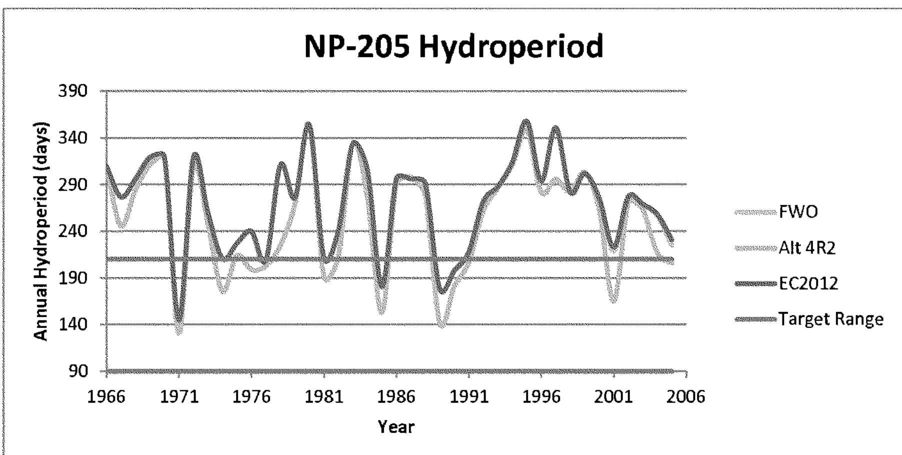


Figure 6-45. CSSS-A comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year at Gauge NP-205.

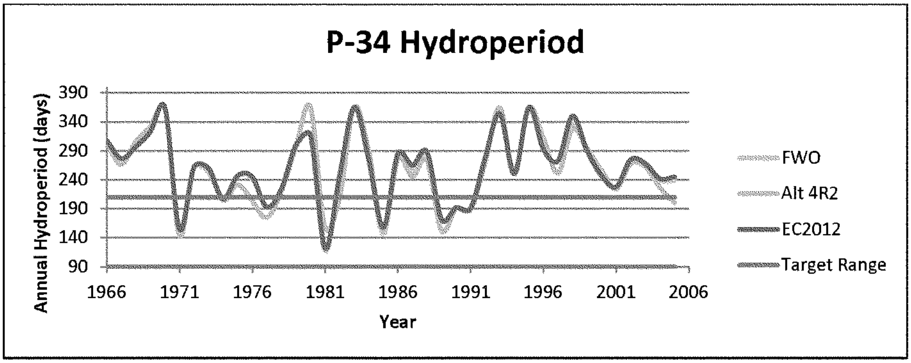


Figure 6-46. CSSS-A comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year at Gauge P-34.

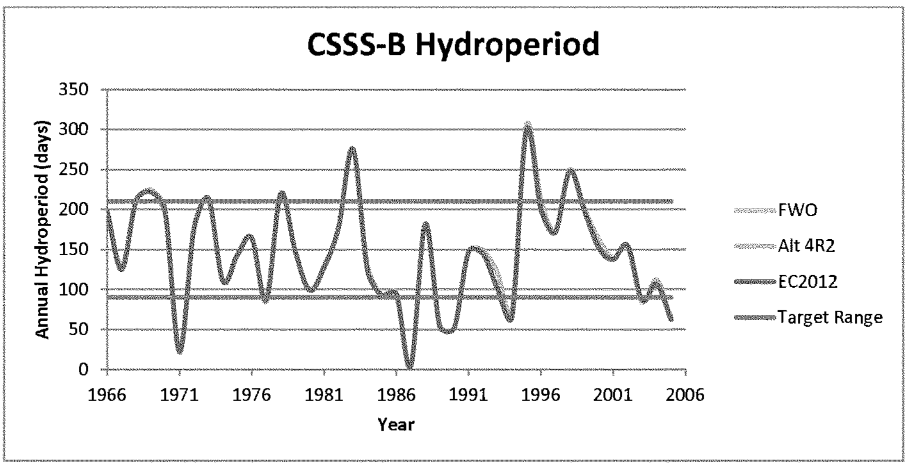


Figure 6-47. CSSS-B comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

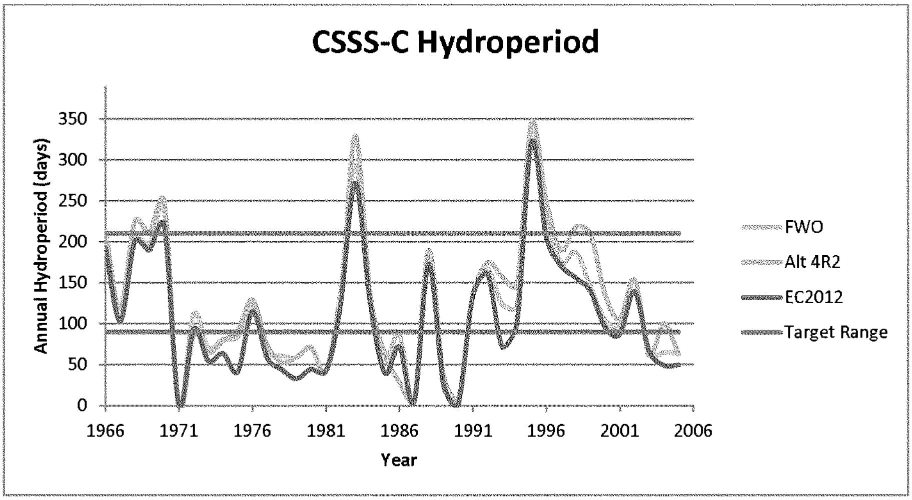


Figure 6-48. CSSS-C comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

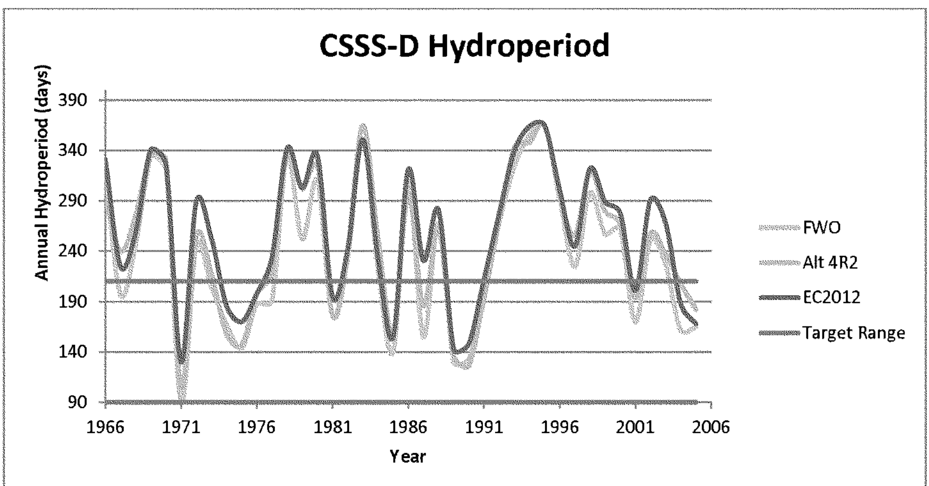


Figure 6-49. CSSS-D comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

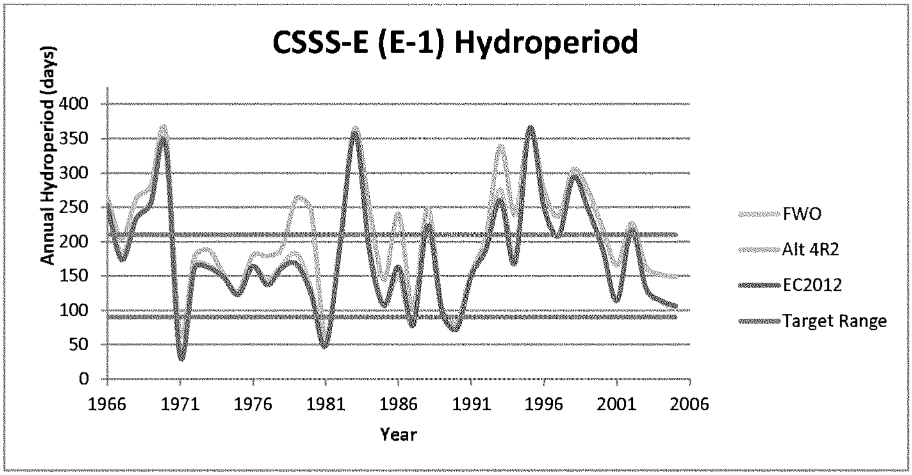


Figure 6-50. CSSS-E-1 comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

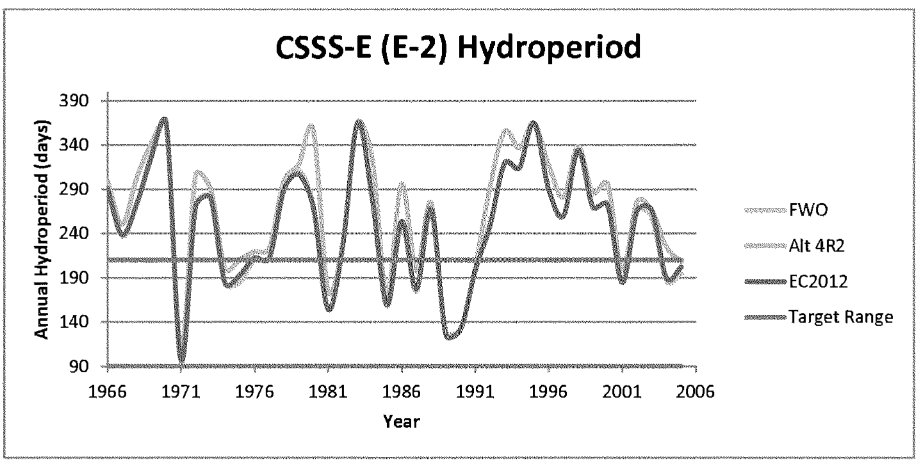


Figure 6-51. CSSS-E-2 comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

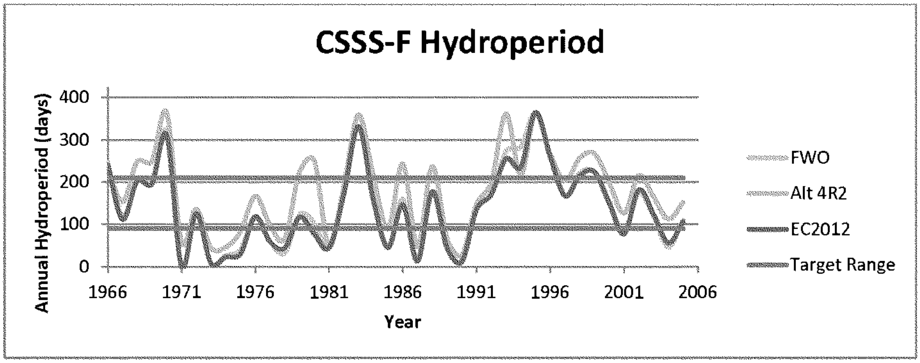


Figure 6-52. CSSS-F comparison of existing conditions, Alt 4R2, and FWO for the number of days between target hydroperiod of 90-210 days per year.

Marl Prairie Indicator

A HSI for marl prairie habitat was used to predict potential effects of implementation of CEPP Alt 4R2 as compared to existing conditions and FWO. The HSI predicts hydrologic suitability of marl prairies based on CSSS survey presence data and threshold ranges (Pearlstine et al. 2011). The HSI measures marl prairie habitat suitability annually for four metrics: (1) average wet season water depths from June – October, (2) average dry season water depths from November–May, (3) discontinuous annual hydroperiods from May-April of the next year, and (4) maximum continuous dry days during the nesting season from March 1-July 15.

Suitability for marl prairie habitat is decreased in the vicinity of CSSS-B, CSSS-D, CSSS-E, and CSSS-F for Alt 4R2 relative to the existing conditions and FWO (**Figure 6-53**). Marl prairie habitat suitability decreased in CSSS-E compared with the existing condition and FWO by 10% and 11%, respectively (**Figure 6-53**). Notable changes occur within the eastern marl prairies in the vicinity of CSSS-E, along the eastern edge of SRS that decrease the marl prairie habitat suitability, shifting into wetter habitats with Alt 4R2 (
Figure 6-54). Increased hydroperiods within the eastern marl prairies may potentially result in a shift in vegetation. Ross and Sah (2004) noted differences in species composition within wet prairies based upon hydroperiod. Shorter hydroperiod prairies were dominated by *Muhlenbergia*, *Schizachyrium* and *Paspalum*, while longer hydroperiod prairies consisted of *Cladium*, *Schoenus*, and *Rhynchospora*. Compared to the existing conditions and FWO, differences in marl prairie habitat suitability within CSSS-B, CSSS-D, and CSSS-F for Alt 4R2 were decreased to a lesser extent as compared to CSSS-E. Marl prairie habitat suitability decreased in CSSS-B, CSSS-D, and CSSS-F compared with the existing condition by 1%, 6%, and 4% respectively (**Figure 6-53**). Decreases of 2%, 5%, and 1% were observed for CSSS-B, CSSS-D, and CSSS-F compared with the FWO (**Figure 6-53**). Potential shifts in vegetation may occur to a lesser degree.

Analyses of marl prairie habitat suitability with the northwestern marl prairies in the vicinity of CSSS-A reveal negligible benefits for Alt 4R2 as compared with the existing conditions and FWO. Pollen data indicate that the marl prairies west of SRS are not a natural feature of the Everglades landscape but developed after twentieth century hydrologic modification of the system reduced flow to the region (Bernhardt and Willard 2006). Prior to the modifications, plant communities at the sites analyzed by Bernhardt and Willard (2006) in western SRS consisted of sawgrass marshes. The authors concluded that "the current spatial distribution and community composition of marl prairies are a response to water management and land cover changes of the twentieth century, and further sampling of modern marl prairie communities and adjacent communities is necessary to document the pre- and post-drainage distribution of marl prairie" (Bernhardt and Willard 2006). Habitat suitability within central and southern CSSS-A (and flanking regions to the east) decline while habitat suitability in northern CSSS-A and regions northeast of CSSS-A slightly improve (**Figure 6-54**). Alt 4R2 provides benefits within CSSS-C compared to the existing conditions and FWO. Marl prairie habitat suitability was improved in CSSS-C compared with the existing condition and FWO by 11% and 1%, respectively (**Figure 6-53**). Benefits are distributed spatially throughout CSSS-C (**Figure 6-54**).

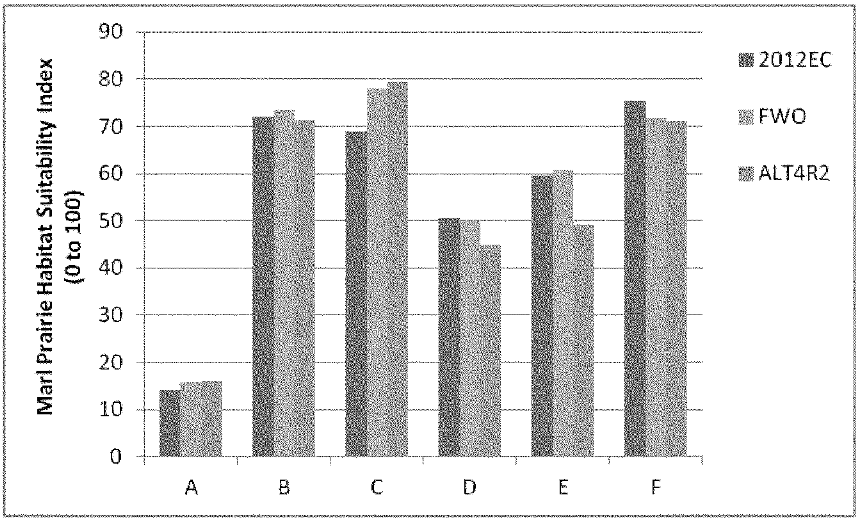


Figure 6-53. Average marl prairie suitability index scores (1965-2005) for existing conditions, Alt 4R2, and FWO.

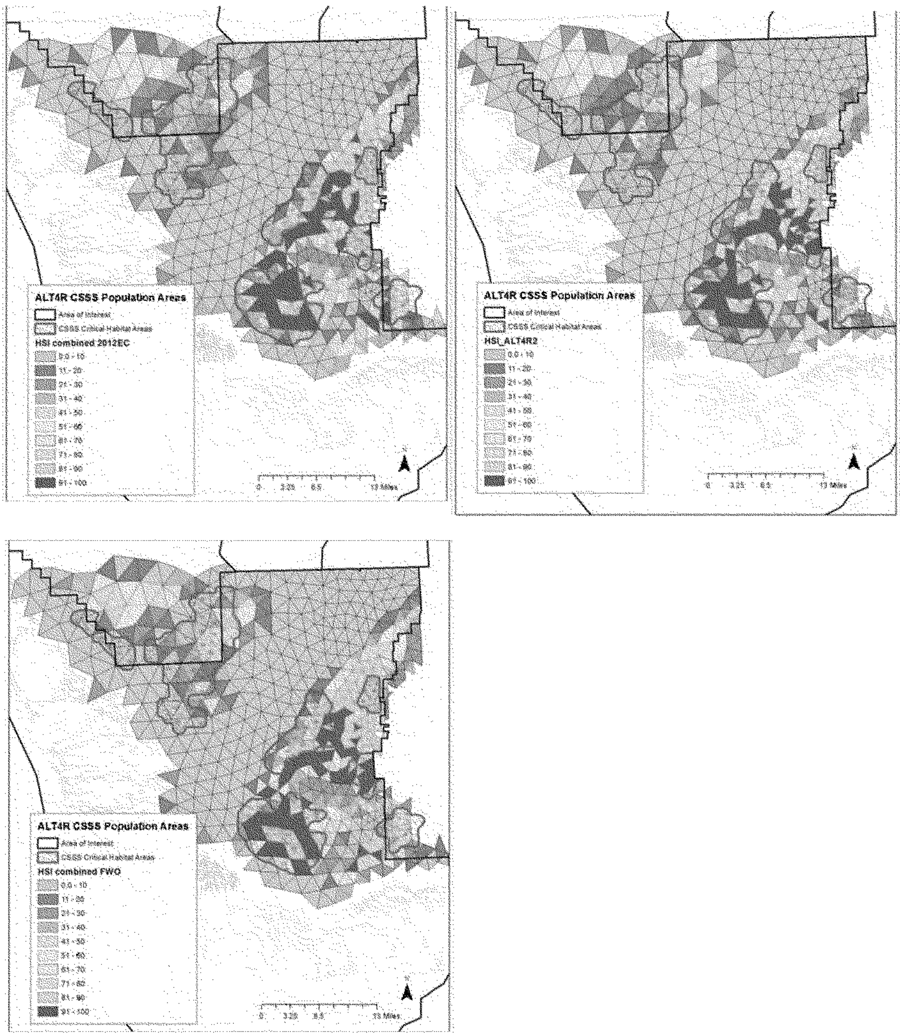


Figure 6-54. Habitat suitability of existing conditions is presented in the top left panel and Alt 4R2 habitat suitability for the combined marl prairie indicator scores at each RSM-GL cell south of Tamiami Trail is presented in the top right panel. FWO is presented in the bottom left panel. Scores vary from 0.0 (not suitable) to 100.0 (most suitable). Subpopulation areas for the Cape Sable seaside sparrow are shown as a blue outline.

6.2.8.2 CSSS Species and "May Affect" Determination

The goal of CEPP and the future CERP is to rehydrate the greater Everglades and provide higher volumes of freshwater into ENP. Overall, CEPP would decrease the number of years that meet the 60-day dry nesting constraint (PM-A) in CSSS-A and E as compared to the existing conditions. While the number of years that PM-A is met is not many, Alt 4R2 remains consistent with the existing conditions and FWO for all other subpopulations for PM-A, with the exception of CSSS-D where the FWO met more years than Alt 4R2 and existing conditions (**Table 6-6**).

Additional analysis of PM-A looking at the number of total dry days during the nesting season for 3 or more consecutive years, revealed that for ECB2012, FWO and Alt 4R2 potentially a few more years would have met the criteria in some of the subpopulations (**Table 6-6**). In 1979, CSSS-A-1 and CSSS-A-2 (56 and 46 days, respectively (with total days over 60) would have met the criteria in total days, which is between two years that did not meet the 60 day requirement, potentially allowing for CSSS nesting during that year to recuperate during that particular nesting season.

Areas within the eastern marl prairies along the boundary of ENP suffer from over-drainage, reduced water flow, exotic tree invasion and frequent human-induced fires (Lockwood et al. 2003, Ross et al. 2006). To alleviate the perpetual drier conditions and its associated problems, increased water flows within this area are required. Alt 4R2 provides more water to SRS and the southern marl prairies. Increased hydroperiods within the eastern marl prairies may act to alleviate some of the problems associated with drier conditions and promote a shift in species community composition. However, marl prairie habitat suitability was met less than the existing conditions and FWO for CSSS-A, CSSS-B, CSSS-D, CSSS-E, and CSSS-F (**Figure 6-53** and **Figure 6-54**).

Since the proposed action potentially raises groundwater levels in sensitive areas for the sparrow, hydrological changes associated with implementation of the action are expected to alter some of the physical and biological features essential to the nesting success and overall conservation of the subspecies. In order to protect CSSS, structural closings implemented under 2006 IOP and preserved under 2012 ERTP were also retained under CEPP. The action related hydrologic changes as compared to the existing conditions are expected to be significant throughout much of CSSS habitat with minimal improvements seen within some areas (northern CSSS-A, CSSS-F). The Corps has determined the action may adversely affect CSSS and is therefore requesting formal consultation under ESA for this species. Metrics could be developed prior to CEPP implementation to incorporate real-time monitoring since other projects will be built and operated prior to CEPP. These projects would provide interim increased water flows to the area and provide information about the transition in the system to higher water levels. This interim process would potentially minimize effects to the subspecies as well as ensure CEPP benefits are realized in other areas of the system.

6.2.8.3 Cape Sable Seaside Sparrow Critical Habitat

Critical habitat for the CSSS was designated on August 11, 1977 (42 FR 42840) and revised on November 6, 2007 (72 FR 62735 62766). Currently, the critical habitat includes areas of land, water, and airspace in the Taylor Slough vicinity of ENP in Miami-Dade and Monroe counties, Florida. Primary constituent elements include suitable soil, vegetation, hydrologic conditions, and forage base. The designated area encompasses approximately 156,350 acres (63,273 hectares). CSSS-A is the only area occupied by sparrows that does not have associated designated critical habitat.

Designated critical habitat for the CSSS includes areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Dade, and Monroe counties, with the following components: those portions of ENP within T57S R36E, T57S R36E, T57S R37E, T58S R35E, T58S R36E, T58S R37E, T58S R35E, T58S R36E, T59S R35E, T59S R36E, T59S R37E. Areas outside of ENP within T55S R37E Sec. 36, T55S R38E Sec. 31, 32, T56S R37E Sec. 1, 2, 11-14, 23-26, T56S R38E Sec. 5-7, 18, 19, T57S R37E Sec. 5-8, T58S R38E Sec. 27, 29-32, T59S R38E Sec. 4 (CFR Vol. 72, No. 214 / 11-6-07). All of the designated CSSS critical habitat lies within CEPP study area (**Figure 6-55**).

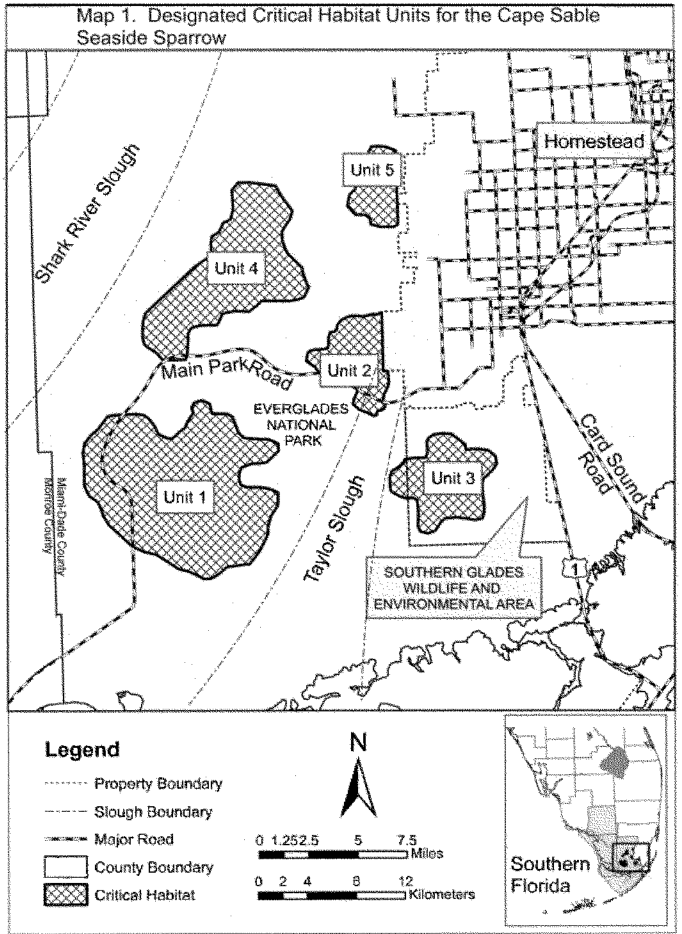


Figure 6-55. Critical habitat for the Cape Sable seaside sparrow.

Because the majority of designated critical habitat lies within ENP, there have been relatively few human-related structural impacts to the land. However, about 471.5 acres (190.8 hectares) of critical habitat were altered during construction of the S-332B detention areas and a portion of the B-C connector. No other permanent alteration of critical habitat is known. Degradation of critical habitat has resulted from flooding within the area of CSSS-D, and frequent fires and woody vegetation encroachment in overdrained areas near CSSS-C and CSSS-F. Degradation of these habitats is not permanent, and they may improve through restoration efforts.

In order to predict the project related effects on the CSSS, one must consider those physical and biological features that are essential to the conservation of the species and their habitat. These include, but are not limited to space for individual and population growth and for normal behavior, food, water, air, light, minerals, or other nutritional or physiological requirements, cover or shelter, sites for breeding, reproduction, and rearing (or development) of offspring, and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species. These requirements, which are based on the biological needs of this species, are described in the final critical habitat designation published in the Federal Register on 6 November 2007 (FR Vol. 72, No. 214).

Primary constituent elements are physical and biological features that have been identified as elements essential to the conservation of the species. As described in the Federal Register (FR Vol. 72, No. 214), the primary constituent elements include:

- Soils that are widespread in the Everglades' short-hydroperiod marshes and support the vegetation types that the CSSS rely on
- Plant species that are characteristic of CSSS habitat in a variety of hydrologic conditions that provide structure sufficient to support CSSS nests, and that comprise the substrate that CSSS utilize when there is standing water
- Contiguous open habitat because CSSS require large, expansive, contiguous habitat patches with sparse woody shrubs or trees
- Hydrologic conditions that would prevent flooding sparrow nests, maintain hospitable conditions for CSSS occupying these areas, and generally support the vegetation species that are essential to CSSS
- Overall the habitat features that support the invertebrate prey base the CSSS rely on and the variability and uniqueness of habitat

Evaluations of project effects to the primary constituent elements are discussed below:

6.2.8.3.1 Calcitic Marl Soils

Marl soils are characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades and support the vegetation community on which CSSS depend. Presently, soils in the marl prairie landscape within CSSS habitat vary in physical and chemical characteristics due to the variation in topography, hydrology, and vegetation (Sah et al. 2007). Alteration of soil characteristics due to project operations would be difficult to detect in the short term.

6.2.8.3.2 Herbaceous Vegetation

Greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species: muhly grass, Florida little bluestem, black sedge, and cordgrass (*Spartina bakeri*) are largely characteristic of areas where CSSS occur. They act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Although many other herbaceous plant species also occur within CSSS habitat (Ross et al. 2006), and some of these may have important roles in the life history of the CSSS, the species identified in the primary constituent relationship consistently occur in areas occupied by sparrows (Sah et al. 2007). With a trend indicating longer hydroperiods affecting the vegetative community composition in CSSS critical habitats, it may be difficult to separate project level effects from other factors (i.e. sea level rise; C-111 SC Project).

6.2.8.3.3 Contiguous Open Habitat

CSSS subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. The components of this primary constituent element are largely predicated on a combination of hydroperiod and periodic fire events. Fires prevent hardwood vegetation from invading these communities and prevent the accretion of dead plant material, both of which decrease the suitability of this habitat type for CSSS. Implementation of the proposed project could extend hydroperiods causing a minimal effect on the occurrence of natural fires in the area.

6.2.8.3.4 Hydrologic Regime-Nesting Criteria

As stated, favorable nesting habitat requires short hydroperiod vegetation characteristic of mixed marl prairie communities. A measure of the potential for CSSS nesting success is the number of consecutive days between March 1 and July 15 that water levels are below ground surface. Preferable discontinuous hydroperiod durations range from 60 to 180 days, although a 40 to 80 consecutive day period is considered favorable (Pimm et al. 2002). These two criteria were analyzed below for each critical habitat unit.

In order to maintain suitable vegetative composition conducive for successful nesting, it is important that water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) more than 30 days during the period from March 15 to June 30 at a frequency of more than two out of every ten years. Water depths greater than 7.9 inches (20 centimeters) during this period will result in elevated nest failure rates (Lockwood et al. 2001, Pimm et al. 2002). If these water depths occur for short periods during nesting season, CSSS may be able to re-nest within the same season. These depths, if they occur for sustained periods (more than 30 days) within CSSS nesting season, will reduce successful nesting to a level that will be insufficient to support a population if they occur more frequently than two out of every ten years. This has occurred within portions of the CSSS range.

6.2.8.4 Potential Effects to Cape Sable Seaside Sparrow Critical Habitat

Effects to each Unit are discussed below.

6.2.8.4.1 Critical Habitat Unit 1/CSSS-B Description

Critical habitat Unit 1 represents the largest CSSS subpopulation and has remained relatively stable since implementation of IOP operations in 2002. Wet prairie vegetation dominates within this unit (Ross et al. 2006). This Unit meets the hydroperiod criterion between 90-210 days per year the most number of years out of the 41 year POR compared to all other units (24 years in Alt 4R2, 25 years in FWO). Alt 4R2 performs slightly different than the hydrologic regime from existing conditions or FWO (**Table 6-14**). In Critical Habitat Unit 1, the nesting criterion was met in 40 years, the same as existing conditions and FWO, thus hydrological conditions within this Critical Habitat Unit would support hospitable conditions for nesting sparrows over the period of record (**Table 6-6**).

6.2.8.4.2 Critical Habitat Unit 2/ CSSS-C Description

Habitat of varying suitability occurs within Unit 2. Long-hydroperiod marshes occur south of the S-332 pump station, while areas to the north are overdrained and prone to frequent fires. The most recent fire occurred in March 2007 when the Frog Pond fire swept through this area. The habitat has yet to fully recover (Sah et al. 2008, Virzi et al. 2009). The variable habitat conditions are thought to be a consequence of the 1980 construction of the S-332 pump station, located at the boundary of ENP and Taylor Slough. Unit 2 holds relatively few CSSS. During intensive nest surveys in 2008, Virzi et al. (2009) documented four females and five males, nine nest attempts and reported nest survival as 22.8%.

Previous research has indicated that habitat is unsuitable for CSSS for two to three years after it burns. This remains consistent with the range wide survey results; surveys in 2010 revealed that 2 birds were counted, giving a population estimate of 32, in 2011 11 birds were counted with a population estimate of 176, and in 2012, 6 were counted with a population estimate of 96. The bird count/population estimate has not been as high as year 2011 since before the 2007 fire. Recent research has indicated that within Unit 2, CSSS-C is suffering from the ill-effects of small population size including fewer breeding individuals, male-biased sex ratios, lower hatch rates, and lower juvenile return rates (Boulton et al. 2009a, Virzi et al. 2009). This unit meets the hydroperiod criterion of 90-210 days per year 15 out of the 41 year POR as compared to the existing conditions of 18 years, and FWO that meets the criteria 19 years **(Table 6-15)**. In Critical Habitat Unit 2, the nesting criterion was met in 39 and 38 years (R3110 and E112, respectively), the same as existing conditions and FWO, thus 95% and 97.5% (respectively) of the time, hydrological conditions within this Critical Habitat Unit would support hospitable conditions for nesting sparrows (**Table 6-6**).

6.2.8.4.3 Critical Habitat Unit 3/CSSS-D Description

Since 1981, when an estimated 400 CSSS resided within Unit 3, this subpopulation experienced a continual decline in population size (Cassey et al. 2007). CSSS-D is a small, dynamic subpopulation that fluctuates annually; occupancy within Unit 3 is low and detection probability is highly variable. Thought to be functionally extirpated in 2007 (Lockwood et al. 2007), CSSS were again encountered within this area in 2009 when Virzi et al. (2009) encountered four males and two females **(Table 6-5)**. However, in 2012, 14 birds were counted with a population estimate of 224, which is substantially higher than between the years 2007 and 2011. Prior to the 2012 survey, vegetation within this critical habitat unit was thought to be unsuitable for CSSS breeding. Since 2000, high water levels and longer hydroperiods have prevailed resulting in a sawgrass-dominated community interspersed with patches of muhly grass at higher elevations (Ross et al. 2003). This unit meets the hydroperiod criteria of 90-210 days per year 10 out of the 41 year POR as compared to the existing conditions of 11 and FWO that meets the criteria 16 years (**Table 6-15**). In Critical Habitat Unit 3, the nesting criterion was met in 20 years as compared with 20 years in the existing conditions and 22 years in FWO, thus 50% of time, hydrological conditions within this Critical Habitat Unit would support hospitable conditions for nesting sparrows (**Table 6-6**).

6.2.8.4.4 Critical Habitat Unit 4/CSSS-E Description

Located along the eastern edge of Shark River Slough, critical habitat Unit 4 encompasses approximately 66 square kilometers. The Rocky Glades separate Unit 4 and CSSS-E from the other eastern subpopulations. Unit 4 holds the second greatest number of CSSS among all subpopulations. This unit is expected to be affected by an altered hydroperiod that is too long to support marl prairie habitat requirements. This unit meets the hydroperiod criteria of 90-210 days per year at E-1 for 18 out of the 41 year POR as compared to the existing conditions and FWO that meets the criteria 24 years. For E-2, Alt 4R2 meets the criteria 10 years versus the existing conditions and FWO at 12 years (**Table 6-15**). Marl prairie habitat suitability decreased in CSSS-E compared with the existing condition and FWO by 10% and 11%, respectively (**Figure 6-53**). Notable changes occur within the eastern marl prairies in the vicinity of CSSS-E, along the eastern edge of SRS that decrease the marl prairie habitat suitability, shifting into wetter habitats with Alt 4R2. In Critical Habitat Unit 4, the nesting criterion was met in 34 years as compared with 38 years in the existing condition and 37 FWO in the northern region of CSSS-E, thus 85% of time, hydrological conditions within this Critical Habitat Unit would support hospitable conditions for nesting sparrows (**Table 6-6**). In the southern region of CSSS-E the nesting criterion was met in 24 years as compared with 28 years in the existing condition and FWO, thus 60% of time, hydrological conditions within this Critical Habitat Unit would support hospitable conditions for nesting sparrows (**Table 6-6**).

6.2.8.4.5 Critical Habitat Unit 5/CSSS-F Description

The most easterly of all the CSSS critical habitat units, Unit 5 is located at the ENP boundary in proximity to agricultural and residential development. Habitat within this critical habitat unit suffers from over-drainage, reduced water flow, exotic tree invasion and frequent human-induced fires (Lockwood et al. 2003, Ross et al. 2006). To alleviate the perpetual drier conditions and its associated problems, increased water flows within this area are required. Unit 5 consists of approximately 14 square kilometers and thus is the smallest of all the units. Surveys from 2007-2009 detected no CSSS within this unit, whereas in 2010 there was one bird count and in 2011, two were detected (**Table 6-5**). This unit meets the hydroperiod criteria of 90-210 days per year 14 out of the 41 year POR as compared to the existing conditions at 17 years and FWO that meets the criteria 18 years (**Table 6-15**). In Critical Habitat Unit 5, the nesting criterion was met in 33 years, the same as with existing conditions and FWO, thus 82.5% of time, hydrological conditions within this Critical Habitat Unit would support hospitable conditions for nesting sparrows (**Table 6-6**).

6.2.8.5 Cape Sable Seaside Sparrow Critical Habitat Effect Determination

The 1999 FWS RPA stated that in addition to the 60-day dry nesting constraint the Corps would have to ensure that 30%, 45%, and 60% of required regulatory releases crossing Tamiami Trail enter ENP east of the L-67 Extension in 2000, 2001, and 2002, respectively, or produce hydroperiods and water levels in the vicinity of subpopulations C, E, and F that meet or exceed those produced by the 30%, 45%, and 60% targets. Hydroperiods and water levels in the vicinity of subpopulations C, E, and F would also have to be produced that equal or exceed conditions that would be produced by implementing the exact provisions of Test 7, Phase II operations (Corps 1995).

Since 1999, through deviations, IOP and ERTP, FWS has always maintained that moving water to the east through the historical flowpath into NESRS was the solution to improve nesting and habitat conditions for CSSS. However, RSM-GL model results indicates that although CEPP acts to restore the historical flowpath by shifting flows east through WCA-3A to WCA-3B and into NESRS, there are still adverse effects on eastern and western sparrow subpopulations. Alt 4R2 performed the worst in CSSS-E across all ecological targets as compared to the existing conditions and FWO. Most of the CSSS habitats have hydroperiods that are too deep for too long to be conducive for the species, which mirrors the existing conditions and FWO in most cases (**Figure 6-433** through **Figure 6-522**). CSSS-E-1 and CSSS-F perform outside of the target range on the higher end more often than the existing conditions for Alt 4R2. CSSS-F and CSSS-C perform below the target range of 90 days more often than going above the 210 days (too wet). Too dry (less than 90 days) of conditions are more conducive to nesting than too wet (above 210 days) due to reasons discussed above. CSSS-B, the largest of the subpopulations, met the ET-2 hydroperiod criterion in 29 of the 41 year POR, which is similar to the existing conditions. Within other subpopulations, hydroperiod targets are only met approximately half of the POR or less under existing conditions, Alt 4R2, and/or FWO (**Table 6-15** and **Figures 6-43 through 6-52**). Therefore, the Corps concludes that CEPP may adversely affect CSSS critical habitat and is therefore requesting formal consultation under ESA for CSSS Critical Habitat.

6.2.9 Other Species Discussion – Bald Eagle

On July 9, 2007, the FWS published the final rule in the Federal Register announcing the removal of the bald eagle from the Federal list of endangered and threatened wildlife. The rule became effective on August 8, 2007. However, this species remains protected under the Migratory Bird Treaty Act and the Bald Eagle Protection Act, therefore potential impacts from project activities are discussed below.

The bald eagle occurs in various habitats near lakes, large rivers and coastlines. Most breeding eagles construct nests within several hundred yards of open water (FWS, 1999). Shorelines, such as the shorelines around Lake Okeechobee, the Okeechobee Waterway, and estuaries provide fishing and loafing perches, nest trees, and open flight paths for the bald eagle (FWS, 1999). The bald eagle primarily feeds on fish, but is known to occasionally prey on small mammals and will feed on carrion. Bald eagles are known to nest around the study area. Nesting season occurs from October through May. The bald eagle mates for life and uses the same nesting site year after year, if the territory is available. According to the FWC database, for the period of 2000-2004, two nests were reported in close proximity to Lake Okeechobee. One nest, located in Palm Beach County near Lake Harbor, was last listed as active in 2003. The second nest, located in Glades County northeast of Lake Port, was active in 2004. Bald eagle nesting locations from 2001-2011 are shown in **Figure 6-56**.

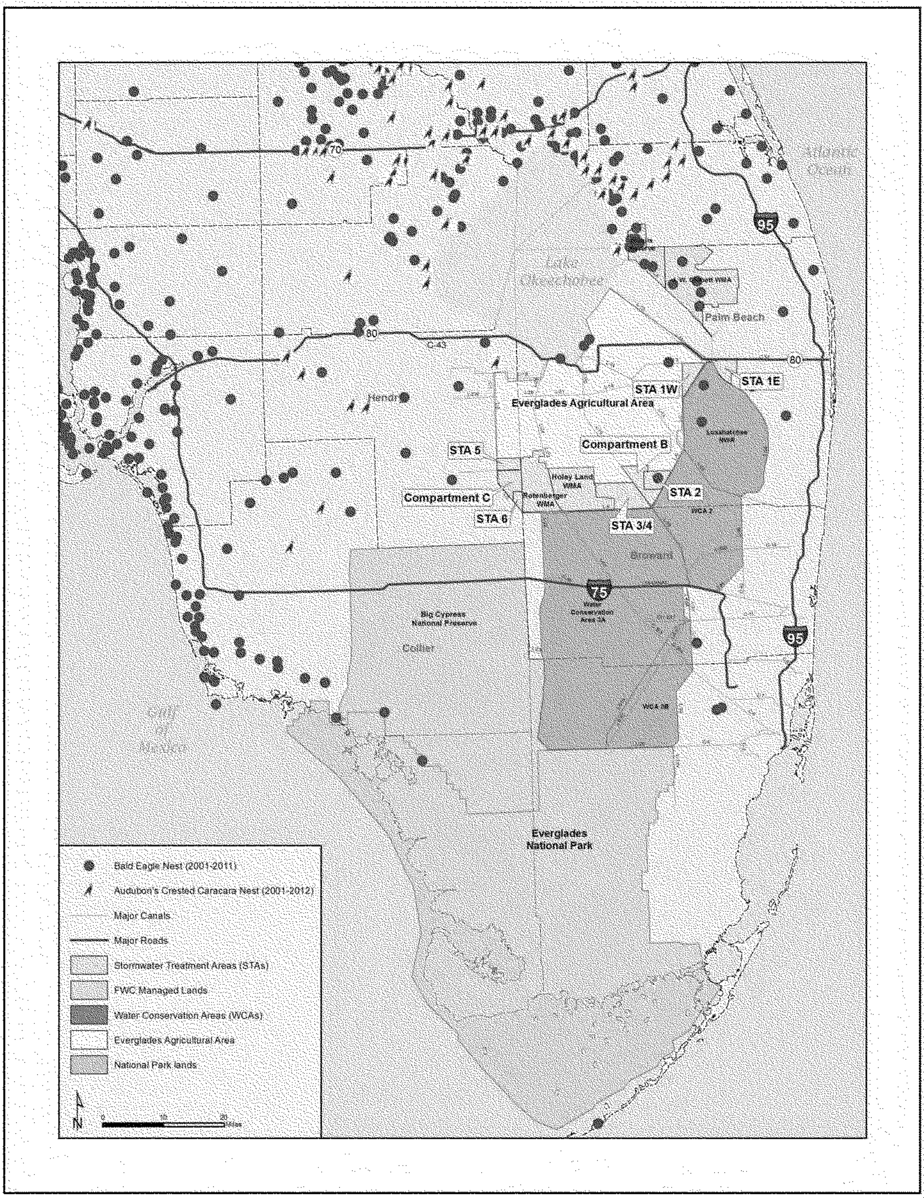


Figure 6-56. Bald eagle nest locations from 2001-2011.

In south Florida, nests are often in the ecotone between forest and marsh or water, and are constructed in dominant or codominant living pines (*Pinus spp.*) or bald cypress (*Taxodium distichum*) (McKewan and Hirth, 1979). Approximately ten percent of eagle nests are located in dead pine trees, while two to three percent occur in other species, such as Australian pine (*Casuarina equisetifolia*) and live oak (*Quercus virginiana*). The stature of nest trees decreases from north to south (Wood et al., 1989) and in Florida Bay eagles nest in black (*Avicennia germinans*) and red mangroves (*Rhizophora mangle*) almost exclusively (96.9 percent), half of which are snags (Curnutt and Robertson, 1994). Suitable habitat for bald eagles is any forested area with potential nesting trees that are within 1.9 miles (3 kilometers) of large open water, such as borrow pits, lakes, rivers, and large canals. Due to the confirmation of nests in Florida Bay it can be surmised that habitat is conducive for bald eagle nesting and foraging within the study area.

7.0 INCREMENTAL IMPACTS ON THREATENED AND ENDANGERED SPECIES

Implementation of CEPP will occur over many years and include many actions by USACE and SFWMD (Please refer to Section 6 of the Draft PIR/EIS). The TSP is composed of implementation phases that include the construction of a recommended plan feature or logical groupings of recommended plan features, agreed upon by the USACE and SFWMD, that maximize benefits to the extent practicable consistent with project dependencies and the Adaptive Management and Monitoring Plans (see **Annex D of the PIR/EIS**).

These implementation phases will achieve incremental hydrologic and environmental benefits. The approach incorporates the adaptive management process, per the guidance of the Programmatic Regulations for the Comprehensive Everglades Restoration (2003) and the Water Resources Development Act of 2007, maximizing the opportunity to realize restoration benefits by initially building project components that utilize existing water in the system that meets State water quality standards. Individual Project Partnership Agreements (PPA), or amendments to existing PPAs, will be executed prior to construction for each implementation phase. **Table 7-1** outlines the implementation phases and uses best professional judgment of the benefits and incremental impacts to threatened and endangered species since modeling of each increment was not done.

Table 7-1. Incremental impacts to threatened and endangered species based on phased implementation.

Implementation Phases	Project Features	Benefits of Recommended Plan	Relationship to CEM	Impacts to T&E Species	Non-CEPP Project Dependencies	CEPP Internal Project Dependencies
Phase 1	L-6 Diversion S-8 Pump Station Modifications L-4 Levee Degrade and Pump Station	The Miami Canal functions as unnatural source of drainage for WCA 3A; effectively overdraining area. Benefits gained from construction of features that re-distribute inflows into northern WCA 3A include <u>localized improvements</u> in • water depths and durations • suitability for slough vegetation • patterns of sheetflow • reductions in the risk of peat fires • beneficial shifts in habitat for wildlife species Southern WCA 3A would continue to be impounded by the L-67 A/C, and L-29 canals until outlet capacity is improved.	*Stressors:* Improved hydroperiods, Increased Sheetflow *Ecological Effects:* Reduced fire risk and soil oxidation, Peat Accretion *Attributes:* Improved fish, alligator, wading bird conditions, Maintain sawgrass, Restore ridge and slough	Improved alligator habitat suitability in northern WCA 3A. Temporary adverse effects to alligators that utilize the Miami Canal will occur due to backfilling of the Miami Canal. The levees along the Miami Canal will be degraded and used to fill in the Miami Canal. Once the Miami Canal is backfilled, created tree islands (~49 acres) will be constructed, which would potentially provide habitat for the indigo snakes, perhaps offsetting the loss of approximately 356 acres of spoil mound and levee habitat. Improved habitat and corridor for the Florida panther through the backfilling of the Miami Canal, but some loss of upland habitat for the panther and their prey species in the removal of the spoil mounds along the Miami Canal. Increased hydroperiods in northern WCA 3A improve habitat for the apple snail and the Everglades snail kite. Increased use of northern WCA 3A is expected with the backfilling of Miami Canal and the restoration of sheetflow in northern WCA 3A for the wood stork due to increased wetland habitat.	A-1 FEB & Restoration Strategies (WQBEL) Appendix A Water Quality Compliance 8.5 SMA and Existing S-356 C-111 South Dade MWD 1-Mile Bridge & Road Raising	L-4 levee degrade and L-5 canal improvements generate primary source of fill for backfilling Miami Canal.
Phase 2	L-5 Canal Improvements Miami Canal Backfill					
Phase 3	L-67 A Structure 1 One L-67C Gap	WCA 3B has become a rain-fed compartment dominated by sawgrass. Remaining tree islands have been reduced in elevation. Flows through NESRS are reduced resulting in lower wet season depths and more frequent and severe dry downs . Over-drainage along the eastern flanks of NESRS has resulted in shifts in vegetative community structure and invasion by exotic	*Stressors:* Improved hydroperiods, Increased sheetflow *Ecological Effects:* Reduced fire risk and soil oxidation, Peat accretion, Improved salinities *Attributes:* Improved fish, alligator,	Improved alligator habitat suitability in WCA 3A, WCA 3B and ENP. Loss of ~160 acres of upland habitat for the indigo snake, but the construction of the Blue Shanty levee creates ~113 acres of upland habitat. Improved habitat and corridor for the Florida panther through the degradation of the L-67C, L-29 and L-67 Extension levees, but some loss/degradation of panther habitat with the construction of the Blue Shanty levee.	BCWPA C-11 Impoundment TTNS Bridging & Road Raising	Evaluation of results from introducing flows into WCA 3B through L-67 A Structure 1 would determine whether additional L-67 A inflow structures could be implemented prior to construction of Blue Shanty levee. (See Adaptive Management
Phase 4	Increase S-356 and S-333 L-29 Divide Structure					
Phase 5	L-67 A Structures 2 and 3 L-67A Spoil Mound Removal					

Phase 6	Remove L-67C Levee SegmentRemove L-67 Extension8.5 Mile Blue Shanty LeveeRemove L-29 Levee Segment	woody species. Increased capacity of S-356 and S-333, degradation of the L-29 levee, and construction of the blue Shanty Levee would increase flows to NESRS and provide minor benefits to Florida Bay. Florida Bay is the main receiving waterbody of the Greater Everglades and is heavily influenced by changes in the timing, distribution, and quantity of freshwater flows upstream. Benefits gained from construction of features that re-introduce flows in WCA 3B, NESRS and Florida Bay include improvements in • water depths and durations • suitability for slough vegetation • patterns of sheetflow • reductions in the risk of peat fires • reductions in the intensity, frequency, and duration of hypersaline events • beneficial shifts in habitat for wildlife species Construction of these features will ready the system for additional inflows from Lake Okeechobee by providing outlet capacity for WCA 3.	wading bird conditions, Maintain sawgrass, Restore ridge and slough, Increased seagrass density	Increased hydroperiods in WCA 3B and ENP improve habitat conditions for the apple snail and the Everglades snail kite. Construction of the Blue Shanty levee will result in the loss of approximately 113 acres of wetland habitat within WCA 3B for the wood stork. However, the construction of other project features, including the degradation of existing levees (i.e. L-67C and L-29) and the backfilling of canals (i.e. L-67 Extension) will result in an increase of wetland habitat within WCA 3A, WCA 3B, and ENP; resulting in wetlands that may be suitable for foraging. Opening flows to NESRS provides more water to SRS and the southern marl prairies rehydrating CSSS habitat. Increased water flows without the additional water from Lake Okeechobee may provide a transition period for the CSSS.		Plan - Annex D) L-67 C, L-67 Ext and L-29 levee removals generate source of fill for Blue Shanty levee. Construction of Blue Shanty levee would occur after increase in capacity of S-356.

Phase 7	Seepage Barrier L-31NA-2 FEBRemove Old Tamiami Trail*	Construction of the A-2 FEB decreases high volume freshwater discharges from Lake Okeechobee to the Northern Estuaries. Additional water from Lake Okeechobee is sent south to achieve the **full extent of ecological benefits** for CEPP. Benefits gained from construction of the A-2 FEB and seepage barrier wall include: • improvements in optimal salinity ranges for estuarine communities • decreased turbidity and sedimentation in the estuaries • increases in the amount of water available for municipal and industrial uses in LECSA 2 (Broward County) and LECSA 3 (Miami-Dade County) by ~ 12 and 15 MGD/day. • assurance of adequate seepage management prior to moving additional water from Lake Okeechobee • landscape improvements (i.e., large-scale connectivity and reduced compartmentalization)	*Stressors:* Improved hydroperiods, Increased sheetflow, Reduced high flows *Ecological* *Effects:* Reduced fire risk and soil oxidation, Peat accretion, Improved salinities *Attributes:* Improved fish, alligator, wading bird conditions, Maintain sawgrass, Restore ridge and slough, Increased oyster and seagrass density	Increasing freshwater flow through the Greater Everglades into ENP will provide increased benefits to alligators within these habitats and improve alligator habitat suitability throughout WCA 3A and ENP. Changes within southern WCA 3A show potential negative effects to alligator production, however, the effects appear relatively negligible Increased freshwater deliveries to ENP, Florida Bay, and Biscayne Bay are predicted to increase suitable habitat for juvenile crocodiles. Implementation of CEPP will directly benefit juvenile crocodiles within the CEPP project area. Eastern indigo snakes have a high probability of occurrence within the proposed A-2 FEB site and as a result of construction of the A-2 FEB are likely to be displaced, thereby removing approximately 14,000 acres of potential habitat. Increased freshwater flows to Florida Bay and the southwestern coastal estuaries would improve salinity, therefore reducing stress on sea grasses that are important to foraging manatees. Damaging flows to the Northern Estuaries related to pulse releases would also be reduced, resulting in decreased sedimentation and silt, and increased light penetration, therefore providing better sea grass survival. Construction of the 14,000 acre FEB would result in conversion of upland habitat that could be potentially used by Florida panther to transverse the area to wetland habitat, thereby eliminating potential habitat within the panther secondary zone in this region. Increased hydroperiods within northern WCA 3A, WCA 3B, and	IRL-S C-44 Reservoir LO Regulation Schedule Revisions	* Old Tamiami Trail can be completed at any time during implementation, but must precede backfilling of L-67 Extension. Seepage Barrier along L-31 N needs to be completed prior to the A-2 FEB.

		associated with the restoration of hydroperiods and sheetflow from the northern regions of WCA-3A to the coastal mangroves of Everglades National Park		ENP would have a beneficial effect on Everglade snail kite and apple snail habitat. CEPP would remain below the recommended range ascension rates for apple snails, meet depth recommendations throughout much of WCA 3 and would therefore support successful apple snail oviposition. Wood storks generally show an increase in numbers in northern WCA 3A, WCA 3B, and southern ENP under Alt 4R2. Wood stork use is predicted to remain stable or decrease for several colonies located in southern WCA 3A adjacent to L-28; however there is potential for these wood stork colonies to utilize adjacent areas where foraging and habitat suitability are increasing. Approximately 14,000 acres of existing land within the footprint of the A-2 parcel currently classified as agricultural will also be improved to a higher quality wetland with construction of the A-2 FEB for wood stork foraging. Hydrologic changes are expected to be significant throughout much of CSSS habitat with minimal improvements seen within some areas (northern CSSS-A, CSSS-F). Moving flows to the east through the historical flow path does not benefit CSSS as originally thought and CEPP actually adversely affects portions of areas currently utilized by CSSS.		

8.0 CUMULATIVE EFFECTS

Cumulative effects include the effects of future Federal, State, Tribal, local, or private actions reasonably certain to occur in the action area considered in this Biological Assessment. Cumulative effects are defined in 40 CFR 1508.7 as those effects that result from:

> *the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.*

Cumulative effects for the proposed action were assessed in accordance with guidance provided by the President's Council on Environmental Quality (CEQ). The primary goal of cumulative effects analysis is to determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative effects of other past, present, and future actions. The following summarizes past, present, and projected USACE efforts that cumulatively affect the regional environment of south Florida. In addition, there are efforts underway by other Federal, State, and local agencies, as well as non-governmental organizations, that are too numerous to mention, that are all working towards similar restoration goals. **Table 8-1** shows the net cumulative effects of the various resources which are directly or indirectly impacted. CEPP is expected to contribute to a net beneficial cumulative impact on the regional ecosystem.

CERP contains 68 components that include approximately 217,000 acres of new reservoirs and wetlands-based water treatment areas. A number of operational components have also been identified in CERP and will, in most cases, occur in conjunction with related construction features. The operational features in CERP include: a modified Lake Okeechobee regulation schedule; environmental water supply deliveries to the Caloosahatchee and St. Lucie Estuaries; modifications to the regulation schedules for WCAs 2A, 2B, 3A, 3B, and the current rainfall delivery formula for ENP to implement rain-driven operations; modified Holey Land Wildlife Management Area Operation Plan; Modified Rotenberger Wildlife Management Area Operations Plan; a modification for coastal well field operations in the Lower East Coast (LEC); LEC utility water conservation; and operational modifications to the southern portion of L-31 and C-111.

CERP projects would increase the supply of freshwater for the Everglades and south Florida ecosystem. Large areas within the study area would be used to increase water storage resulting from CERP Projects for the overall gain and long term benefit of the regional system. These project features would provide important storage functions and are essential to the overall restoration of the freshwater marshes and the estuaries of the greater Everglades ecosystem. Project components in the area, especially storage, seepage control, and redirection of point source canal flows to overland flow will act to restore more natural freshwater flows to the northern and southern estuaries, reduce seepage losses from the Everglades, improve recharge of the Biscayne aquifer, and should result in other beneficial environmental effects.

Construction has begun on the first generation of CERP project modifications already authorized by Congress. These include the Indian River Lagoon-South Project, the Picayune Strand Restoration Project, and the Site 1 Impoundment Project. The second generation of CERP projects for Congressional authorization includes the Biscayne Bay Coastal Wetlands Project, Broward County Water Preserve Areas Project, the Caloosahatchee River (C-43) West Basin Storage Reservoir, and the C-111 Spreader

Canal Western Project. These projects will result in significant environmental benefits to the CERP project area, improving the quantity, quality, timing and delivery of water to the natural system.

Non-CERP projects assumed to be in the future without project condition for CEPP, which incorporate similar restoration goals of improving flow and water quality to the Everglades, include the DOI Tamiami Trail Modifications Next Steps (TTMNS) Project and the Restoration Strategies Regional Water Quality Preliminary Plan (SFWMD 2012). The DOI through the National Park Service (NPS) and ENP completed a study to evaluate the feasibility of additional Tamiami Trail bridge length, beyond that to be constructed pursuant to the MWD Project, to restore more natural water flow to ENP and Florida Bay and for the purpose of restoring habitat within the ENP. The TTMNS project was authorized by Congress in the Consolidated Appropriations Act, 2012. The Restoration Strategies Regional Water Quality Preliminary Plan describes resulting projects developed to address water quality concerns associated with existing flows to the Everglades Protection Area (EPA) to achieve water quality standards established for the Everglades. The SFWMD is implementing a technical plan to complete six projects that will create more than 6,500 acres of new STAs and 110,000 acre feet of additional water storage through construction of FEBs.

The C&SF Flood Control project has numerous water management structures consisting of culverts, spillways, and pump stations that have specified operating criteria for managing or regulating water levels for Congressionally-authorized project purposes. Regulation schedules have been, and will continue to be, designed to balance multiple, and often competing, project purposes and objectives. Managing for better performance of one objective often lessens the effectiveness of performance of competing objectives. For example, for Lake Okeechobee, higher regulation schedules tend to benefit water supply, but may increase the risk to public health and safety, and can harm the ecology of the lake. By contrast, lower lake schedules may produce lake levels more desirable for the lake ecology and improved flood protection, but reduce water supply potential.

In addition to CERP and non-CERP projects previously specified, the CEPP future without project condition includes implementation of the Everglades Restoration Transition Plan (ERTP) for WCA 3A, ENP, and the SDCS, which replaced the Interim Operational Plan (IOP) for Protection of the Cape Sable Seaside Sparrow (CSSS). From July 2002 through October 2012, WCA 3A was regulated according to a seasonally varying 8.75 to 10.75 feet, NGVD regulation schedule and the Rainfall Plan (initiated in 1985), as per IOP. The primary objective in implementing IOP was to adhere to a 1999 FWS Jeopardy Opinion to reduce damaging high water levels within CSSS habitat west of SRS (i.e. CSSS-A). The purpose of IOP was to provide an improved opportunity for CSSS nesting by maintaining water levels below ground level for a minimum of 60 consecutive days between March 1 and July 15, corresponding to the CSSS breeding season. In addition, a secondary purpose of IOP was to allow CSSS habitat to recover from prolonged flooding during the mid-1990s. The ERTP superseded the IOP in October 2012 and is intended to define water management operating criteria for the C&SF project features and constructed features of the MWD and Canal-111 South Dade Projects (C-111 SD) until a Combined Operational Plan (COP) is implemented following completion of the MWD and C-111SD projects. ERTP objectives include improving conditions in WCA 3A for the endangered Everglade snail kite, wood stork and wading bird species while maintaining protection for the endangered Cape Sable seaside sparrow (CSSS) and Congressionally-authorized purposes of the C&SF Flood Control project.

Table 8-1. Summary of Cumulative Effects.

Hydrology	
Past Actions	Flood and water control projects have greatly altered the natural hydrology.
Present Actions	Federal and state agencies are coordinating on and implementing projects to improve hydrology.
Proposed Action	Reductions in high discharge events from Lake Okeechobee to the Northern Estuaries. Significant beneficial hydrologic effects are anticipated within the Greater Everglades through restoration of sheetflow and rehydration of previously drained areas. Improved hydrologic conditions will result from increasing depths and extending hydroperiods in WCA 3A, WCA 3B, and ENP.
Future Actions	Additional CERP projects propose to restore hydrology to more natural conditions.
Cumulative Effect	Although it is unlikely that natural hydrologic conditions would be fully restored to pre-drainage conditions, improved hydrology would occur. CERP is expected to improve the quantity, quality, timing and distribution of freshwater flow.
Threatened and Endangered Species	
Past Actions	Water management practices and urbanization have resulted in the degradation of existing habitat function and direct habitat loss leading to negative population trends of threatened and endangered species.
Present Actions	Ongoing efforts have been made by Federal and state agencies to implement projects to improve hydrology within the project area. Ongoing projects have been implemented to maintain CSSS populations. The FWS recovery plan is used as a management tool.
Proposed Action	No effect on Audubon's Crested Caracara. May affect the eastern indigo snake, Florida panther, wood stork, Everglade snail kite, Everglade snail kite critical habitat, Florida manatee, Florida manatee critical habitat, crocodile, and crocodile critical habitat. Adverse affect on CSSS and CSSS critical habitat.
Future Actions	Ongoing projects would be implemented to maintain threatened and endangered species within the project area. ERTP implementation represents a paradigm shift from single species to multi-species management. ERTP includes performance measures specifically directed at managing water levels and releases for the protection of multiple species and their habitats within the project area.
Cumulative Effect	Habitat improvement, monitoring and management of threatened and endangered species are anticipated to allow populations to be maintained. Improvement of degraded populations is expected to be facilitated by the restoration and enhancement of suitable habitat through efforts to restore more natural hydrologic conditions within the project area.
Fish and Wildlife Resources	
Past Actions	Water management practices have resulted in aquatic vegetation community changes and a resultant disruption of aquatic productivity and function that has had repercussions through the food web, including effects on wading birds, large predatory fishes, reptiles and mammals.
Present Actions	Ongoing efforts have been made by Federal and state agencies to implement projects to improve hydrology within the project area to restore habitat conditions for fish and wildlife resources.
Proposed Action	Negligible effects to fish and wildlife resources within Lake Okeechobee, and the EAA. Reductions in the number of high discharge events to the Northern Estuaries are anticipated to improve suitable habitat for key indicator species such as oysters. Significant beneficial effects are anticipated within the Greater Everglades. Rehydration within previously dry areas of WCA 3A, 3B, and ENP would increase the spatial extent of suitable habitat. Increases in forage prey availability (crayfish, other invertebrates, and fish) would directly benefit amphibian, reptile,

	small mammal, and wading bird species. Nesting and foraging activities of resident bird species are anticipated to be significantly improved. Increased freshwater flows to Florida Bay would aid in improving suitable habitat for pink shrimp, juvenile spotted seatrout, sea turtles, manatee and crocodiles among other species.
Future Actions	Some level of improvement to fish and wildlife resources is expected to occur as a result of implementation of projects with the capability of improving the timing, quantity, quality and distribution of freshwater flow to the study area. Hydrologic restoration planned as part of CERP would further improve fish and wildlife habitat.
Cumulative Effect	Habitat improvement efforts are anticipated to benefit fish and wildlife resources.
Vegetation and Wetlands	
Past Actions	Drainage of Florida's interior wetlands, conversion of wetlands to agriculture, and urban development has reduced the spatial extent and quality of wetland resources.
Present Actions	Efforts are being taken by state and Federal regulatory agencies to reduce wetland losses.
Proposed Action	Negligible effects to vegetation within Lake Okeechobee and the EAA are anticipated. Reductions in the number of high discharge events to the Northern Estuaries are anticipated to improve conditions for seagrass beds. Significant beneficial effects are anticipated within the Greater Everglades. Improved hydroperiods and sheetflow within WCA 3A, 3B and ENP would result in reduced soil oxidation, promoting peat accretion necessary to rebuild the complex mosaic of habitats across the landscape. Increased freshwater flows to Florida Bay would aid to lower salinity levels, benefiting mangrove communities and seagrass beds.
Future Actions	Some level of improvement to vegetative communities is expected to occur as a result of implementation of projects with the capability of improving the timing, quantity, quality and distribution of freshwater flow to the study area. More natural hydrology as part of the CERP would assist in restoring natural plant communities.
Cumulative Effect	While the spatial extent of natural plant communities would not be restored to historic proportions, the quality of vegetative communities would be improved.
Water Quality	
Past Actions	Water quality has been degraded from urban, suburban, commercial, industrial, recreational and agricultural development.
Present Actions	Efforts to improve water quality from agricultural areas are ongoing. Federal and state projects can temporarily elevate localized levels of suspended solids and turbidity.
Proposed Action	Implementation of the project is not expected to significantly affect the water quality of Lake Okeechobee or the Northern Estuaries. Changes in the quantity, timing, and distribution of flows within WCA 3A and WCA 3B may result in temporary increases in phosphorus concentrations at some TP Rule monitoring stations; however, this should not significantly affect TP Rule compliance. Over the long-term, distributing the flow over the northern WCA-3A marsh, reducing short-circuiting down the canals, adding more flow from the lake that is treated to the WQBEL, should result in improved water quality within WCA 3 and a reduction in flow weighted mean total phosphorous concentration entering the Park. Southern Estuaries salinity conditions are expected to be improved by the project.
Future Actions	Actions by the State of Florida's Restoration Strategies will decrease pollutant concentration and loadings to the project area. If authorized in the next Water Resources Development Act (WRDA), the Broward County WPA Project, (report approved in 2007) would reduce storm runoff deliveries to WCA 3 and improve water quality coming across Tamiami Trail.

Cumulative Effect	While anthropogenic effects on water quality are unlikely to be eliminated, water quality is expected to slowly improve over existing and recent past conditions.

9.0 CONSERVATION MEASURES

The Corps acknowledges the potential usage and occurrence of the previously discussed threatened and endangered species and/or critical habitat within the CEPP study area. Species and habitat monitoring would continue to identify population trends for the CSSS, Everglade snail kite, wood stork, and the vegetation characteristic of their habitats. Potential mitigation measures for affected species will be negotiated with FWS once the Corps receives the Biological Opinion. CSSS mitigation measures could include preemptive measures to offset the potential adverse effects of the project including translocation of species to more suitable habitat, improvement of habitat within ENP, and/or improvement of habitat within some of the critical habitat areas that will be improved by CEPP, such as CSSS-A. However, not all of these potential measures would be within the Corps authority to implement and the Corps will work proactively with FWS, the U.S. Department of the Interior and Everglades National Park to address concerns. Habitat restoration measures discussed with the FWS could also include prescribed fire, evaluation of the role of woody vegetation in CSSS habitat, and removal of woody vegetation. Monitoring that would help determine the current CSSS population would be useful in determining actual project effects, and could include development of a spatially explicit population estimator, conducting intensive nesting monitoring, conducting helicopter surveys, population modeling, and hydrologic monitoring.

The Corps proposes to use panther credits in the Picayune Strand Restoration Project to offset the loss of habitat due to construction of project features as described in (**Table 6-2**).. 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 the manatee, and *Draft Standard Protection Measures for the Eastern Indigo Snake* (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.

10.0 CONCLUSIONS

State-Listed Species: Effects of project activities are not likely to adversely affect state protected species (**Table 5-2**). Impacts to state-listed wading bird species will be similar to those described for the federally endangered wood stork. Modifications to the existing C&SF project are designed to improve hydrologic conditions for wading birds through increasing foraging opportunities within WCA 3 and ENP, thereby directly benefitting these species within the CEPP study area.

Federally-Listed Species: The Corps acknowledges the probable existence of 40 federally-listed threatened, endangered, and candidate species within the boundaries of the CEPP 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 reasons discussed in Section 6 include the following: Crenulate lead plant, cape sable thoroughwort, Deltoid's spurge, Garber's spurge, Small's milkpea, tiny polygala, Okeechobee gourd, Miami blue butterfly, Schaus swallowtail butterfly, stock island tree snail, piping plover, red-cockaded woodpecker, Roseate tern, and Northern crested caracara.

The Corps acknowledges the potential existence of fifteen federally listed threatened and endangered species under NMFS purview within the boundaries of the CEPP study area. Although the green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, and the loggerhead sea turtle are known to potentially exist within close proximity of the project area, any project related impacts through restoration efforts will ultimately benefit estuarine and nearshore communities and associated biota. Based on available information, it is evident that the smalltooth sawfish, resides, travels, and/or forages within the study area and could be affected by CEPP implementation. Thus the Corps has determined that CEPP, may affect, but is not likely to adversely affect, sea turtles and smalltooth sawfish. 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, the Gulf sturgeon, blue whale, fin whale, humpback whale, sei whale, sperm whale, elkhorn, and staghorn stony corals. The Corps has determined that the proposed project will have "no effect" on these species utilizing the study area.

The conversion of agricultural land to a FEB in the EAA and other project features will result in a loss of habitat for the indigo snake and the Florida panther. However, increased water flows through the WCA 3 and ENP would indirectly increase foraging habitat for the panther as some of its prey eats fish. Constructed tree islands along the Miami Canal backfill could potentially create some deer habitat to also increase prey, as well as potentially providing some upland habitat for indigo snake. Eastern indigo snakes currently inhabit EAA agricultural fields used for sugar cane production and regularly burned. Soils in this area are hydric (wetland) soils that will support wetlands, which is not typically the type of area the snakes are found in. Eastern indigo snakes would still have relatively large areas of undeveloped and agricultural land in the EAA to maintain their population.

Within the Greater Everglades, altered hydrology has led to degradation of the native vegetation communities, such as tree islands, sawgrass marsh mosaic, and marl prairies, and the expansion of undesirable cattail monocultures. As habitats have been degraded, abundance and diversity of wildlife populations have been affected as well. Restoration of sheetflow and historic hydropatterns within WCA 3 and ENP will result in beneficial shifts toward more desirable vegetation communities, landscape patterns, and animal populations.

Wood storks would benefit from increased freshwater sheetflow due to an increased foraging base in WCA 2, 3, and ENP. Based on Beeren's frequency of use model, wood stork use and foraging would increase due to implementation of CEPP (Bereens 2013). Changes in the quality, quantity, timing, and distribution of water under CEPP provides opportunities for improved vegetation in northern WCA 3A, 3B, and ENP, including expansion of sloughs and wet prairies, and contraction of sawgrass prairies, thus benefiting the Everglades snail kite. Conversion back to sloughs and wet prairies would provide improved apple snail ascension rates and meet apple snail depth recommendations (Darby et al. 2002), which support successful apple snail oviposition, a key factor in snail kite survival. Designated Everglade snail kite critical habitat would also be improved with increased sheetflow to WCAs and ENP. There would be no effect on Everglade snail kite designated critical habitat within Lake Okeechobee, WCA 1, or WCA 2 because CEPP is redirecting approximately 210,000 acre feet of additional water that currently flows into the St. Lucie and Caloosahatchee Estuaries to the historical southerly flow path south through FEBs and existing STAs.

Based on the best available information, it is evident that the CSSS would likely be adversely affected by CEPP implementation. However, neither existing nor projected future conditions provide an ideal outlook for the CSSS. Comparisons of existing conditions and the CEPP recommended plan (Section 6) show that some areas utilized by sparrows are slightly improved by CEPP implementation, while others remain the same or slightly worse than existing conditions. While there are slight improvements to critical habitat areas in CSSS-A, CSSS-F, and CSSS-B (some metrics), other areas show an adverse affect. Natural fluctuations in climate and weather are difficult to predict (e.g., Hurricane Andrew where a decline in species population happened afterwards). Actions discussed in Section 7 of this document may help improve undesirable conditions in areas formerly inhabited by the sparrow prior to CEPP implementation, potentially contributing to an increase in the CSSS population.

Changes in hydrology of the freshwater systems have led to effects on the estuarine and marine environments of Florida Bay and Biscayne Bay. Alterations in seasonal deliveries to Florida Bay have resulted in extreme salinity fluctuations. Implementation of CEPP would improve the production of bay flora and fauna by moderating unnatural shifts in salinity through improvements to freshwater delivered to coastal wetlands and downstream estuaries in ENP, Florida Bay, and Biscayne Bay. These improvements directly benefit the American crocodile and its critical habitat and Florida manatee and its critical habitat with increased freshwater flows to the estuaries. CEPP has the potential to reduce the frequency and volume of high level flows from Lake Okeechobee to the Caloosahatchee River Estuary and the St. Lucie Estuary, thus reducing the potential for adverse impacts on estuarine and nearshore biota associated with EFH. This is a significant improvement for estuarine systems compared to existing conditions.

The Corps recognizes the need for re-initiation of consultation if modifications to the project are made and/or additional information involving potential effects to listed species becomes available. The Corps commits to maintain ongoing communications with the FWS, NMFS, and FWC in the event of project modifications. This document is being submitted for formal consultation with the FWS pursuant to Section 7 of the ESA.

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Comment Response Matrix for the Fish and Wildlife Service Request for Additional Information on the Central Everglades Planning Project Endangered Species Act Biological Assessment

Comment ID or Page Number	Comment	Response
General	The Corps did not make an effect determination on the Florida semaphore cactus (proposed endangered)	The Florida semaphore cactus is listed in Table 5-3 which is the list of species within CEPP project area that are candidate species for protection under the Endangered Species Act. It is also stated in this same section that "A number of candidate plant species are known to exist or potentially exist in the study area, most of which are also associated with pine rocklands. Adverse effects to federally listed candidate plant species are not anticipated due to implementation of CEPP." The Corps would have a "no effect" determination.
General Comment No. 1	We spent many hours reviewing and providing comments to the Corps on the first draft of the BA (May 2013). We were concerned to see that many of those comments, particularly those relating to the snail kite and CSSS, were not addressed in this draft.	We addressed the comments received from FWS on the draft BA and the responses were incorporated into the BA that was formally transmitted to FWS on August 5, 2013. The comments in this Request for Additional Information are new comments that were not previously submitted to the Corps.
General Comment No. 2	There is increasing discussion in public forums and in the draft Project Implementation Report (PIR) about how incremental implementation of CEPP will take place; however, there is no mention of incremental impacts on listed species. This will affect the timing and magnitude of impacts to species and needs to be discussed in the BA.	Using best professional judgment, a discussion about the incremental impacts on listed species was added to the BA (refer to Section 7.0 and Table 7-1). Additional modeling of each increment will not be done for this project and therefore cannot be included in the BA.
General Comment No. 3	There is no description of any known unrelated future non-Federal activities ("cumulative effects") reasonably certain to occur within the action area that are likely to affect the listed species.	A cumulative effects section was added to the BA that outlines the cumulative effects as defined in 40 CFR 1508.7 which includes the effects of future State, Tribal, local, and/or private actions reasonably certain to occur in the action area considered in the BA (refer to Section 8.0). The cumulative effects analysis is consistent with the analysis that was conducted for the CEPP Draft PIR and EIS in accordance with

		the NEPA, however we recognize that FWS will not consider future Federal actions for purposes of ESA cumulative impacts analysis.
General Comment No. 4	The Service requests the following information on the acreages to complete the eastern indigo snake analysis.	Table 6-1 was added to Section 6.2.3 that outlines the acres of the different project features. 1. Miami Canal spoil mounds to be degraded: 321 acres 2. L-4 degrade: 35 acres 3. L-29 degrade: 46 acres 4. L-67C gap degrade: 9 acres 5. L-67C flow way degrade: 64 6. L-67 extension levee degrade: 41 acres 7. Old Tamiami Trail Road degrade: 31 acres 8. Tree islands to be created on the Miami Canal: 49 acres 9. The upland areas on the new Blue Shanty Levee: 113 acres 10. Spoil Mounds retained: 27 acres
General Comment No. 5	The use of Existing Condition Baseline (ECB) verses ECB 2012 yields different results (e.g., hydroperiods in indicator region A-1) that are not intuitive to those familiar with the Everglades Restoration Transition Plan (ERTP). As we recall, ERTP did not result in benefits to Subpopulation A (CSSS-A) (as it was meant to make conditions in WCA-3A better while maintaining CSSS-A) but now the baseline has been modified. ERTP has barely been in place a year and we have little data to judge its effect on sparrows in CSSS-A or to analyze a proposed change to the base conditions from a model run that is unsupported by on-the-ground data (e.g., ERTP lowered the top of the 3A regulation schedule, however, this cannot be met in the real world because the system is not designed to do so). An analysis should be included to determine what, if any, effect the changing of the base conditions has on sparrow results and the extent that ERTP will indeed provide the modeled base condition.	When CEPP planning began in Nov 2011 the ERTP ROD had not been signed so IOP was considered the ECB. The ERTP ROD was signed in October 2012 a year into the planning effort. The ECB was the baseline used during the for CEPP PIR/EIS formulation effort. The updated ECB 2012, which incorporated the changed operational conditions associated with ERTP, was used for the Savings Clause analysis and for the purposes of the BA and BO that to reflect the changes in operations associated with ERTP. With the approval of FWS (Kevin Palmer email July 3, 2013), we proceeded with the BA analysis using ECB2012. An analysis of the effect of IOP (ECB) compared to ERTP (ECB2012) was done in the ERTP EIS, ERTP BA and ERTP BO. These references are included in the CEPP BA. A Model Assumption section was added to the document (Section 4.3.5) that describes the model runs and shows the comparison between the baselines.
General	Is the acreage (or general location, if exact acreages are	The C-111 Spreader Canal Western Project used

Comment No.6	not known) impacted in CSSS-D demonstrated by the CEPP modeling the same acreage as that shown impacted under the C-111 Spreader Canal Project? If so, are they really an impact? If not, are they cumulative and what impact to sparrows in this area will occur from the additional impact?	MODBRANCH to estimate differences in stage within CSSS-D. The project was not modeled as part of the Existing Condition Baseline for CEPP. This CERP project was included as part of the Future Without Project Condition. Any differences that occur between Alternative 4R2 and the Future Without Project Condition as measured by the CSSS performance metrics would occur as a result of implementing the Tentatively Selected Plan (TSP) as modeled during the CEPP planning effort.
Page 41	The BA indicates that total annual flows to Biscayne Bay are expected to increase under CEPP, which should improve crocodile habitat. However, the Corps failed to note that the seasonal timing of flows changes and that there are reductions in flows to some areas of Biscayne Bay during the dry season. What are the effects of this on juvenile crocodile survival/habitat?	A Habitat Suitability Index for juvenile American crocodiles was used to predict potential effects of implementation of Alternative 4R2 in Florida Bay. This analysis was not available for Biscayne Bay; however an assessment of potential effects of implementation of Alternative 4R2 for Biscayne Bay has been included in the CEPP Supplemental Technical Analysis in Section 6.2.2. Implementation of Alternative 4R2 decreased flow to the most southern portion of Biscayne Bay (Manatee Bay, Barnes Sound, and Card Sound) during the wet season by 8,300 acre feet per year relative to existing conditions. Decreases observed during the dry season were less with 800 acre feet per year. Most crocodiles within this area have been observed near Card Sound Road, the southeast corner of Florida Power and Light Company's Turkey Point Power Plant, and the Crocodile Lake National Wildlife Refuge on the Key Largo shore of Barnes Sound. Fewer crocodiles have been observed near the S-197 structure (Cherkiss et al. 2001). Salinity changes at these most populated sites would likely be less than 3 ppt based on an 8,000 acre feet per year decrease in flow. The project may affect, but not likely to adversely affect the American Crocodile in Biscayne Bay.
Page 41	Additionally, if you are not requesting a formal consultation on crocodiles then your effect determination should be changed from "may affect" to "may affect, but not likely to adversely affect."	Per the ESA, the Corps is not requesting formal consultation on the American crocodile and has made a may effect, not likely to adversely affect determination.

Page 44	The only effect ascribed to indigo snake in the A-2 Flow Equalization Basin is "displacement." We believe it is just as likely that eastern indigo snakes will be injured or killed due to their tendency to occupy burrows or other underground refugia in vegetative areas where they may not be readily observable by equipment/vehicle operators.	Language was added in Section 6.2.3 that states "Also, due to the secretive nature of the Eastern indigo snake and their tendency to occupy burrows or other underground refugia in vegetative areas where they may not be readily observable by equipment/vehicle operators, some may be taken as a result of construction. Standard construction procedures will be used to avoid Eastern indigo snakes within construction areas following the Standard Protection Measures for the Eastern Indigo Snake (USFWS Dated August 12, 2013). The contractor would be required to keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage of fish and wildlife resources. The contractor would be required to inform the construction team of the potential presence of threatened and endangered species in the work are, the need for construction conservation measures, and any requirements resulting from ESA Section 7 consultation."
Page 48	The analysis of effects of CEPP on the Florida panther is missing. Please include an analysis of how many acres are fallow and provide habitat for panthers, and how many acres of panther habitat will be lost or altered with implementation of CEPP. Please also include a discussion of the credits available at Picayune for compensation of adverse effects. Also, recognize that any panther compensation through restoration activities at Picayune must be complete before impacts to panthers from CEPP occur.	The analysis has been added to Section 6.2.5 and includes Table 6-2 that outlines the acres of panther habitat impacted by each CEPP feature, the zone of impacted lands and the panther habitat unit value. In order for the Corps to determine the appropriate number of PHU for mitigation, the Corps requests further information on PSRP Panther Mitigation Bank and methodology for determining number of credits necessary. Table 6-2 has been included with the appropriate acres and habitat unit values for each CEPP feature. The Corps has employed best professional judgment and information and the methodology provided in the 2009 PRSP BO to calculate credits in Table 6-2. Therefore, based upon the USACE calculations in Table 6-2, it appears that no panther credits at PRSP will be necessary for CEPP; it is self-mitigating and will actually generate 49 additional credits. Based upon the 7 March 2013 letter from FWS to Florida

		Wildlife Federation, there are approximately 319,593 credits remaining at PSRP. However, please note that this figure includes 100,173 credits reserved for the EAA BO dated 4/14/06 (33,740 acres). The EAA Reservoir was never completed and a portion of that project (14,000 acres) will be used for the CEPP A-2 FEB. Therefore, the Corps requests that FWS remove the 100,173 EAA credits from the Panther Mitigation ledger.
Page 54	The BA indicates that kite nesting activity has been low "since the Emergency Deviations to the WCA 3A Regulation Schedule" in 1998. Is it the Corps' determination that these deviations are responsible for the kite population decline? Please also provide a population graph that shows each year for which kite nesting data are available and discuss whether nesting success was considered good or poor on a per year basis.	It is not the Corps' determination that the deviations are responsible for the kite population decline. The report states that the decline in the kite population may be due to several factors and that each decline has coincided, in part, with a severe regional drought throughout the southern portion of the Everglade snail kite's range. Figure 6-12 was added that includes the number of young fledged from 1992-2012.
Page 58. Section 6.2.6.4.	The BA applies the Multi-Species Transition Strategy (MSTS) inappropriately in that it cannot be used to evaluate effects of water depth on kites. The MSTS windows can only be used to evaluate the 3AVG stage, and the target area for that and the snail recommendation is southwest WCA3A (no other areas within the Everglades). This is explained further in the MSTS white paper and the Service's 2010 ERTP Biological Opinion. At this time, the Corps' snail kite analysis is insufficient.	There has been dialogue between the Corps and FWS about the kite analysis and the application of the MSTS for the snail kite analysis for CEPP. Furthermore, the Corps states that we believe this is inappropriate and thus why we used the apple snail depth targets to infer available forage for snail kites as a result of this project. Unlike the MSTS snail kite depths, the apple snail data is based upon peer reviewed literature. This was clarified in Section 6.2.6.4 and related references to the MSTS snail kite depths were removed. Vegetation analysis using the output of the ELVeS model has been added to this section.
Page 58	Please provide the kite analyses for gages W-2 and 3AS3WI. These gages were defined in the 2010 ERTP Biological Opinion as really important to monitoring and analyzing the kite and snails by the Service and Dr. Darby. This was noted early on and throughout the CEPP planning process.	Concur and results are provided. The gages were added to Table 6-5 and included in the analysis in Section 6.2.6.4.
Page 64.	The BA states, "The Corps could utilize the	Appropriate language was added to Section 6.2.6.5 to address

Section 6.2.6.5 Snail Kite Species Effect Determination	operational flexibility inherent" to achieve appropriate snail kite recession rates. Please explain what operation capabilities exist now and in the future with CEPP that could be used to benefit snail kites (especially with regards to recession rates). Is this part of the project description that the Corps will provide?	the comment. Operational flexibility is a general term which is supported through specific criteria located within the 2011 ERTP Final EIS, Appendix A-3, Operational Guidance to describe current operational flexibility and the 2013 CEPP Draft Project Operation Plan (CEPP Draft PIR/EIS Annex C) to describe flexibility within CEPP. One example of operational flexibility is the ability to release up to a certain volume of water through individual structures, allowing flexibility in making low or high volume discharge releases which may act to increase or decrease depths or recession rates.
Page 77	The BA presents a discussion of where foraging conditions, as indicated by hydrologic changes, may occur relative to Alternative (Alt) 4R2. It should also indicate the number of wood stork rookeries that could be either adversely affected or benefitted by the project. The BA also needs to present an analysis of likely effects from these hydrologic changes (particularly the negative effects) to the wood stork.	The Wood Stork Foraging Probability Index (STORKI v. 1.0) was developed to provide rapid simulations of wood stork foraging conditions in response to modeled CERP scenarios. Wood Stork species distribution was also modeled by Beerens 2013 in support of the RECOVER ecological evaluation. Graphics in Section 6.2.7.1 (Potential Effects to the Wood Stork) referencing the mean percent change in wading bird cell use has been updated to include the current locations of wood stork colonies. Additional information regarding predicted effects to existing wood stork colonies have been added to Section 6.2.7.2 (Wood Stork Species Effect Determination).
Page 79	The BA states, "Wood storks generally showed increased numbers in northern WCA 3A, WCA 3B, and southern ENP under Alt 4R2 compared to the FWO (Figure 6-19). The existing conditions showed a similar trend in percent differences to the FWO, indicating that Alt 4R2 also performs better than existing conditions (Figure 6-20)." The BA does present two color-coded graphics depicting differences, but neither of these show the difference between Alt 4R2 and the existing condition. Nor are there any data tabulated to support the previous conclusion of "increased numbers" of wood storks.	A graphic depicting the mean percent change in wading bird cell use for Alternative 4R2 relative to the existing conditions has been added to Section 6.2.7.1 (Potential Effects to the Wood Stork). The referenced statement regarding "increased numbers" of wood storks has been edited and clarification provided.
Page 81	In regards to recommendations made during Periodic Scientist calls regarding wood storks, the BA states, "The	Language has been added to clarify flexibility that may be expected upon CEPP implementation. See response above for

	Corps could utilize the operational flexibility inherent within operations to achieve the recommendation." Again, what flexibilities exist now for storks and what would under the CEPP? Is this part of the project description that the Corps will provide?	FWS comment Page 64. Section 6.2.6.5 Snail Kite Species Effect Determination. One example of operational flexibility is the ability to release up to a certain volume of water through individual structures, allowing flexibility in making low or high volume discharge releases which may act to increase or decrease depths or recession rates.
Page 81. Figure 6-21	In ERTP, the Service used water depth and recession rate graphs to depict whether conditions were going to become too dry or too wet at sites near rookeries within the core foraging areas. The Corps provides a "stop light" column graph that shows conditions are not good, but there is no indication as to whether conditions are becoming drier or wetter or if recession rates are too fast or too slow for foraging. Please provide site-specific analyses of water depths and recession rates.	Throughout the CEPP planning effort, the Corps has communicated with the FWS regarding analyses to be used for the wood stork. The model results provided by the Wood Stork Foraging Probability Model (STORKI v. 1.0) and Beerens 2013 provide a more sophisticated analysis than that employed for ERTP. This information was presented at numerous CEPP Eco Sub Team meetings in which FWS was in attendance. The "stop light" graphic depicting dry season recession rates were included in the BA since it was used in ERTP. Additional information regarding predicted effects to wood storks based on results of Figure 6-21 (WCA 3A Dry Season Recession Rates (PM-F) has been added.
Page 82. 6.2.7.2 Wood Stork Species Effect Determination	The Corps recognizes an impact to wood storks via permanent loss of wetland habitat from the construction of the proposed Blue Shanty Levee, yet they did not assess it in the BA. Additionally, there is no discussion in this section of the potential effects to existing wood stork colonies, only a discussion of potential benefits to areas that could be used by storks in the future. Please address these issues.	The BA notes that with Alternative 4R2, a levee will be constructed within WCA 3B that will result in the permanent loss of wood stork foraging habitat. The construction of the Blue Shanty Levee will result in the loss of approximately 113 acres of wetland habitat within WCA 3B. This information in addition to the direct gain of wetland acreage as a result of construction of the TSP has been included in the CEPP Supplemental Technical Analysis. In response to the latter part of the above comment, statements regarding potential effects to existing colonies have been included in Section 6.2.7.1 (Potential Effects to the Wood Stork and Section 6.2.7.2 (Wood Stork Species Effect Determination. Foraging and habitat suitability are predicted to increase for wood stork colonies previously and/or currently located within WCA 3B (3B Mud East) (Beerens 2013). Wood stork colonies may be beneficially affected.

Page 83	The BA indicates that CSSS research by Lockwood "have revealed substantial movements between subpopulations east of SRS suggesting that the CSSS has considerable capacity to colonize unoccupied suitable habitat." Lockwood's research showed that only 4 of 299 tagged birds moved from one subpopulation to another. Please explain how this equates to "considerable capacity"? Are you stating that movements between subpopulations is likely or only that it is possible, but rarely documented (and most of these birds were males). Additionally, are you assuming that there is suitable habitat outside the known subpopulations? If so, where would that be?	The research results come from conclusions drawn by the 2007 Avian Panel. We are not assuming that there is suitable habitat outside the known subpopulations because FWS recognizes the need to do a full scale survey to determine where there would be suitable habitat. The text has been revised to suggest that CSSS may have the capacity to colonize unoccupied suitable habitat if it is available as well as the potential for translocation into suitable habitat.
Page 92. Table 6-5	Table is missing data for E-2.	The post-process data was not provided for E-1 and E-2, only one gage was post processed by the modelers. We post processed the gage cells that make up E-1 and E-2 and added that data to the table.
Page 93	The X axis scale is incorrectly labeled in Figures 6-25 through 6-37.	The axes have been corrected.
Page 100	The BA states "Research suggests that CSSS are capable of short and long range movement which could suggest that if the area around CSSS-E and CSSS-D becomes too wet, the birds could reside in the CSSS-B ..." The vast majority of research on CSSS movement documents that they exhibit strong site fidelity moving only within several hectares of their natal site. The distance between either CSSS-E or CSSS-D and CSSS-B are at the upper (i.e., longest) range of the distances recorded for CSSS movement. Also, most of these movements have only been recorded over contiguous prairie habitat. Your statement that birds could move to and reside in CSSS-B, pre-supposes that those immigrating sparrows: (a) know that CSSS-B exists, (b) know which direction to fly to get there; (c) have the energetic resources to travel that distance, (d) will encounter suitable habitat, space, and forage conditions in CSSS-B, and probably most importantly, (e) that	Concur; the section has been rewritten to reflect our analysis.

	enough birds will make this journey to make a difference to the population's persistence. We recommend you base your analysis on likely effects of the project on the species of interest without drawing overly speculative conclusions from available sources.	
Page 100	The BA states "These areas [CSSS-F and CSSS-C] have a smaller population count than E, however, if birds from areas that are becoming too wet migrated towards B, F, and C, the populations may have a better chance of survival with increased subpopulation size." What evidence do you have to support this conclusion (is there available sparrow habitat that is not being utilized in F and C)?	Concur, the sentence has been deleted.
Page 100	Please also provide information that the likelihood that sparrow movement is a viable alternative to enhancement of habitat within the subpopulations as a means to improve subpopulation size and survival.	The paragraph has been revised based on this comment. Hydrologic restoration in areas that are too dry due to CEPP should enhance habitat outside the current subpopulations in which sparrows may colonize or be translocated.
Page101	Field research has shown that even though a 60-day dry period criterion is met, other conditions such as weather, temperature, food availability, etc. may delay the onset of breeding by up to a month. The 60-day criterion should be considered a minimum in terms of nesting condition availability. The CEPP modeling does not seem to indicate that water moves to the east as much as originally anticipated; therefore, please discuss the effects on CSSS-A of continued low numbers of years (22 out of 40) meeting the 60-day criterion in Indicator Region-A1 and the significant reduction to 25 years in Indicator Region-A2, in a subpopulation that at one time was the largest, and has been severely reduced since 1993 with no indication of meaningful recovery to date. Please also discuss the same for CSSS-D and E.	The 60-day dry period criterion is a FWS minimum length of time from the 1999 Jeopardy Opinion RPA. The discussion of the effect of continued low numbers was discussed in Section 6.2.8. A discussion of the modeling results for CSSS-A, D and E was added to Section 6.2.8.1.
Page 102. Table 6-6 through 6-9	It appears that the Corps used different locations (i.e., single gauge locations instead of the indicator regions we provided them) for this metric than were used for the hydroperiod	All the data that was post processed by the modelers was presented. The post-process data was not provided for the indicator regions as done for ET-2. The gages that were

	metric. The metrics should use the same indicator regions. Also, these tables contain a wealth of information on the potential length of CSSS breeding season. Although it is understood the PM-A metric was one tool to evaluate effects of the project on nesting, a more complete understanding of effects could be obtained by expanding the analysis to include consideration of multiple (2 or more) consecutive years meeting/not meeting the target in IR-A2, and an average continuous dry period over the period of record compared for each scenario (in the case of multiple days per year, use the largest number of contiguous days). This may indicate overall effects between the scenarios rather than just identifying years as red, yellow, or green. Also, in multiple consecutive wet (i.e., yellow or red) years, what operational flexibility is there in the system to potentially avoid cumulative impacts to sparrow habitat? Additionally, please describe the conditions in the 1990s that seem to result in more negative effects in CSSS sub populations A-2, E-1 and E-2.	analyzed were specific to where nesting occurred in 2013 as stated in the BA. To add consistency we have included the same gages that were presented in Figures 6-26 to 6-38 to the total number of dry day tables. Additional analysis was performed that determined the average continuous dry period over the period of record and was reported in Table 6-14. An additional discussion about those results was added to the PM-A discussion. A description of the conditions in the 1990s was added. Operational flexibility was added to the discussion.
Page 106. Ecological Target 2	Please discuss the potential effects of Ecological Target 2 analysis on the CSSS. This metric is the key indicator that affects the quality of habitat for sparrows. In every subpopulation except for A-1, this metric indicates a degraded condition with the project (and specifically in CSSS-E-1). In every subpopulation except B, this metric is met less than half the period of record (8 to 18 years). What have been and what will be the long term ramifications of this? There are much data available from the RSM model and post-processing, but very little of it was used in this analysis. An analysis of acreage changes by scenario should have been performed to quantify effects.	Additional RSM model and post processing was done and an additional table was added that compares the average annual hydroperiod over the POR. An additional discussion of the impacts was included. The Marl Prairie HSI described the spatial impacts in the section below the discussion of the ET-2 results.
Page 112. Marl Prairie Indicator	Given the availability of RSM post-processed data, the BA should include an analysis on the aerial extent of changes (acreages, distribution, location, etc.). The marl prairie	At the time of the BA submittal we did not have the marl prairie habitat suitability analysis from ENP. We received the finalized CEPP Marl Prairie Indicator write

	indicator shows a 50 percent reduction in the index for CSSS-A, 30 percent reduction for CSSS-D and E, 16 percent reduction for CSSS-F, 8 percent reduction for CSSS-B, with only a 19 percent increase in the indicator for CSSS-C one of the smallest subpopulations. What is your interpretation of these effects on the sparrow?	up on 26 August 2013. Compared to the existing conditions and FWO, differences in marl prairie habitat suitability within CSSS-B, CSSS-D, and CSSS-F for Alt 4R2 were decreased to a lesser extent as compared to CSSS-E. This section has been enhanced with a more appropriate summary based on this new information.
Page 112	The BA states that "differences in marl prairie habitat suitability within CSSS-B, CSSS-D, and CSSS-F for Alt 4R2 were minor." However, there are no values or statistics to back up that statement. There appears to be a 30 percent drop in habitat suitability in CSSS- D from the existing condition to Alt 4R2. Please explain how a 30 percent drop is a "minor" difference in habitat suitability for sparrows.	At the time of the BA submittal we did not have the marl prairie habitat suitability analysis from ENP. We received the finalized CEPP Marl Prairie Indicator write up on 26 August 2013. Compared to the existing conditions and FWO, differences in marl prairie habitat suitability within CSSS-B, CSSS-D, and CSSS-F for Alt 4R2 were decreased to a lesser extent as compared to CSSS-E. This section has been enhanced with a more appropriate summary based on this new information.
Page 114. Third paragraph	The BA states, "Further changes in operations that limit flows into ENP for protection of CSSS have the potential to limit CEPP benefits to the northern estuaries, WCA-3A, ENP, Florida Bay, the southwestern coastal estuaries, and other threatened and endangered species...." This statement is misleading in that it lacks definition of the "changes in operations" and quantification of flows that could actually reduce downstream benefits. It also does not recognize the level of uncertainty with the method used to calculate potential benefits. As written, it is an unfounded statement and should be either substantiated with evidence or removed from the BA.	FWS may request operational constraints but at this time have not been provided any proposed limits to evaluate. Without knowing the limits we are unable to quantify flows into ENP that would lessen the benefits of CEPP. The statement has been removed.
Page 114	The BA states " ...the action related hydrologic changes as compared to the existing conditions are expected to be minimal throughout much of CSSS habitat ...". Given the degree of negative effects indicated by the hydroperiod and marl prairie metrics, it is not apparent to the Service how the Corps reached this conclusion. Please explain.	Concur – the statement has been changed to adversely affect.

Page 117. 6.2.8.3.4 Hydrologic Regime-Nesting Criteria	It appears that the author has mixed the nesting and habitat performance measures and did not include an analysis of these criteria. Please do an analysis for this metric.	The two criteria used to assess the critical habitat were hydroperiod and the number of dry days during the nesting season. This has been clarified in the text of each critical habitat unit and the hydrologic conditions during the nesting season were added to each critical habitat unit.
Page 118. Section 6.2.8.4.4	Modeling seems to indicate the greatest potential for habitat change due to the CEPP will occur in CSSS-E. Please quantify the acreages and locations of where the altered hydroperiod will occur in CSSS-E. The result of this assessment will be a primary factor in determining adverse modification of critical habitat for CSSS.	Information from the finalized CEPP Marl Prairie Indicator write up indicate that marl prairie habitat suitability decreased in CSSS-E compared with the existing condition and FWO by 10% and 11% respectively. Notable changes occur along the eastern edge of SRS within the vicinity of CSSS-E. Figure 6-52 (Marl Prairie Habitat Suitability) depicts marl prairie habitat suitability for each RSM-GL cell within Critical Habitat Unit 4 (CSSS-E). This updated information has been added to Section 6.2.8.1 (Potential Effects on CSSS) and in Section 6.2.8.4.4 (Critical habitat Unit 4).
Page 119	The BA states, "The CEPP goal of increasing the hydroperiod throughout WCA 3A and ENP does not coincide with the hydroperiods needed to maintain a drier, marl prairie habitat that is necessary for the CSSS." This is an inappropriate statement in that it generalizes the CSSS's requirements (relative to the CEPP) and perpetuates inaccuracies to the reader that the CEPP and the existence of CSSS are in opposition. It is not just a question of water depth, but where, when, and how long that depth occurs. To say the CEPP "does not coincide" with the needs of the CSSS minimizes the efforts that the Service and the Corps have put forth over the last 15 years to shift flows from WCA-3A easterly and into Everglades National Park. The Corps' statement also presupposes a level of knowledge about the habitat, topography, CSSS population size, and overall uncertainty of the CEPP that is not demonstrated in the BA.	The sentence was deleted and the following sentence was added. "Since 1999, through deviations, IOP and ERTP, FWS has always maintained that moving water to the east through the historical flowpath into NESRS was the solution to improve nesting and habitat conditions for CSSS. However, RSM-GL model results indicate that although CEPP acts to restore the historical flowpath by shifting flows east through WCA-3A to WCA-3B and into NESRS, there are still adverse effects on eastern and western sparrow subpopulations."

Page 121. Conservation Measures	The BA identifies a number of CSSS conservation measures but does not indicate a willingness to implement them. Does the Corps intend to implement any or all of these measures as part of the proposed action?	We will negotiate mitigation measures based on a draft BO or prior to FWS finalizing the BO. We have Standard Protection Measures in place for construction and monitoring will be determined based on the BO.
Page 121. Conservation Measures	The BA states, "Additional monitoring of panthers should not be necessary due to use of the approved mitigation bank." We cannot agree to this statement at this time. It may be appropriate to use a proportional amount of CEPP funding to monitor panthers at Picayune in accordance with the amount of compensation. It is not acceptable to have no accounting of whether or not the panther credits "purchased" were maintained as anticipated in the original compensation agreement.	The analysis has been added to Section 6.2.5 and includes Table 6-2 that outlines the acres of panther habitat impacted by each CEPP feature, the zone of impacted lands and the panther habitat unit value. In order for the Corps to determine the appropriate number of PHU for mitigation, the Corps requests further information on PSRP Panther Mitigation Bank and methodology for determining number of credits necessary. Table 6-2 has been included with the appropriate acres and habitat unit values for each CEPP feature. The information/methodology provided in the 2009 PRSP BO is not readily discernible or sufficient to calculate units, thus the Corps has employed best professional judgment to calculate credits in Table 6-2. Therefore, based upon the Corps calculations in Table 6-2, it appears that no panther credits at PRSP will be necessary for CEPP; it is self-mitigating and will actually generate 49 additional credits. Based upon the 7 March 2013 letter from FWS to Florida Wildlife Federation, there are approximately 319,593 credits remaining at PSRP. However, please note that this figure includes 100,173 credits reserved for the EAA BO dated 4/14/06 (33,740 acres). The EAA Reservoir was never completed and a portion of that project (14,000 acres) will be used for the CEPP A-2 FEB. Therefore, the Corps requests that FWS remove the 100,173 EAA credits from the Panther Mitigation ledger. Monitoring will be determined based on the BO. The statement was deleted.
Page 123	The BA concludes, "Comparisons of existing conditions and the CEPP recommended plan (Section 6) show that some areas utilized by sparrows are slightly improved by CEPP implementation, while others remain the same or slightly	The purpose of the BA is to analyze the effect of the CEPP project. It is not under the purview of the Corps to analyze the decline of a species and the items required for recovery. There is a recovery plan for the CSSS that needs to be

	worse than existing conditions. Slight improvements to critical habitat areas in CSSS-A, CSSS-F, and CSSS-B (some metrics) could potentially provide the interim habitat needed to keep the CSSS population as is, with potential for physical habitat improvements as well." The Corps' analysis is not sufficient to support these conclusions. A more robust analysis is needed to provide a better understanding of the processes underlying the current decline of the species, actions needed for its recovery, and how the proposed project will interact with those.	implemented by FWS to answer the questions that are not under the purview of the Corps. The statements have been rewritten to state what is supported by the analysis that was conducted.

A.6 Endangered Species Act Biological Opinion

National Marine Fisheries Service provided the USACE with the Endangered Species Act Programmatic Biological Assessment for the Comprehensive Everglades Restoration Plan (CERP) on December 17, 2013 that included CEPP.

The Corps entered formal consultation with USFWS on the Everglade snail kite (*Rostrhamus sociablis plumbeus*), 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*). A Programmatic Biological Opinion (BO) was received on April 9, 2014, which clearly states that further consultation will be needed when more specific project details are finalized during PED. While this document does not authorize incidental take of three endangered avian species (CSSS, snail kite, and wood stork), it does describe the anticipated effects based on current information. Upon completing ESA Section 7 consultation for each PPA, USACE will undertake the agreed-to avoidance and minimization measures and implementing terms and conditions (TCs). When USACE is closer to constructing phases of CEPP that will affect listed species, FWS will provide separate consultation document(s) which may authorize incidental take, and provide applicable reasonable and prudent measures (RPMs) and TCs. The preliminary conclusion is that the proposed project is not likely to jeopardize the continued existence of the species listed above and are not likely to adversely modify critical habitat, where designated. The Programmatic Biological Opinion concurred on the Corps' determination of may affect, but is not likely to adversely affect 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* ssp. *deltoidea*), Garber's spurge (*Chamaesyce garberii*), Small's milkpea (*Galactia smallii*), and tiny polygala (*Polygala smallii*). Furthermore, the Service concurred 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.

Incidental take was not provided for the Everglade snail kite, the CSSS and the wood stork, however take is anticipated on these three species. Take will be enumerated when a final biological opinion is required for each phase of CEPP implementation. Incidental take of eastern indigo snake is likely during construction and operation, particularly construction of the A-2 FEB and the Miami Canal backfill. The amount of take includes 14,000 acres of the FEB currently in sugar cane and row crops that will become inundated and mostly unusable to indigo snakes. Up to 268 snakes could be harassed through being displaced as a result of the CEPP and up to two indigo snakes may be injured or killed (harmed).

Although the Programmatic Biological Opinion does not specify RPMs and TCs for the three avian species, endangered species monitoring costs include a conservative estimate of potential required monitoring based on information provided by USFWS to ensure the costs were captured. Estimated endangered species monitoring costs are $3,111,200 pre construction, $35,122,200 during the construction period and the O&M cost will be approximately $1,885,200 annually.

A.6.1 National Marine Fisheries Service Comprehensive Everglades Restoration Plan Endangered Species Act Programmatic Biological Opinion

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
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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.

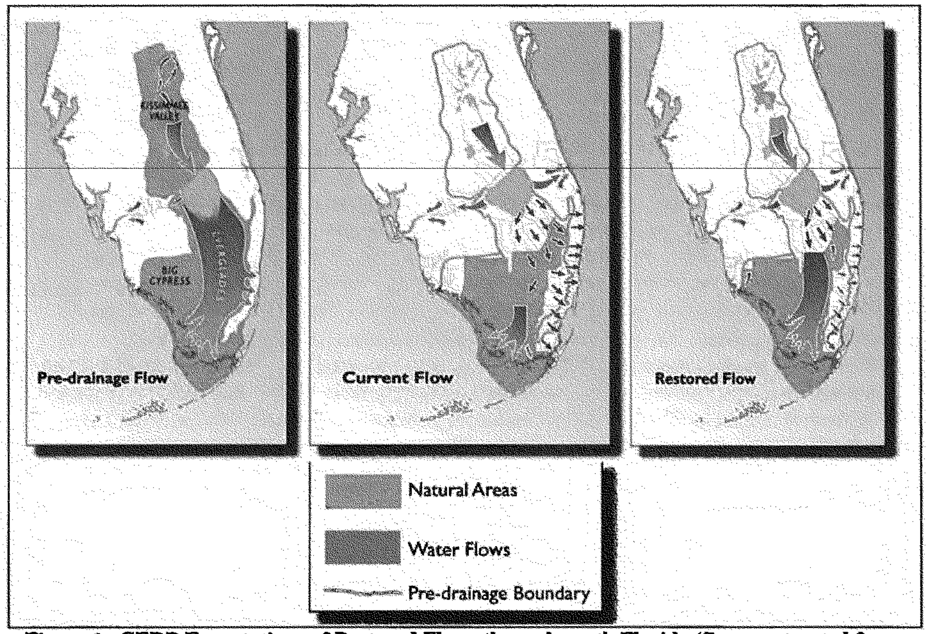


Figure 1. CERP Expectations of Restored Flows through south Florida (figure extracted from CEPP powerpoint presentations)

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.

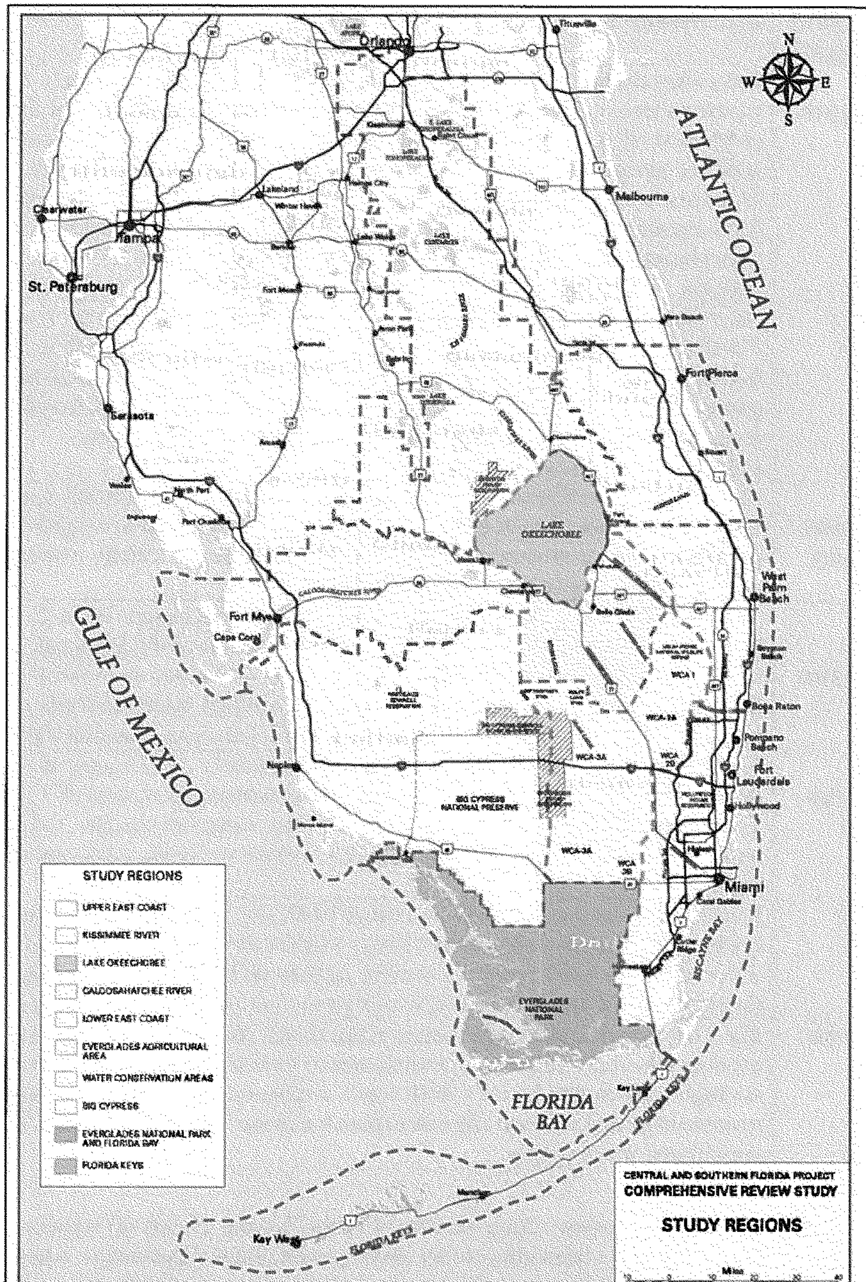


Figure 2. CERP Study Area

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.

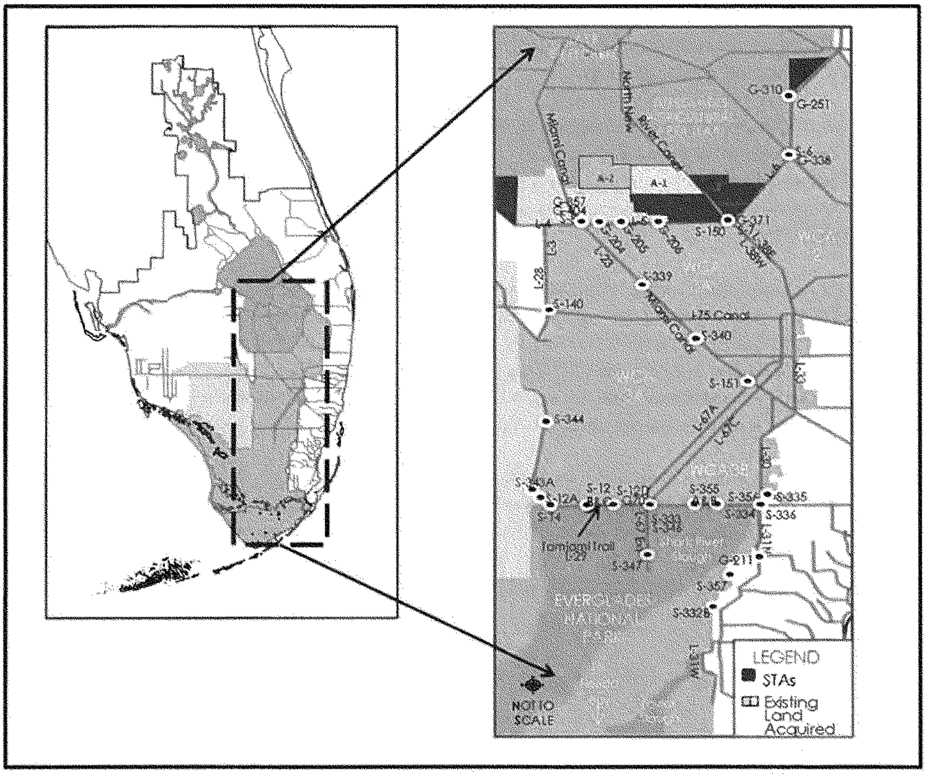


Figure 3. Current Structural Features in South Florida with Locations of EAA, WCAs, and ENP

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.

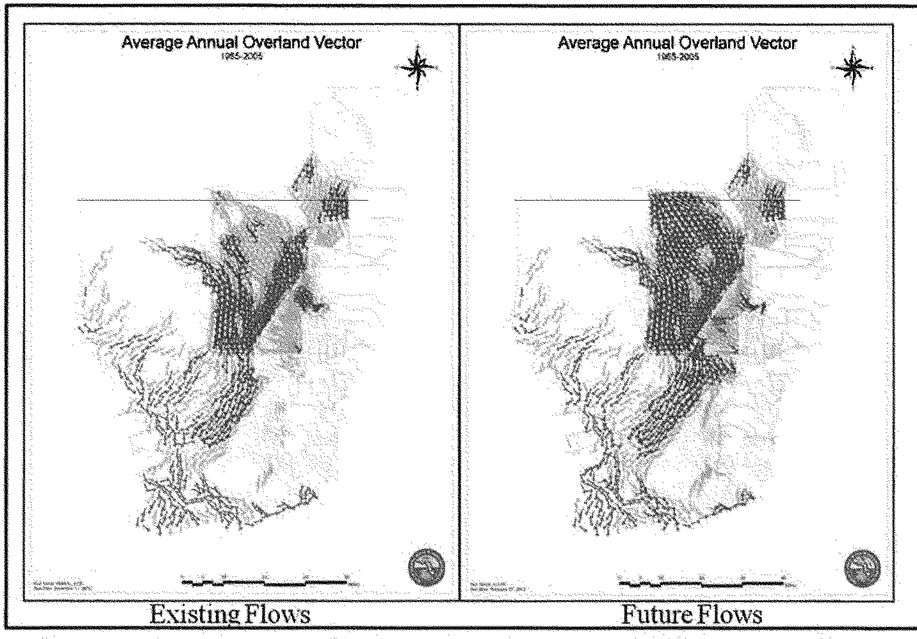


Figure 4. Existing and Future with Project Flows. Blue arrows indicate more water flowing throughout the areas. The box in Figure 2 depicts the same region shown in this figure. (Figure extracted from CEPP PIR/EIS Appendix G – Benefits Analysis)

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).

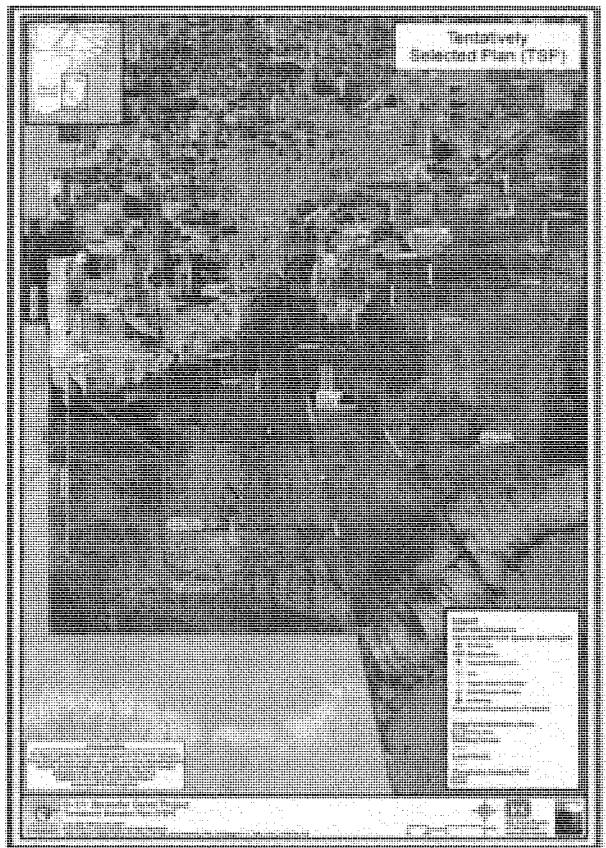


Figure 5. C-111 Spreader Canal Project Area

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.

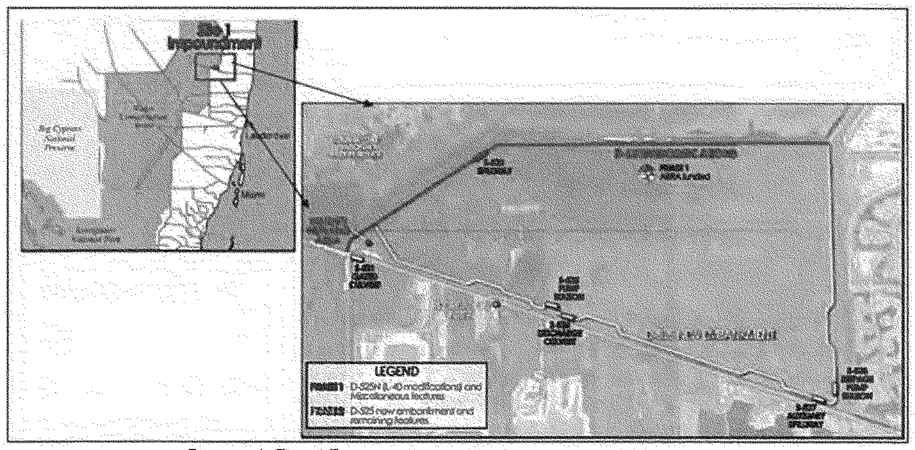


Figure 6. Site 1 Impoundment Project Area and Features

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).

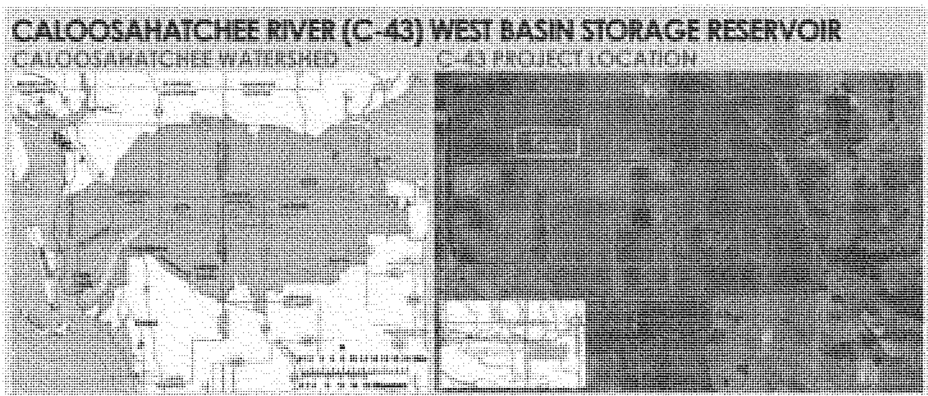


Figure 7. C-43 Project Location and Features

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).

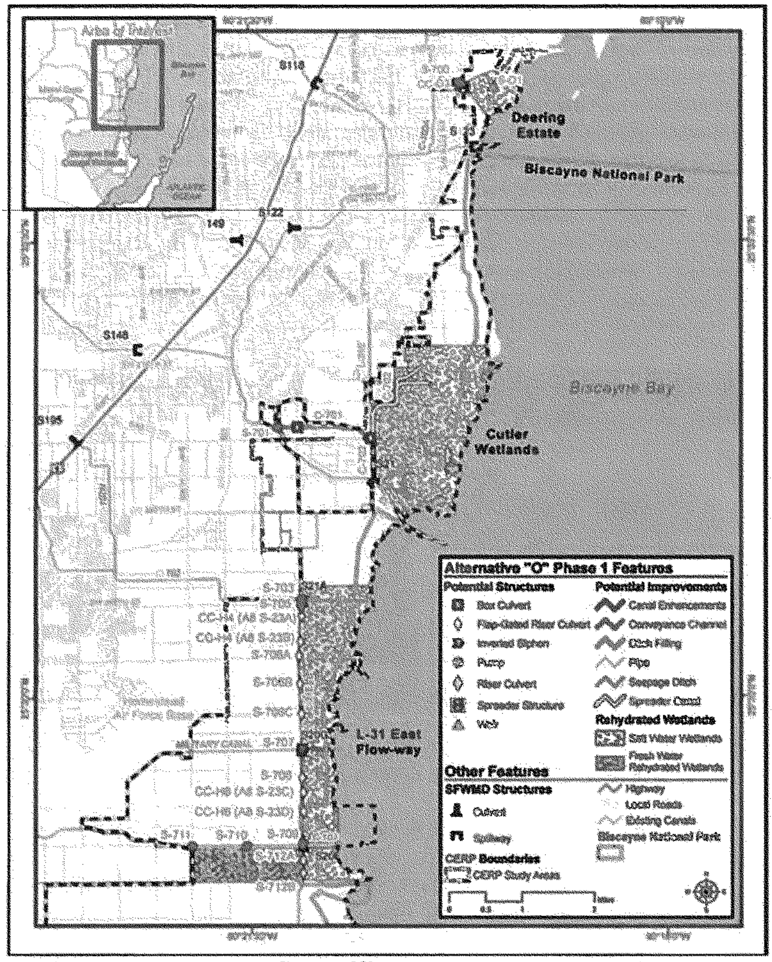


Figure 8. Biscayne Bay Coastal Wetlands Project Location and Features

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).

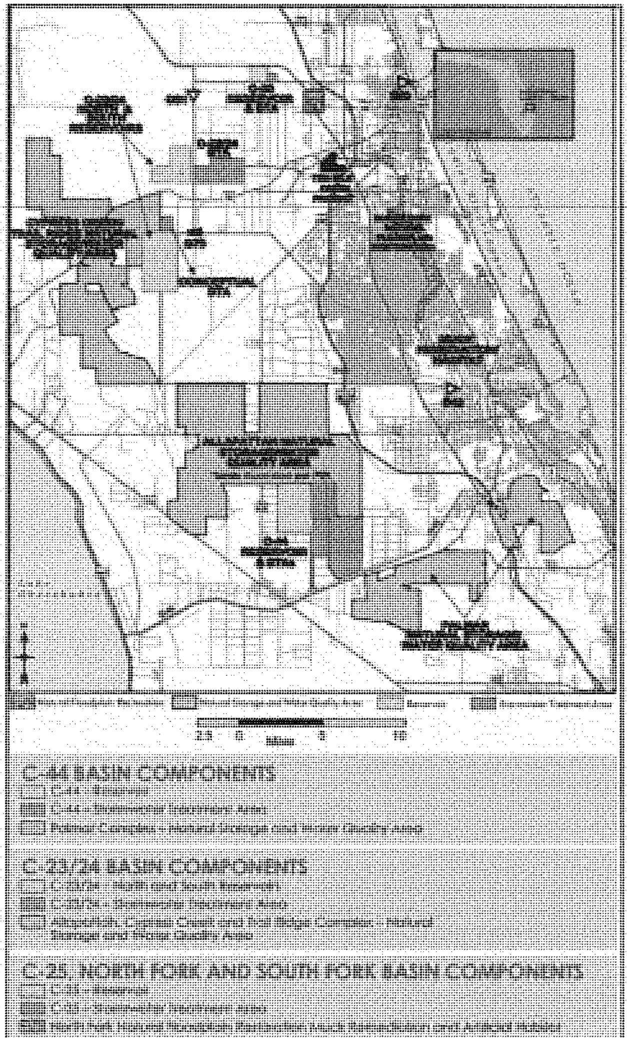


Figure 9. Indian River Lagoon South Project Location and Features

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.

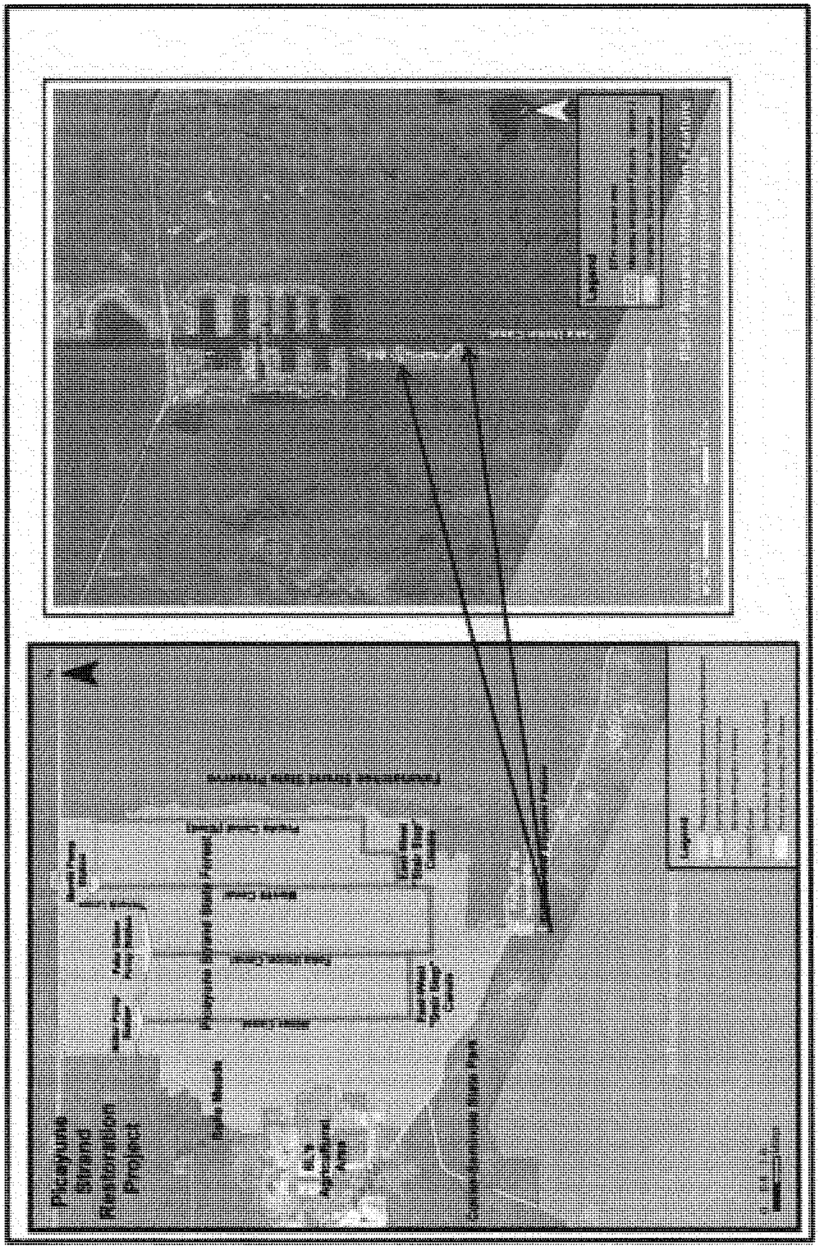


Figure 10. Picayune Strand Project Area and Potential Manatee Mitigation Feature with Smalltooth Sawfish Critical Habitat

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).

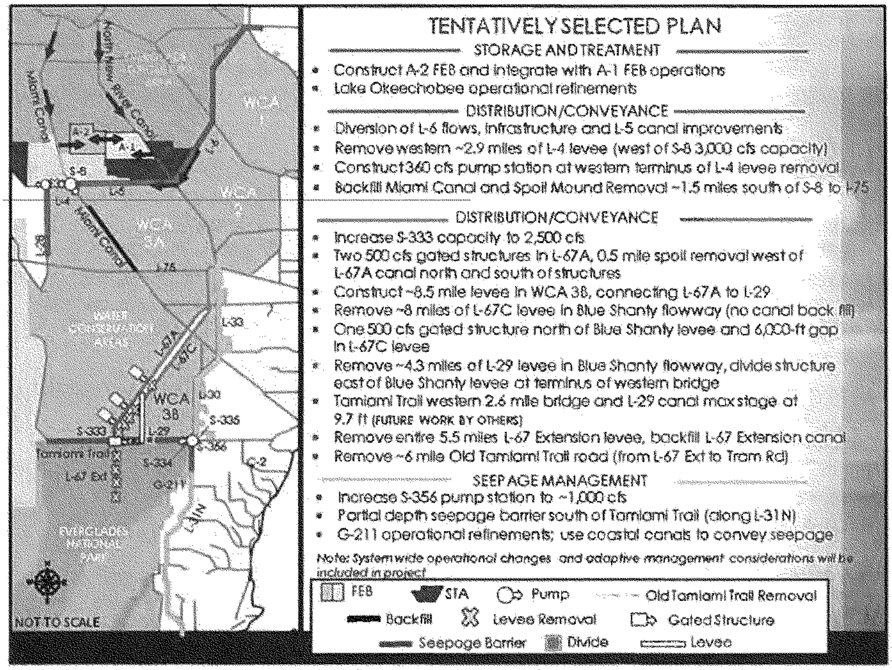


Figure 11. Central Everglades Planning Project Features

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).

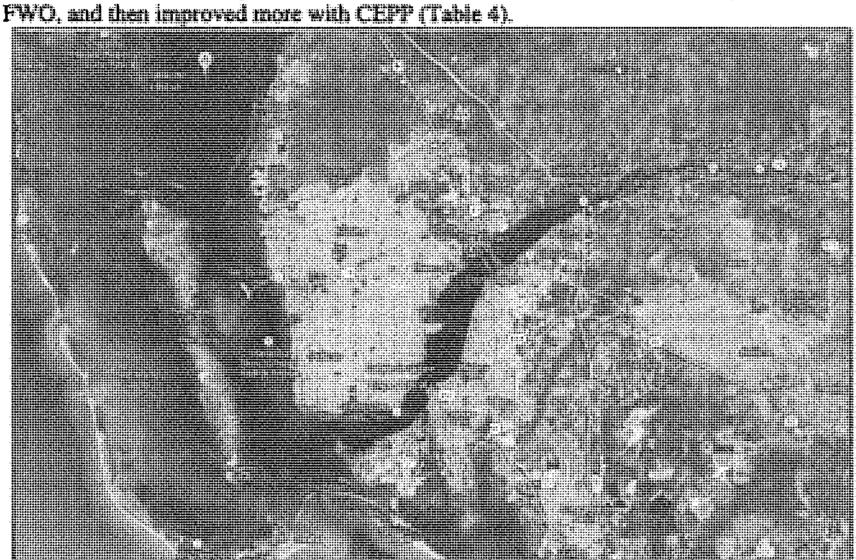


Figure 12. Salinity collection points in the Caloosahatchee Estuary used in CEPP Analysis. The red dots indicate where information was collected.

[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 0 3 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.

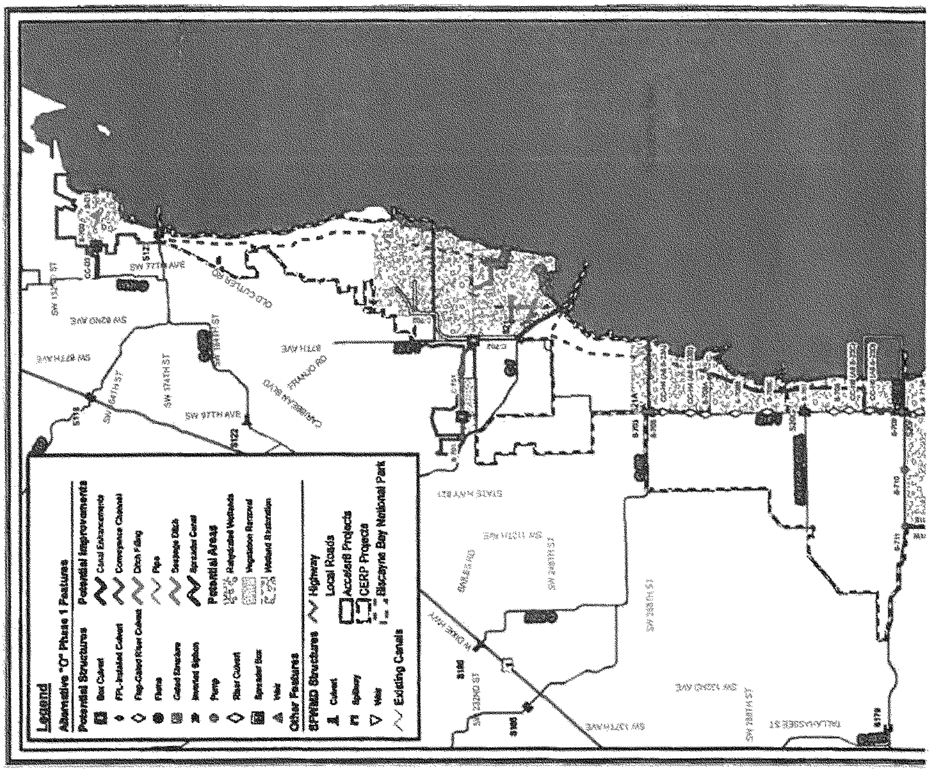
Sincerely,

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
Potential Improvements
Potential Areas
Other Features
SFWMD Structures
Highway
Local Roads
Acceler8 Projects
CERP Projects
Biscayne Bay National Park
Existing Canals
OLD CUTLER RD
STATE HWY 821

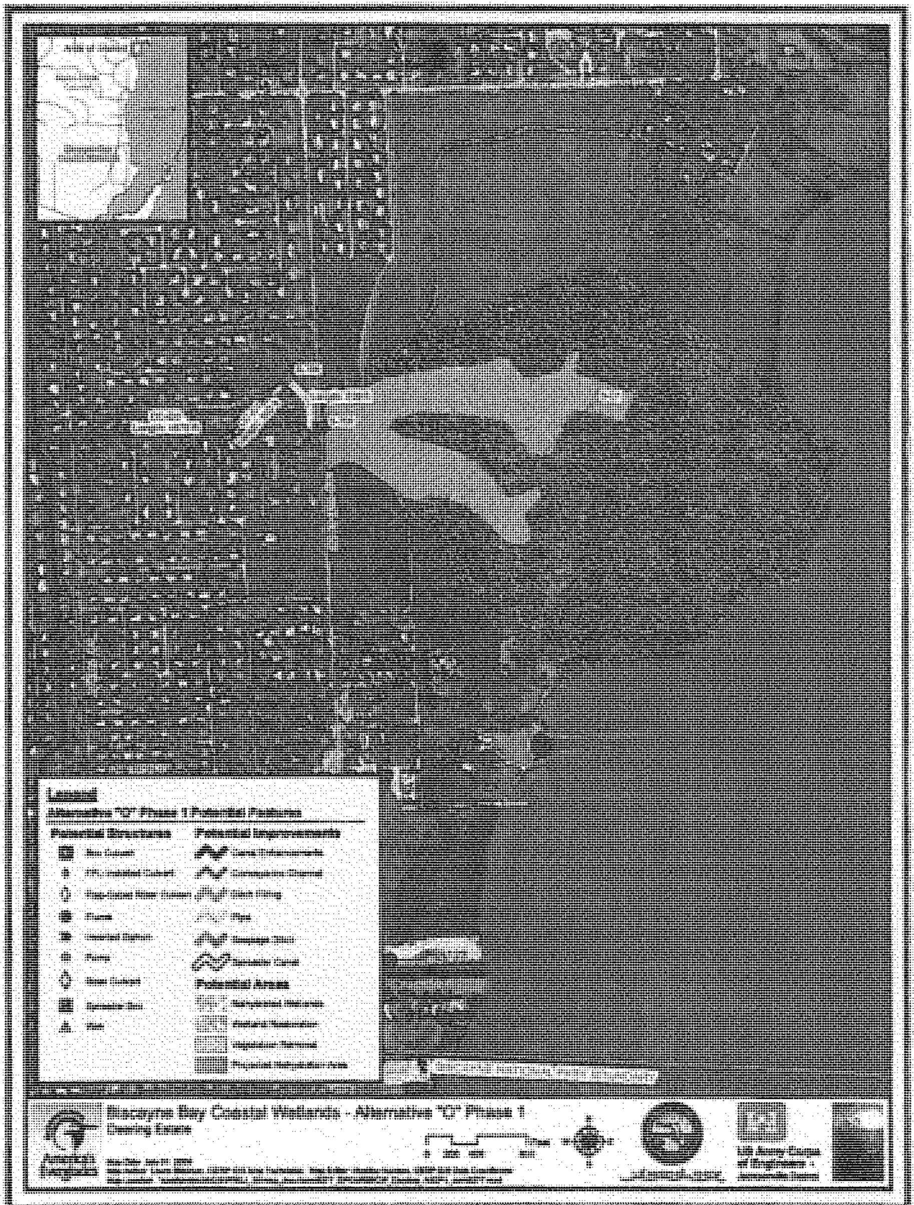


FIGURE A4-2: BISCAYNE BAY COASTAL WETLANDS DEERING ESTATE

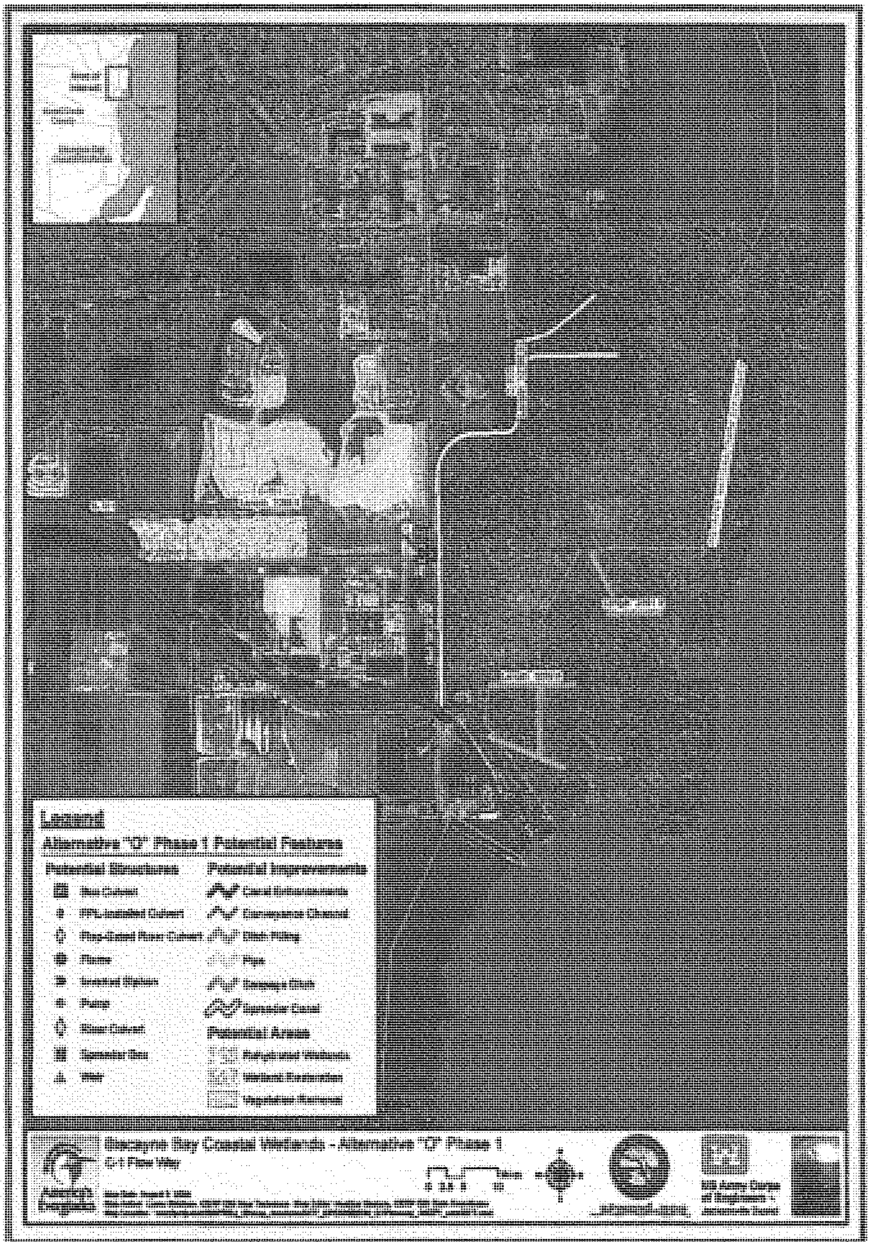


FIGURE A4-3: BISCAYNE BAY COASTAL WETLANDS C-1 FLOW WAY

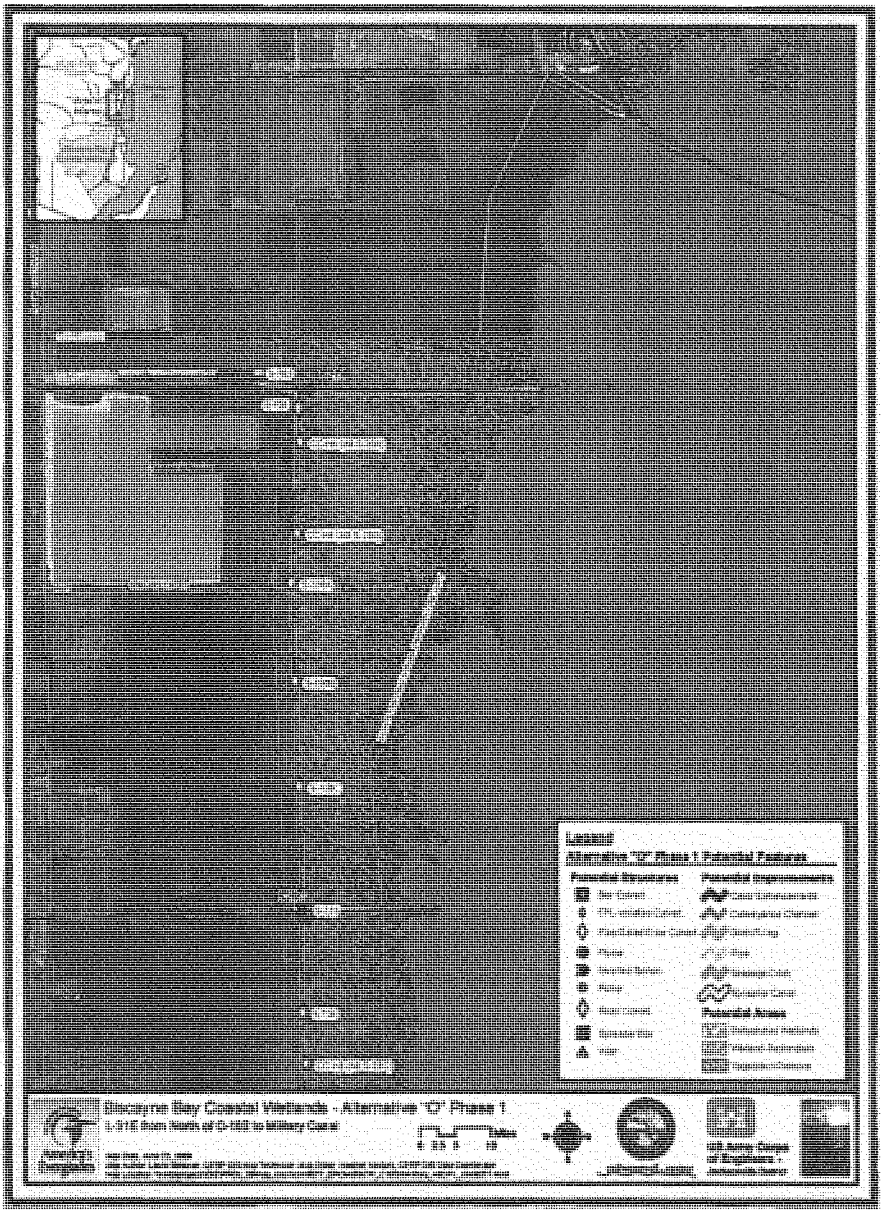


FIGURE A4-4: BISCAYNE BAY COASTAL WETLANDS L-31 FROM NORTH OF C-102 TO MILITARY CANAL

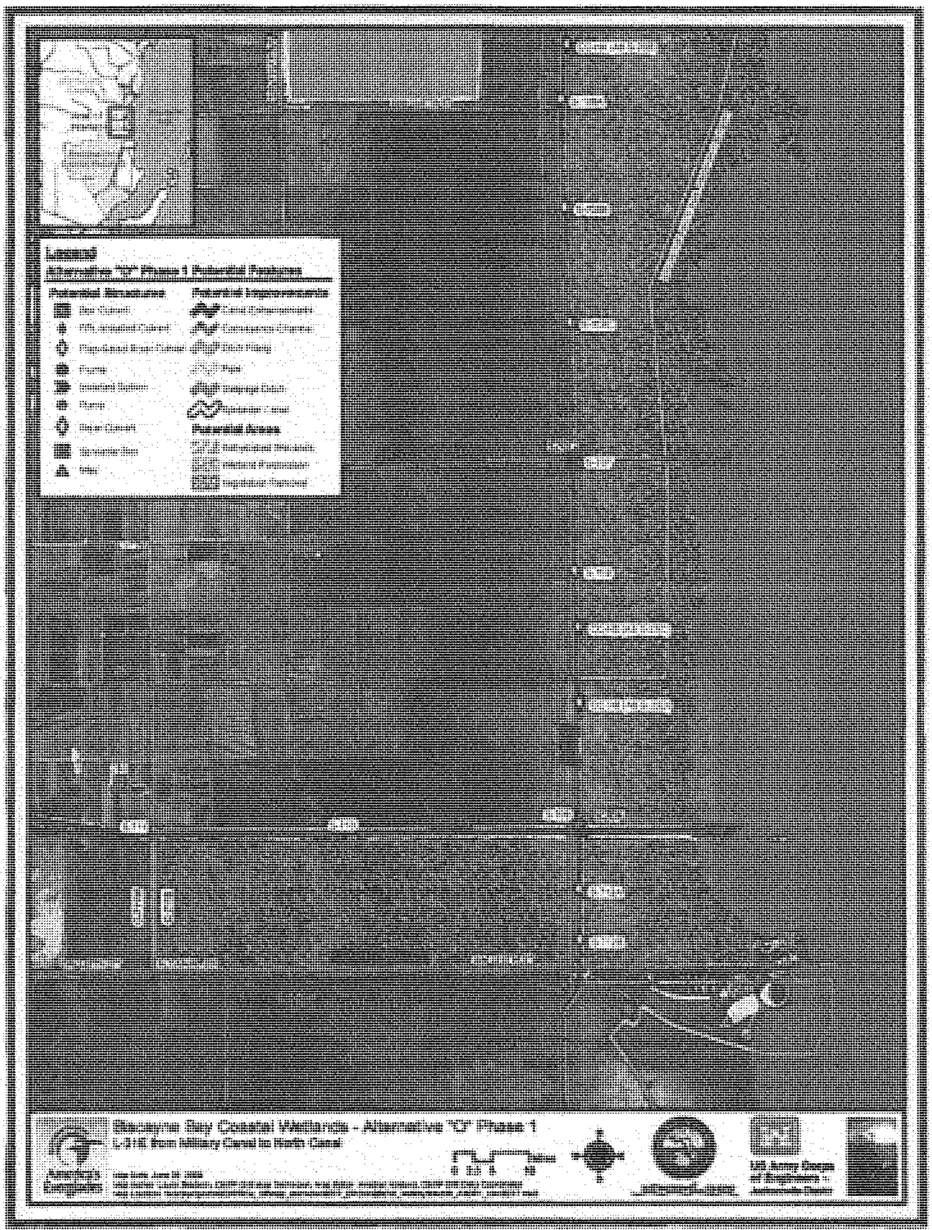


FIGURE A4-5: BISCAYNE BAY COASTAL WETLANDS L-31E FROM MILITARY CANAL TO NORTH CANAL

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.
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> 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:

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> 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
>
>

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> 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

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,

Roy D. Crabtree

for, Joseph E. Powers, Ph.D.
Acting Regional Administrator

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,

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)
District, West Palm Beach, Florida (Matthew Morrison)
DOI, West Palm Beach, Florida (Shannon Estenoz)
ENP, Homestead, Florida (Tylan Dean)
DEP, West Palm Beach, Florida (Inger Hanson)
FWC, West Palm Beach, Florida (Barron Moody)
NOAA Fisheries, Miami, Florida (Dr. Joan Browder)
Service, Atlanta, Georgia (David Horning)
SOL/DOI, Atlanta, Georgia (Michael Stevens)

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

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LIST OF FIGURES

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LIST OF ACRONYMS

ac-ft	Acre-feet
ABS	Archbold Biological Station
Act	Endangered Species Act
Alt	Alternative
AM	Adaptive Management
AMO	Atlantic Multi-decadal Oscillation
BA	Biological Assessment
BICY	Big Cypress National Preserve
ERTP	Everglades Restoration Transition Plan
C-111SC	C-111 Spreader Canal
C&SF	Central and Southern Florida Project
cm	Centimeter
CEPP	Central Everglades Planning Project
CERP	Comprehensive Everglades Restoration Plan
CMP	Comprehensive Management Plan
Corps	U.S. Army Corps of Engineers
CSRS	Central Shark River Slough
CSSS	Cape Sable Seaside Sparrow
District	South Florida Water Management District
EAA	Everglades Agricultural Area
ECB	Existing Conditions Baseline
ENP	Everglades National Park
ERTP	Everglades Restoration Transition Plan
ET	Ecological Targets
FEB	Flow Equalization Basin
FWC	Florida Fish and Wildlife Conservation Commission
FWO	Future Without Project
GIS	Geographic Information System
HSI	Habitat Suitability Indices
HU	Habitat Unit
IPCC	Intergovernmental Panel on Climate Change
IOP	Interim Operational Plan
IRL	Indian River Lagoon
ISOP	Interim Structural and Operational Plan
KCOL	Kissimmee Chain of Lakes
kg	kilogram
km	kilometer
NESRS	Northeast Shark River Slough
NGVD	National Geodetic Vertical Datum
NSM	Natural System Model
NWR	National Wildlife Refuge
PAL	Planning Aid Letter
PCE	Primary Constituent Elements
PHU	Panther habitat unit

LIST OF ACRONYMS (continued)

PM	Performance Measure
POR	Period of Record
PIR	Project Implementation Report
PVA	Population viability analysis
RAI	Request for Additional Information
ROD	Record of Decision
RPM	Reasonable and Prudent Measures
RSM	Regional Simulation Model
RSM-BN	Regional Simulation Model for Basins
SDCS	South Dade Conveyance System
SEI	Sustainable Ecosystems Institute
Service	U.S. Fish and Wildlife Service
SFESO	South Florida Ecological Services Office
STA	Stormwater Treatment Area
SRS	Shark River Slough
T&E	Threaten and Endangered Species
TC	Terms and Conditions
TSP	Tentatively Selected Plan
WCA	Water Conservation Area
WRDA	Water Resources Development Act
WSRS	Western Shark River Slough

PROJECT UNCERTAINTIES

The Service is providing the U.S. Army Corps of Engineers (Corps) with a Programmatic Biological Opinion with no enumeration of take for three key avian species (Cape Sable seaside sparrow (CSSS) [*Ammodramus maritimus mirabilis*], Everglade snail kite [*Rostrhamus sociabilis*], and wood stork [*Mycteria Americana*]), at the present time, due to numerous project uncertainties. Chief among the project uncertainties that affects the U.S. Fish and Wildlife Service's (Service) ability to provide a final analysis for all affected species is the project implementation schedule. Although the project was planned as a single stand-alone action it must be constructed in phases because of cost and sheer geographic scope. There is considerable uncertainty as to when and how certain aspects of the project will be built, and when they will begin to affect listed species in the study area. Factors complicating the schedule timeline include uncertainty as to when the project will be authorized and several predecessor projects that must be completed prior to the beginning of Central Everglade Planning Project (CEPP) construction. These include the A-1 Flow Equalization Basin (FEB) and the State's Restoration Strategies Project which addresses water quality issues and must be monitored for at least 5 years post completion to ensure compliance. This project has been estimated to be completed in 2029, however, estimates are unsure and it is unclear which parts of CEPP (if any) can proceed in the interim. A complete list of Non-CEPP Project Dependencies can be found in the Project Implementation Report (PIR) (Corps 2013) but others include: water quality compliance; 8.5 Square Mile Area and existing S-356 and C-111 South Dade; Modified Water Deliveries 1-Mile Bridge and Road Raising; Broward County Water Preserve Areas C-11 Impoundment; Tamiami Trail: Next Steps Bridging and Road Raising; Indian River Lagoon (IRL) South C-44 Reservoir; and Lake Okeechobee Regulation Schedule Revisions.

These uncertainties coupled with the 'high level' hydrologic modeling provided for CEPP and absence of a detailed operating plan give the Service concern in providing the Corps with a level of anticipated take. Many things will likely change between now and the time when projects are built and begin to affect species. The Service fully supports the project and is convinced that a slow transition into the project will be beneficial for all species.

CONSULTATION HISTORY

The Service and Corps have consulted on many actions in the project area, dating back to 1983, that are in many cases directly applicable to the current consultation. In order to keep this document shorter in length, the reader may review an extended consultation history in the *Everglades Restoration Transition Plan* (ERTP) Biological Opinion (Service 2010a). The following history pertains only to the CEPP, but does not constitute an exhaustive list of all meetings and correspondence.

The Service has been engaged in early informal consultation on CEPP since the first, of many meetings, which took place on **November 15, 2011**. This was a unique meeting for Everglade's restoration projects in that it was a Risk Registry Workshop, at which, the Corps solicited comments and concerns from the Project Delivery Team (PDT) regarding the new 18-month planning process that would be implemented for CEPP. Among other comments, the Service expressed concern that there may not be adequate time for a thorough regulatory review which, unlike the Corps process, would not be legally streamlined for this project. Concern was also expressed that the new "modeling paradigm" which was going to be implemented by the South Florida Water Management District (District) could impede or slow down the evaluation process that agencies and stakeholders throughout the project area had used for past projects. Lastly, the Service expressed concern that the shear scope of the project, and high level of planning, may not provide the detail necessary to complete a full and detailed regulatory review.

On **January 20, 2012**, the Service provided its first Planning Aid Letter (PAL) which covered the project goals and objectives, management actions that should be considered, as well as information regarding ecological performance measures (PM) including those for Threatened and Endangered (T&E) species.

On **February 27, 2012**, staff from the Corps, District, and Service met in Vero Beach to discuss the new modeling paradigm and potential performance measures (PM) to use for T&E species and other natural resources in CEPP. It was not clear at that time exactly how the project would be modeled but all parties agreed that the ERTP performance metrics should be used when possible. It should be noted here that the ERTP metrics were not used in conjunction with an established system-wide hydrologic model during ERTP and would need to be coded and refined during the CEPP process for use with the new Regional Simulation Model (RSM). The subsequent model output produced by the RSM, and post-processed by the new PM's, was completely different from that produced during any prior project and necessitated a steep learning curve to comprehend.

March 27, 2012. The Service submitted a second PAL which covered parts of the planning process such as management measure screening, alternative formulation, modeling strategy, and natural resource considerations including targets for T&E species.

On **July 19, 2012**, the Service provided a write-up which outlined indicator regions which should be used to evaluate model output in CSSS. Preliminary modeling was using individual gauge locations which were not adequately covering the spatial extent of CSSS.

At the **August 14, 2012**, PDT meeting, the Service presented background information on the CSSS and preliminary modeling results. The Service expressed to the team that the preliminary CSSS modeling, which utilized 0, 25, 50, 75 and 100 percent of pre-drainage Natural System Model (NSM) flow was not adequate for evaluating project effects to CSSS. We also expressed concern that we were running out of time without having adequately evaluated the lower part of the CEPP action area (below the red line) where a majority of listed species would be affected.

On **December 12, 2012**, the Service submitted its third PAL which provided input on the conceptual design and modeling of the final array of alternatives.

On **January 21, 2013**, the Service received a request from the Corps for confirmation of federally-listed species and their designated critical habitat and candidate species likely to be present in the study area for the CEPP.

On **January 25, 2013**, the Service presented to the PDT, a preliminary threatened and endangered species analysis. In it, the Service concluded that some of the PMs were not working as intended and that CSSS PMs were indicating impacts to CSSS-E and little benefit to CSSS-A. Other more detailed analyses were being planned and executed for the final consultation. At this time, work began to assemble a list of monitoring and research projects that could be implemented to avoid, reduce or mitigate for impacts to CSSS.

During the Corps value engineering week long workshop, the Service submitted a white paper titled "Draft Guidelines for Water Management in WCA-2A" on **February 8, 2013**. The white paper provided the modelers and water managers with ecological targets (ET) and a draft stage hydrograph that more closely resembles an environmentally preferred water management strategy for Water Conservation Area (WCA) 2A. This white paper was coordinated between the Service and Florida Fish and Wildlife Conservation Commission (FWC).

By letter dated **May 10, 2013**, the Service provided the complete species list and accompanying designated critical habitat maps which concluded the statutory requirements set forth in 50 CFR §402.12(d) of the Act. As additional information, the Service provided the Corps with updated maps for known wood stork and Everglades snail kite nests, Florida panther (*Puma concolor coryi*) telemetry locations, and bald eagle (*Haliaeetus leucocephalus*) and Audubon's crested caracara (*Polyborus plancus audubonii*) nests in the CEPP study area.

On **May 17, 2013**, via email, the Corps submitted a Draft Biological Assessment (BA), cover letter and appendix B for CEPP.

On **June 3, 2013**, via email, the Service submitted comments to the Corps on the Draft BA. This was an intensive review and the Service offered many comments and suggestions to improve the BA.

On **June 25, 2013**, Service staff travelled to West Palm Beach to brief the Chief of Everglades Restoration for the Department of the Interior on CEPP impacts to CSSS and other natural resources.

On **July 18, 2013**, Service staff briefed the Service's Regional Director on CEPP impacts to CSSS and other natural resources.

On **July 23, 2013**, Service staff briefed the Assistant Secretary for Fish, Wildlife and Parks of the Department of the Interior on CEPP impacts to CSSS and other natural resources.

On **August 5, 2013**, the Service received the Corps' signed BA for CEPP. The Service reviewed this letter and prepared a Request for Additional Information (RAI).

On **September 5, 2013**, the Service sent the Corps a letter RAI regarding CEPP project effects. The Service asked the Corps to submit a revised BA with the additional information and other revisions not previously made.

On **October 24, 2013**, in response to the Service's RAI, the Corps provided a comment matrix and Supplemental Technical Assessment but no revised BA. The Service deemed this new information, as complete as possible, and started the 135 day "clock" to complete section 7 consultation. However, the Corps has requested that a consultation document be provided on December 17, 2013, to fit their critical path schedule, to which the Service has agreed. This, in effect, will give the Service 54 days to prepare the document.

On **December 3, 2013**, the Service, Corps, and District staff convened a webinar to discuss expectations regarding section 7 consultation. The Service agreed to provide a consultation document by the requested deadline of December 17; however, it would be preliminary at this time and not provide the Corps with an exemption for taking threatened or endangered species.

The Corps further refined these determinations and requested formal consultation on the CSSS, Everglade snail kite, wood stork, Florida panther, and eastern indigo snake. The Corps requested informal consultation on the American crocodile, Florida manatee, deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala.

On **December 3, 2013**, the Corps provided a "no effect" determination via email for the newly proposed endangered Florida semaphore cactus.

On **December 13, 2013**, the Corps provided a letter changing the request for Formal Consultation to a request for Early Consultation. This was mutually agreed to at a meeting held on November 12, 2013, as a way for the parties to proceed with a Preliminary Biological Opinion that is currently being revised as a Programmatic Biological Opinion.

As of **October 24, 2013**, we received enough information for initiation of formal consultation on the Everglade snail kite, CSSS, wood stork, and eastern indigo snake for this project; however, due to the level of project uncertainty, we have not received sufficient information to complete formal consultation for three avian species. The Service is providing this Programmatic Biological Opinion to the Corps with intent to conclude formal consultation for the three avian species in the future when sufficient details become available.

On **February 25, 2014**, a briefing was held in Washington, D.C., which was attended by several members of the Corps and Service's vertical chain to discuss a path forward to achieve Congressional authorization of the CEPP Project. It was determined at this meeting that the Service's Preliminary Biological Opinion would be revised as a Programmatic Biological Opinion; however, there would still be no authorization of incidental take for three avian species (CSSS, snail kite, wood stork) due to project uncertainties. Some of the Terms and Conditions (TCs) previously included in the document would be moved to Conservation Recommendations.

On **April 7, 2014**, a webinar/conference call was held among the Corps, DOI, and FWS to discuss the Programmatic Biological Opinion and whether additional refinements to the Programmatic Biological Opinion were appropriate. During the discussion, the agencies recognized that there was not enough detailed information for the FWS to anticipate the amount or extent of incidental take that may occur for the three avian species (CSSS, Everglade snail kite, and wood stork). Therefore, RPMs and TCs could not be appropriately identified at this time and the originally proposed RPMs and TCs for the CSSS, Everglade snail kite, and wood stork should be removed from the document. Two Conservation Recommendations were also removed because of lack of detailed information. Other revisions were also made to indicate that ESA consultation would be completed when more project details were determined.

Project Location and Species Effects Determinations

The CEPP study area covers a large geographic extent and includes multiple counties in south Florida. General geographic areas contained within the study area include the Saint Lucie Estuary, Caloosahatchee Estuary, Lake Okeechobee, Everglades Agricultural Area (EAA), Greater Everglades, Everglades National Park (ENP), and the southern estuaries Biscayne Bay and Florida Bay. The study area can be found in Figure 1.

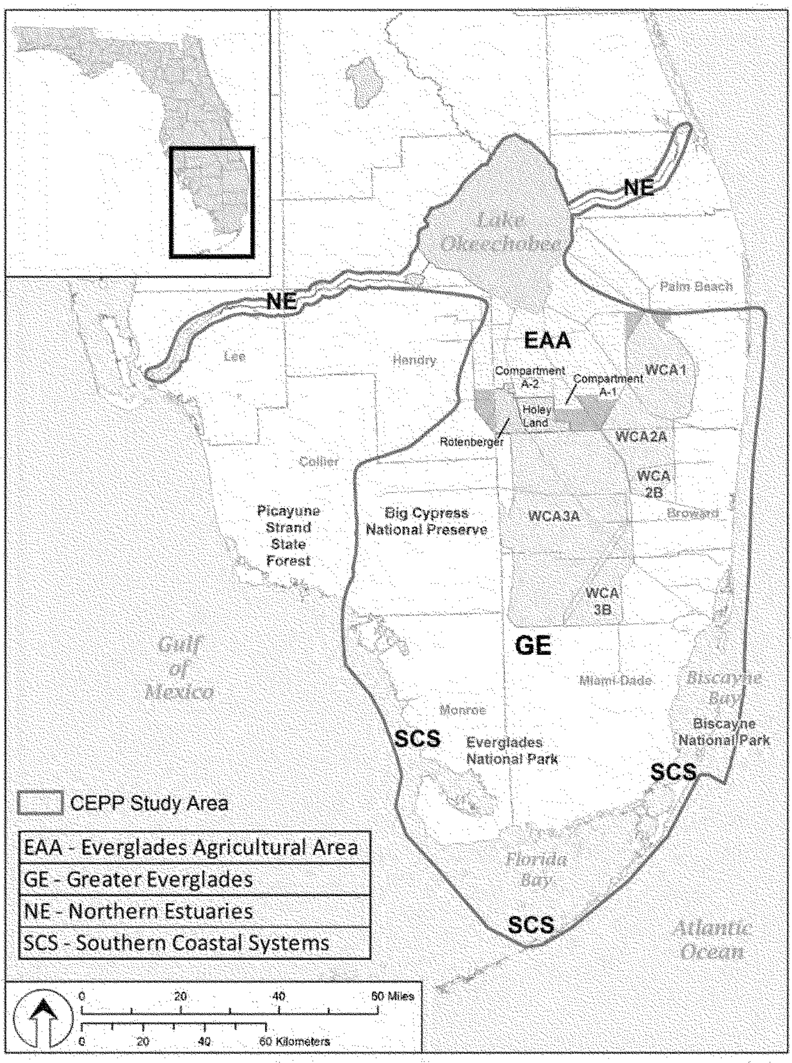

Figure 1. Major watersheds and geographic areas within the CEPP study area.

The Corps' BA described the potential effects of the proposed CEPP Project on federally-listed threatened and endangered species, and provided the effect determinations for these species which is presented in Table1.

Table 1. The Corps' effect determinations of the CEPP on federally-listed species and critical habitats.

	Common Name	Scientific Name	Status*	Determination
Mammals	Florida bonneted bat	*Eumops floridanus*	E	No Effect
	Florida panther	*Puma concolor coryi*	E	May Affect
	Florida manatee	*Trichechus manatus latirostris*	E, CH	May Affect
Birds	Cape Sable Seaside Sparrow	*Ammodramus maritimus mirabilis*	E, CH	May Affect
	Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	May Affect
	Northern crested caracara	*Caracara cheriway*	T	No Effect
	Piping Plover	*Charadrius melodus*	T	No Effect
	Red-cockaded woodpecker	*Picoides borealis*	E	No Effect
	Roseate tern	*Sterna dougallii dougallii*	T	No Effect
	Wood stork	*Mycteria americana*	E	May Effect
Reptiles	American alligator	*Alligator mississippiensis*	T/SA	May Effect
	American crocodile	*Crocodylus acutus*	T,CH	May Effect
	Eastern indigo snake	*Drymarchon corais couperi*	T	May Effect
	Gopher tortoise	*Gopherus polyphemus*	C	
Invertebrates	Bartram's hairstreak butterfly	*Strymon acis bartrami*	C	No Effect
	Florida leafwing butterfly	*Anaea troglodyta floridalis*	C	No Effect
	Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	No Effect
	Stock Island tree snail	*Orthalicus reses* (not incl. nesodryas)	T	No Effect
	Miami blue butterfly	*Cyclargus thomasi bethunebakeri*	E	No Effect
Plants	Beach jacquemonia	*Jacquemontia reclinata*	E	No Effect
	Big pine partridge pea	*Chamaecrista* var. *keyensis*	C	No Effect
	Blodgett's silverbush	*Argythamnia blodgettii*	C	No Effect
	Cape Sable thoroughwort	*Chromolaena frustrata*	PrE, PrCH	No Effect
	Carter's small-flowered flax	*Linum carteri* var. *carteri*	C	No Effect
	Crenulate lead plant	*Amorpha crenulata*	E	No Effect
	Deltoid spurge	*Chamaesyce deltoidea spp. deltoidea* *Sideroxylon reclinatum spp.*	E	May Affect
	Florida brickell-bush	*Brickellia mosieri*	C	No Effect
	Florida bristle fern	*Trichomanes punctatum spp. floridanum*	C	No Effect
	Florida pineland crabgrass	*Digitaria pauciflora*	C	No Effect
	Florida prairie-clover	*Dalea carthagenensis* var. *floridana*	C	No Effect
	Florida semaphore cactus	*Consolea corallicola*	PrE	No Effect
	Garber's spurge	*Chamaesyce garberi*	T	May Affect
	Florida pineland crabgrass	*Digitaria pauciflora*	C	No Effect
	Okeechobee gourd	*Cucurbita okeechobeensis ssp. okeechobeenis*	E	No Effect
	Pineland sandmat	*Chamaesyce deltoidea spp. pinetorum*	C	No Effect
	Sand flax	*Linum arenicola*	C	No Effect
	Small's milkpea	*Galactia smallii*	E	May Affect
	Tiny polygala	*Polygala smallii*	E	May Affect

*Status Codes: E= Endangered, T=Threatened, T/SA=Threatened Similar Appearance, C= Candidate, CH=Critical Habitat, PrE=Proposed Endangered; PrCH=Proposed Critical Habitat.

INFORMAL CONSULTATION

The following section pertains to the seven federally listed threatened or endangered species for which the Corps provided an effect determination of "may affect" but for which they did not request formal consultation. For these species, consultation was informal in that adverse effects are not anticipated, based on current information.

Florida Panther

Florida panthers have used, and are likely to continue to use, the action area as portions of home ranges, or for dispersal. Panthers do not use the open water areas of the WCA and ENP on a regular basis. They may, during periods of low water, hunt on tree islands where prey may be present. They have been documented crossing Shark River Slough (SRS) as well, but primarily use the higher elevations within ENP. The Corps has indicated that CEPP will increase hydroperiods in WCA-3 and ENP. This increase in hydroperiod is unlikely to significantly affect the higher elevations used by panthers.

For the purposes of CEPP, the primary effect to the Florida panther is through habitat loss from the construction of the A-2 FEB. The effects of the A-2 FEB are expected to occur at the time of construction. These effects may include: (1) permanent loss and fragmentation of panther habitat (including habitat for feeding, breeding, and dispersing); (2) permanent loss and fragmentation of habitat that supports prey; (3) reduction in the geographic distribution of habitat; (4) harassment due to construction activities; and (5) enhancement, restoration and preservation of habitat resulting from habitat compensation. Indirect effects of the action potentially include: (1) increased risk of roadway mortality due to increases in vehicular traffic; (2) increased disturbance to panthers and prey due to human recreational activities; (3) reduction in panther prey; (4) reduction in the value of adjacent habitat due to habitat fragmentation; and (5) potential increase in intraspecific aggression due to reduction of the geographic distribution of habitat.

As stated in our September 6, 2013, Biological Opinion amendment for the A-1 FEB, radio-collared panthers have not been located on the A-2 FEB site. Within 25 miles of the site, there were 1,188 panther telemetry locations between February 2006 and April 2012 with the closest occurrence approximately 12 miles from the project footprint. Fifteen Florida panther deaths occurred within a 25-mile buffer from January 2006 through 2013, with the closest death being 16.5 miles from the project site. Three Florida panther sightings were reported within 25 miles of the proposed project site between 2006 and 2012, with the closest sighting approximately 17 miles from the project footprint. Only one of these sightings was confirmed. Between 2006 and 2012, three dens were documented within the 25-mile buffer at approximately 20, 21.5 and 25 miles from the project footprint.

The A-2 FEB is a component of CEPP. The A-1 and A-2 FEBs are located on the same footprint as the formerly proposed A-1 reservoir. The original A-1 Reservoir included 2 cells. Cell 1 became the A-1 FEB and Cell 2 will become the A-2 FEB, according to the CEPP project description. The A-2 FEB will cover approximately 14,000 acres. Effects to the Florida panther from the A-1 FEB were addressed in our April 14, 2006, Biological Opinion for the A-1 Reservoir. Using the Service's Panther Compensation Calculator and assuming the A-2 FEB would provide no habitat benefits, which is the worst case scenario, construction of the A-2 FEB would require 46,290 Panther habitat units (PHU) to compensate for the loss of approximately 13,887 acres of fallow and active crop land. During the Acceler8 process, the EAA stormwater treatment area (STA) expansion and Picayune Strand Restoration Project were identified as providing 517,763 PHUs of panther compensation for CERP projects (Table 2). Several Band 1 Acceler8 projects removed some of these credits, however, there remains a balance of credits sufficient to compensate for construction of the A-2 FEB (Table 2).

Based on information provided by the Corps and information in other consultations, research, policies, and associated documents, the Corps has determined that the proposed construction of the A-2 FEB may affect, but is not likely to adversely affect the Florida panther. The Service concurs.

Table 2. Florida Panther Habitat Matrix Panther HUs by individual Band 1/Acceler8 Project – Development.

			Project Development							
			Functional Units Needed							
			Pre				Post			
Band 1/ Acceler8 Project Name	Land Cover Type	Habitat Value	Primary Acres	Secondary Acres	Other Acres	PHU	Primary Acres	Secondary Acres	Other Acres	PHU
C-43 West Storage Reservoir (*Includes Test Cell Project footprint)	Freshwater marsh	9		8	3	54				0
	Bottomland hardwood	9		1		6				0
	Cypress swamp	9	4	26	6	210				0
	Grassland/pasture	7	3			21				0
	Shrub swamp	5		39		130				0
	Shrub and brush	5		26		87				0
	Orchards/groves	4	123	5,254.5	4,966	21,252				0
	Exotic plants	3		28	7	63				0
	Reservoir	1.5		2		2				0
	Water	0		78.9	26	0	130	5,594	5,016	0
	Urban	0		77	9	0				0
	Subtotal		**130**	**5,540.4**	**5,017**	**21,825**	**130**	**5,594**	**5,016**	**0**
EAA A-1 Reservoir	Grassland/pasture	7				0			198	462
	Shrub swamp	5			187.6	313				0
	Shrub and brush	5				0			82	137
	Crop land	4			15,467.5	20,623				0
	Reservoir	1.5				0			13	7
	Water	0			149.8	0			15,353	0
	Urban	0			119.1	0			278	0
	Subtotal		**0**	**0**	**15,924**	**20,936**	**0**	**0**	**15,924**	**606**
C-111 Spreader	Freshwater marsh	9	2,348			21,132	225			2,025
	Shrub swamp	5	1,088			5,440				0
	STA	4.5				0	3,436			15,462
	Water	0	225			0				0
	Subtotal		**3,661**	**0**	**0**	**26,572**	**3,661**	**0**	**0**	**17,487**
Projects Combined	**Total**		**3,791**	**5,540**	**20,941**	**69,333**	**3,791**	**5,594**	**20,940**	**18,093**

All values are estimates and habitat impacts will be updated as individual Band 1/Acceler8 Project plans are developed.

Florida Manatee

Florida manatees (*Trichechus manatus latirostris*) have been observed in conveyance canals within the CEPP project area, specifically in the lower C-111 Canal just downstream of S-197, in the L-29 (Tamiami Trail) Canal, and adjacent nearshore seagrass beds throughout Florida Bay. In the northern area of the project, manatees have been observed in the C-44 and C-43 Canals that connect Lake Okeechobee to the St. Lucie and Caloosahatchee River Estuaries, respectively. Manatees are found in the seagrass beds of these estuaries as well as the adjacent IRL. The extensive acreages of seagrass beds in the bays and estuaries provide important feeding areas for Florida manatees. Florida manatees also depend upon canals as a source of freshwater, a resting site, and thermal 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.

With the implementation of CEPP Alternative (Alt) 4R2, there will be an increase in freshwater flow to Florida Bay, Biscayne Bay and the southwestern coastal estuaries that should improve the salinity for seagrasses therefore providing more forage opportunities to manatees. Conversely, implementation of this plan will reduce damaging freshwater flows from Lake Okeechobee to the St. Lucie, Indian River Lagoon, and Caloosahatchee River estuaries. This reduction would lead to a decrease in sedimentation and silt, and an increase in light penetration, therefore allowing for an increase in seagrass survival.

Construction activities associated with Alt 4R2 include the backfilling of portions of the Miami Canal from just south of the S-8 Structure to just north of Interstate 75. Since manatees can access this area and become stranded, eliminating the canal and allowing water to flow into the marshes and downstream will be a benefit. The Corps committed to avoiding and minimizing for adverse effects during construction activities by implementing construction conservation measures as outlined in *Standard Manatee Conditions for In-Water Work* (FWC 2011). The Service concurs with the Corps' effect determination that CEPP may affect, but is not likely to adversely affect, the Florida manatee.

Florida Manatee Critical Habitat

Critical habitat for the Florida manatee was designated in 1976 (50 CFR 17.95). For the southern section of this project, the Florida manatee's critical habitat includes all waters of Card, Barnes, Blackwater, Little Blackwater, Manatee, and Buttonwood sounds between Key Largo, Monroe County, and the mainland of Miami-Dade County. Another component of designated critical habitat is defined as Biscayne Bay, and all adjoining and connected lakes, rivers, canals, and waterways from the southern tip of Key Biscayne northward to and including Maule Lake, Miami-Dade County (CFR 50 Parts 1 to 199; 10-01-00). For the northern section of the project critical habitat includes the Caloosahatchee River, downstream from the Florida State Highway 31 bridge on the west coast and on the east coast includes that section of the intracoastal waterway from the town of Sewalls 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.

Seagrasses within Florida estuaries have been subjected to salinities that are either too high or too low depending on the amount and duration of freshwater flow coming into the systems through manmade canals. With the implementation of Alt 4R2, there should be a reduction in the number and severity of high volume freshwater discharges to the Caloosahatchee and St. Lucie River Estuaries and improvements in seasonal inflow deliveries to Florida Bay and Biscayne Bay which should increase seagrass survival, distribution and species composition. In conclusion, the Service concurs with the Corps' determination that CEPP may affect, but is not likely to adversely affect, designated critical habitat for the Florida manatee.

American Crocodile

American crocodiles range throughout the coastal and estuarine areas of south Florida from Lake Worth Lagoon on the east coast to Charlotte Harbor (Cherkiss et al. 2011) on the west coast; thus, there is a high probability of occurrence in the Florida Bay and Biscayne Bay areas affected by the project. There are three primary nesting populations in south Florida: Florida Bay, Turkey Point on Biscayne Bay, and Key Largo—the former two nesting and dispersal areas being affected by the project. Of particular note on crocodile distribution for this evaluation are the results from a recent study that indicates an increase in relative abundance of crocodiles in Biscayne Bay with nesting documented along the shoreline of central Biscayne Bay (Cherkiss et al. 2011).

The life history characteristic that is of primary concern regarding the affects from this project is the need for low salinity conditions for the growth and survival of hatchling and juvenile crocodiles. Optimal salinity for these life stages is 0 to 20 parts per thousand in the wetlands and coastal creeks during the wet season and partway through the dry season (approximately June through January) (Mazzotti et al. 2002). Changes in hydrology that would increase existing salinity conditions in the crocodile reproduction areas would degrade juvenile habitat for this federally threatened species. Conversely, hydrologic changes that would decrease salinity from existing conditions would improve juvenile crocodile habitat.

Hydrologic modeling indicates that all CEPP alternatives, including the Tentatively Selected Plan (TSP), will increase freshwater flows to Florida Bay (Service 2013b, 2013c). These flow increases translate to slight but beneficial salinity decreases in Florida Bay. When these salinity decreases are incorporated into the Habitat Suitability Index for the American crocodile (Service 2013b), results indicate a slight increase in index values under the CEPP TSP and other project alternatives (Corps 2013b) compared to existing and future without project conditions. Thus, CEPP appears to improve habitat for the American crocodile in Florida Bay.

Although restoration of Biscayne Bay is not an objective of CEPP, it is important that CEPP-induced changes in hydrology do not negatively impact this region. CEPP hydrologic modeling indicates that total annual flow to the bay will increase slightly from the TSP compared to existing conditions (Service 2013c). However, a more in-depth analysis indicates that three of the five conveyance canals in central Biscayne Bay show a slight decrease in annual flows to the bay, and all five canals in this region show a decrease in dry season flows of 3 to 20 percent under the TSP compared to existing conditions (Service 2013c). In south-central Biscayne Bay, simulations indicate an increase in annual mean flows at four of the five conveyance canals under Alt 4R2 compared to Existing Conditions Baseline (ECB). The fifth canal shows no change in annual mean flows between Alt 4R2 and ECB. Results also show significant reductions in flow to Manatee Bay (via the C-111) under the TSP compared to ECB, but these are attributed to the CERP C-111 Spreader Canal (C-111SC) Western Project, and flows are quite small compared to other Biscayne Bay conveyance canals.

It should be noted that hydrologic simulations from previous CEPP alternatives indicated significant flow reductions at conveyance canals in south Biscayne Bay (Service 2013b), and it is unclear how the TSP alleviated those previous simulated reductions. Also, a lack of appropriate tools or models precludes translating flows to the bay into salinity conditions, and the crocodile Habitat Suitability Indices cannot be applied because of lack of salinity and prey biomass input.

Based on its May 2013 BA the Corps has determined the project "may affect, but not likely adversely affect" the American crocodile. The Service concurs with the Corps' determination. However, given the possible flow reduction that may occur in central and southern Biscayne Bay as a result of CEPP and the inherent uncertainties of hydrologic models particularly at the boundaries of their domain as is the case in this region, the Service recommends frequent evaluation of flow data collected at the coastal water management structures in Miami-Dade County to ensure that any reductions in flow can be detected early and alleviated through operational modifications. Flow reductions, if they occur, would increase salinity in this region of Biscayne Bay which may negatively impact juvenile crocodile habitat. Monitoring of freshwater flows to Biscayne Bay is currently included in the CEPP Adaptive Management (AM) and so should be continued for the life of the project. However, the CEPP AM Plan does not currently include the frequency by which freshwater flows should be assessed nor thresholds that identify significant freshwater flow reductions. The Service recommends that these components of Biscayne Bay flow assessments be included in the Final CEPP Adaptive Management Plan. If freshwater flow assessments indicate reductions or if this monitoring and evaluation ceases for any reason, reinitiation of consultation for the American crocodile may be necessary.

American Crocodile Critical Habitat

According to 50 CFR 17.95, designated critical habitat for the American crocodile includes the extreme southern region of Biscayne Bay, Florida Bay, and areas of the southwest Florida coast. Based on the above evaluation for the crocodile, it is likely that CEPP will improve habitat in the Florida Bay region. Also, it is highly unlikely that the possible reductions in flow to Biscayne Bay due to CEPP will affect designated critical habitat in Biscayne Bay because the conveyance canals for which modeling shows flow reductions by the TSP are located approximately 15 miles from the northern boundary of designated critical habitat.

In its May 2013 BA, the Corps has determined that the project "may affect, but not likely adversely affect" designated critical habitat for the American crocodile. The Service concurs with the Corps' determination.

Deltoid Spurge, Garber's Spurge, Small's Milkpea, and Tiny Polygala

The primary habitat for these threatened and endangered plant species are the pine rocklands. This community occurs on areas of relatively higher elevation and consequently, has been subject to intense development pressure. In addition, the pine rocklands are a fire-maintained community and require a specific fire frequency to maintain the open shrub/herbaceous stratum and to control hardwood encroachment (Gunderson 1997). Fire suppression, fragmentation, invasion by exotic species, and a lowered water table have negatively affected the remaining tracts of pine rocklands, prompting the listing of these species under the Endangered Species Act of 1973, as amended in 1998 (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*) (Service 1999).

The list below provides the most recent 5-year species status reviews conducted by the Service for the deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala.

Species	Species Status	Year	Threats to Species and Habitat
Deltoid Spurge	declining	Service 2010b	Lack of fire, invasive/exotic plants
Garber's Spurge	unknown	Service 2007a	Lack of fire, invasive/exotic plants
Small's Milkpea	declining	Service 2010c	Lack of fire, invasive/exotic plants
Tiny Polygala	declining	Service 2010d	Lack of fire, invasive/exotic plants

Within the project area, the pine rocklands occur on the Miami Rock Ridge and extend into the Everglades as Long Pine Key in ENP. These listed plant species have the potential to occur within the Rocky Glades surrounding the Frog Pond Detention Area. However, under the CEPP, there are no proposed changes to the operations that would affect pine rocklands. Therefore, the Corps determined that the project "may affect, but is not likely to adversely affect" the deltoid spurge, Garber's spurge, Small's milkpea, and tiny polygala. The Service concurs with these determinations.

As discussed above, the Service concurs that the CEPP Project is not likely to adversely affect these seven species. Therefore, they will not be discussed further in this Programmatic Biological Opinion. However; as new project details emerge or details assessed in this consultation change or if the status of the species changes, the Corps may need to reinitiate consultation.

PROGRAMMATIC BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The purpose of the CEPP is to restore or improve the Everglades ecosystem (including wetlands, uplands, and associated estuaries), water quality, water supply, and recreation while protecting cultural and archeological resources and values. The recommended plan would achieve these benefits by reducing the large pulses of regulatory flood control releases sent from Lake Okeechobee by redirecting approximately 210,000 acre-feet (ac-ft) of additional water on an annual basis to the historical southerly flow path. Water will be delivered first to FEB which will provide water quality improvement through retention and attenuation of high flows, prior to delivery to existing STAs. Started in the FEBs the STAs will continue to reduce phosphorus concentrations in the water to meet required water quality standards. Rerouting this treated water south and redistributing it across spreader canals will facilitate hydropattern restoration in WCA 3A. This, in combination with Miami Canal backfilling and other CERP components, will re-establish a 500,000-acre flowing system through the northern most extent of the remnant Everglades. The treated water will be distributed through WCA-3A to the western side WCA-3B and finally ENP via structures and creation of the Blue Shanty Flowway. The Blue Shanty Flowway will restore continuous sheetflow and reconnect a portion of WCA-3B to ENP and Florida Bay. A seepage barrier wall and pump station will manage seepage to maintain levels of flood protection and water supply in the urban and agricultural areas east of ENP. The CEPP recommended plan was chosen based upon detailed estimates of hydrology across the 41-year period of record (POR) (January 1965 – December 2005) generated by the Regional Simulation Model for Basins (RSM-BN) for the Northern Estuaries and the RSM for the Glades and Lower East Coast Service Area (RSM-GL) for the Greater Everglades and Florida Bay" (Figure 2; Corps 2013).

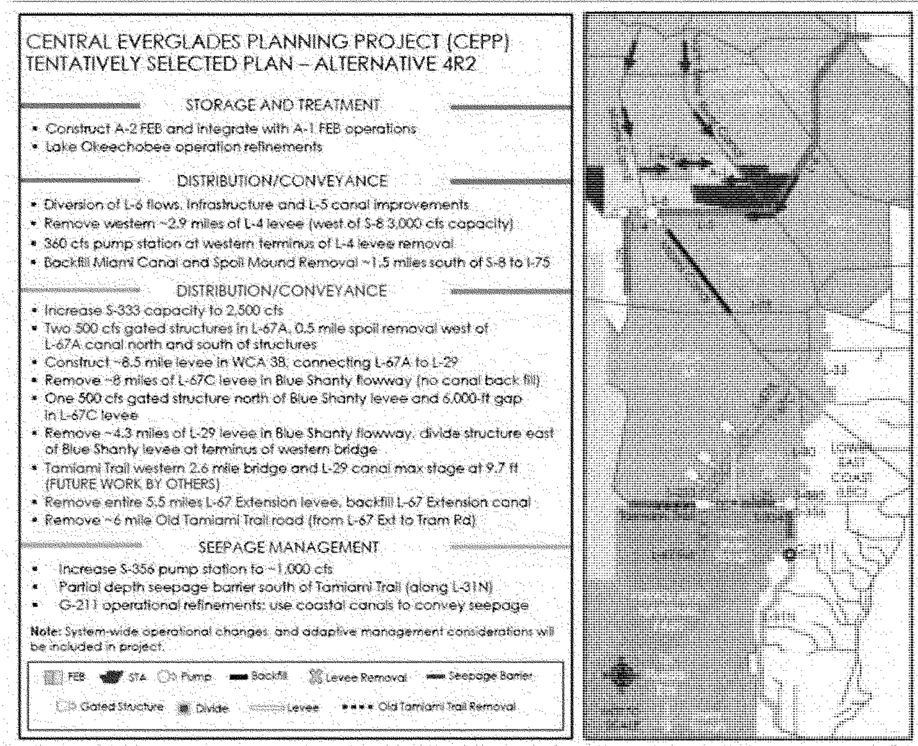

Figure 2. Map of Alternative 4R2, the TSP for CEPP and descriptions of associated features (Corps 2013).

Action Area

The action area is defined as all areas to be directly or indirectly affected by the Federal action and not just the immediate area involved in the action. Therefore, the Service considers the action area for CEPP as all lands within the project footprint including areas affected by planned operational changes and all lands located within the entire ranges of the CSSS and Everglade snail kite. The action area also includes the areas within 18.6 miles from any wood stork rookery active since 2003 in south Florida (Figure 3).

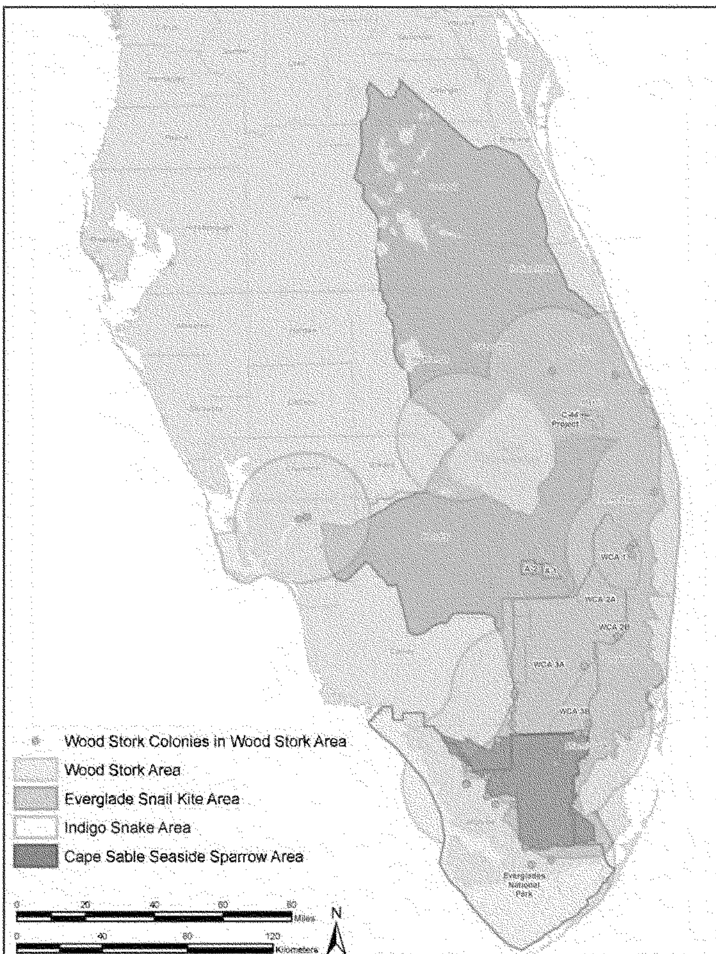

Figure 3. Map showing the action area for CEPP based on the listed species and their ranges.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

Cape Sable Seaside Sparrow

Species/Critical Habitat Description

The CSSS is one of eight extant subspecies of seaside sparrow in North America. Its distribution is limited to the short-hydroperiod wetlands, or marl prairies, located at the southern end of the greater Everglades ecosystem, on the southern tip of mainland Florida. Unlike most other subspecies of seaside sparrow, which occupy primarily brackish tidal systems (Post and Greenlaw 1994), this sparrow currently occurs primarily in the short-hydroperiod wet prairies, also referred to as marl prairies. The sparrow is generally sedentary, secretive, and non-migratory, although sparrows are known to migrate between subpopulations (Lockwood et al. 2008; Virzi et al. 2009).

Life History

Breeding and Nesting

Sparrows generally begin nesting in early March (Lockwood et al. 2001), but may begin territorial behavior, courtship, and nest-building in late February (Werner and Woolfenden 1983; Lockwood et al. 1997). This timing coincides with the dry season, and most areas within the marl prairies are either dry or only shallowly inundated at the beginning of the breeding season. During the dry portion of the breeding season (March to May), sparrows build nests above the ground, but relatively low in the vegetation (6.7 to 7.1 inches) (Werner 1975; Lockwood et al. 2001). During the wet portion of the sparrow breeding season (June to August), sparrows build their nests higher in the vegetation than during dry periods, an average of 8.3 inches above the ground surface (Lockwood et al. 2001). Wet-season nests probably occur in taller vegetation than during the dry season because even at the nest height, there must be sufficient height and density of vegetation remaining above the nest to cover and conceal nests.

Pimm et al. (2002) suggest that nesting will not be initiated if water levels are at a depth greater than 4 inches during the breeding season. For many years, rising water levels resulting from the onset of summer rains were thought to end the breeding season (Werner 1975). While these statements are generally true, the sparrows may respond to changes in hydrologic conditions as long as water levels are not prohibitively high. Large rainfall events early in the wet season may cause some nest failure and sparrows generally cease breeding when water levels rise above the mean height of the nests above the ground (Lockwood et al. 1997; Basier et al. 2008; Cade and Dong 2008). However, if water levels subsequently drop, sparrows may again initiate breeding activity. The initiation of molt, which usually occurs in early September, is probably the best indicator of the true end of the breeding season.

CSSSs lay three to four eggs per clutch (Werner 1978, Pimm et al. 2002) with a hatching rate ranging between 0.66 and 1.00 (Boulton et al. 2009). The sparrow nesting cycle, from nest construction to independence of young, lasts about 30 to 50 days (Werner 1975; Lockwood et al. 2001), and sparrows may renest following both successful and failed nesting attempts (Werner 1975; Post and Greenlaw 1994; Lockwood et al. 2001). Both parents rear and feed the young birds and may do so for an additional 10 to 20 days after the young fledge (Woolfenden 1956, 1968; Trost 1968). Sparrows are incapable of flight until they are about 17 days old; when approached, flightless fledglings will freeze on a perch until the threat is less than approximately 3 feet away, and then run along the ground (Werner 1975; Lockwood et al. 1997).

Because of the potential for a long breeding season in southern Florida, sparrows may regularly nest several times within a year, and may be capable of successfully fledging two to four clutches, though few sparrows probably reach this level of success (Lockwood et al. 2001). Second and third nesting attempts may occur during the early portion of the wet season, and nests later in the season usually occur over water.

Nest success rates vary among years, and range from 12 to 60 percent, depending upon time within the breeding season (Lockwood et al. 2001; Baiser et al. 2008; Boulton et al. 2009). Substantially higher nest success rates occur within the early portion of the breeding season (prior to June 1) followed by a decline in success as the breeding season progresses to a low of about 20 percent after June 1. Nest predation is the primary documented cause of nest failure (Lockwood et al. 2001; Pimm et al. 2002; Baiser et al. 2008; Boulton et al. 2009; Virzi et al. 2009), accounting for more than 75 percent of all nest failures (Lockwood et al. 1997; Baiser et al. 2008). A complete array of nest predators has not been determined, however, raccoons (*Procyon lotor*), rice rats (*Oryzomys palustris*), and snakes, including exotic pythons may be the predominant predators (Lockwood et al. 1997; Post and Greenlaw 2000; Dean and Morrison 2001). As water levels begin to rise above ground surface with the onset of the summer rains in May to June, nest predation rates also rise. Nests that are active after June 1st, when water levels are above ground, are more than twice as likely to fail as nests during drier periods (Lockwood et al. 2001; Baiser et al. 2008; Cade and Dong 2008). This effect appears to be a result of both increased likelihood of nests being flooded and an increased likelihood of predation (Lockwood et al. 1997, 2001; Pimm et al. 2002).

Outside of the breeding season, sparrows generally remain sedentary in the general vicinity of their breeding territories, but expand the area that they use compared to the breeding season territory (Dean and Morrison 2001). Average non-breeding season home range size was approximately 42 acres in size, and ranged from 14.1 to 137.1 acres (Dean and Morrison 2001). Some individuals make exploratory movements away from the area of their territories, and may occasionally relocate their territories and home ranges before resuming a sedentary movement pattern (Dean and Morrison 2001).

Sparrow subpopulations require large patches of contiguous open habitat (about 4,000 acres or larger). The minimum area required to support a population has not been specifically determined, but the smallest area that has remained occupied by sparrows for an extended period is about 4,000 acres. Individuals are area-sensitive, and generally avoid the edges where other habitat types meet the marl prairies. They will only occupy small patches (less than 100 acres) of marl prairie vegetation when they occur within large, expansive areas and are not close to forested boundaries (Dean and Morrison 2001). Large expanses of deep water or wooded habitat may act as barriers to long-range movements (Dean and Morrison 2001). Once sparrows establish a breeding territory, they exhibit high site fidelity, and each individual sparrow may only occupy a small area for the majority of its life (Werner 1975). Although sparrows are generally sedentary and avoid forested areas, recent research has revealed limited movement between subpopulations east of SRS (Lockwood et al. 2008; Virzi et al. 2009). The occurrence of sparrows over time within each of the subpopulations indicates a centrality, that is, sparrows most consistently occur and are most abundant near the center of the patch of habitat in which they occur.

Within a patch of occupied suitable habitat, sparrow breeding territories do not generally saturate the entire area. Even when sparrows occur at high densities, small areas usually remain between adjacent territories, though some territories do appear to overlap (Cassey et al. 2007). Therefore, some gaps that appear to be suitable habitat may remain unclaimed by territorial sparrows (Werner 1975). In many cases, areas that appear to be suitable for sparrow occupancy may not be suitable during certain environmental conditions and this may cause sparrow territories to appear to be widely separated from neighboring territories (Cassey et al. 2007).

CSSSs are generally short-lived, with an average individual annual survival rate of 66 percent (Lockwood et al. 2001). The average lifespan is probably 2 to 3 years. Consequently, a sparrow population requires favorable breeding conditions in most years to be self-sustaining, and cannot persist under poor conditions for extended periods (Lockwood et al. 1997, 2001; Pimm et al. 2002).

Feeding Behavior

While detailed information about the diet of CSSSs is not known, invertebrates comprise the majority of their diet, though sparrows may also consume seeds when they are available (Werner 1975; Post and Greenlaw 1994). Howell (1932) identified the contents of 15 sparrow stomachs and primarily found remains of insects and spiders, as well as amphipods, mollusks, and plant matter. Primary prey items that are fed to nestlings during the breeding season include grasshoppers (*Orthoptera*), moths and butterflies (*Lepidoptera*), dragonflies (*Odonata*), and other common large insects (Post and Greenlaw 1994; Stevenson and Anderson 1994; Lockwood et al. 1997; Pimm et al. 2002). Adult sparrows probably consume the same species during the nesting season. Sparrows may consume different proportions of different species over time and among sites, suggesting that they are dietary generalists (Pimm et al. 2002). During the non-breeding season, preliminary information from evaluation of fecal collections suggests that a variety of small invertebrates, including weevils and small mollusks are regularly consumed (Dean and Morrison 2001). Evidence of seed consumption was only present in 4 percent of samples (Dean and Morrison 2001). These non-breeding season samples may not be representative of the foods most frequently consumed during that season and may only represent a portion of the items ingested.

While the sparrow appears to be a dietary generalist, an important characteristic of sparrow habitat is its ability to support a diverse array of insect fauna. In addition, these food items must be available to sparrows both during periods when there is dry ground and during extended periods of inundation. The specific foraging substrates used are unknown, but they probably vary throughout the year in response to hydrologic conditions.

Habitat and Hydrologic Requirements

Sparrows inhabiting the CEPP action area occur mostly within the short-hydroperiod freshwater marl prairies of the southern Everglades that flank the deeper sloughs. The most commonly associated vegetation species in occupied freshwater habitat is muhly grass (*Muhlenbergia filipes*) (Werner 1975; Kushlan and Bass 1983; Werner and Woolfenden 1983; Post and Greenlaw 1994; Stevenson and Anderson 1994). However, a variety of vegetation species occur within the freshwater marl prairies occupied by sparrows, including habitat where *muhlenbergia* is absent (Ross et al. 2006). Other dominant species that occur in these prairies include sawgrass, south Florida bluestem (*Schizachyrium rhizomatum*), black-topped sedge (*Schoenus nigricans*), and beak rushes (*Rhynchospora* spp.) (Werner and Woolfenden 1983; Ross et al. 2006).

Sparrows occupy these marl prairie communities year-round, and the vegetation must support all sparrow life stages. During the dry season when the habitat is typically dry, usually coinciding with the late winter and early spring (December to May), sparrows traverse the ground surface beneath the grasses, and only occasionally perch within the vegetation. During the wet season (June to November), the ground surface is inundated, with peak water depths occasionally exceeding 2 feet (Nott et al. 1998). During these periods, sparrows travel within the grasses, perching low in the clumps, hopping among the bases of dense grass clumps, and walking over matted grass litter. During the wet season sparrows fly more frequently, and regularly perch low in the vegetation, but generally remain inconspicuous (Dean and Morrison 2001).

Small tree islands and individual trees and shrubs occur throughout the areas occupied by the sparrows, but at a very low density. Sparrows do not appear to require woody vegetation during any aspect of their normal behavior, and generally avoid areas where shrubs and trees are either dense or evenly distributed. However, the small tree islands and scattered shrubs and trees may serve as refugia during extreme environmental conditions, and may be used as escape cover when fleeing from potential predators (Dean and Morrison 2001). Because of their general aversion to dense trees and woody vegetation, encroachment of trees and shrubs quickly degrades potential sparrow habitat.

Hydrologic conditions have significant direct and indirect effects on sparrows. First, water depth or depth of inundation within sparrow habitat is directly related to the sparrow's ability to move, forage, nest, find shelter, and avoid predators and harsh environmental conditions. Average annual rainfall in the Everglades is approximately 56 inches per year (ENP 2005), with the majority of this falling within the summer months, which coincides with the latter half of the sparrow nesting season. This rainfall has a strong influence on the hydrologic characteristics of the marl prairies. However, throughout southern Florida, hydrologic conditions are also influenced by water management actions. The operation of a system of canals, levees, pumps, and other water management structures, can have wide-ranging impacts on the hydrologic conditions throughout much of the remaining marl prairies (Johnson et al. 1988; Van Lent and Johnson 1993; Pimm et al. 2002).

At water depths greater than 2 feet above ground surface, the majority of the vegetation in sparrow habitat is completely inundated, leaving sparrows with limited refugia. Conditions such as these may result in significant impacts to sparrow survival, and if they occur during the breeding season, these water levels cause flooding and loss of sparrow nests (Nott et al. 1998; Pimm and Bass 2002). Even more moderate water levels, in the range of 6 inches above ground surface, may inundate enough habitat that sparrows cannot find shelter and are restricted in their movements. These water levels, when they occur during the nesting season, result in increased rates of nest failure due to predation (Lockwood et al. 1997; Baiser et al. 2008). While topographical (elevation) variation within the remaining Everglades is relatively small, differences in elevation as little as 1 foot can result in different habitat characteristics.

The vegetation species composition and structure/density in the Everglades are largely influenced by the rise and fall of annual water levels or hydroperiods. Water quality has the potential to influence vegetation communities in sparrow habitat, but the literature characterized below highlights the predominant effects that hydroperiod and fire plays on vegetation composition. Hydroperiods that range from 60 to 270 days support the full variety of vegetation conditions that are generally suitable for sparrows (Ross et al. 2006), though the vegetation composition and structure may vary significantly. Persistent annual increases in hydroperiod may result in changes in vegetation communities from marl prairies or mixed prairies to sawgrass dominated communities resembling sawgrass marshes (Nott et al. 1998). Detailed studies relating hydroperiod characteristics to sparrow habitat have concluded that an average annual discontinuous hydroperiod range (average number of days in a year that water level or stage is above ground surface) of 90 to 210 days is optimal for the plant species important for sparrow nesting and for maintenance of sparrow habitat (Olmsted 1984; Kushlan et al. 1982; Kushlan 1990a; Wetzel 2001; Ross et al. 2006).

Average hydroperiods that extend much beyond 240 days per year will more closely resemble sawgrass marsh communities (Ross et al. 2006) which are unlikely to support sparrows in the long term. Conversely, areas that are subjected to short hydroperiods generally have higher fire frequency than areas with longer-hydroperiods (Lockwood et al. 2003; Ross et al. 2006), and are readily invaded by woody shrubs and trees (Werner 1975; Davis et al. 2005). Both an increased incidence of fire and an increased density and occurrence of woody shrubs detract from the suitability of an area as sparrow habitat.

The local variability across the landscape within areas where sparrows occur produces a heterogeneous arrangement of different vegetation conditions that all provide habitat for sparrows during some environmental conditions. A complex relationship between hydrologic conditions, fire history, and soil depth determine the specific vegetation communities at a particular site, and variation in these characteristics may result in a complex mosaic of vegetation (Taylor 1983; Ross et al. 2006). The combination of hydroperiod and periodic fire events are critical in the maintenance of suitable mixed marl prairie communities for the sparrow (Kushlan and Bass 1983). This variability is characteristic of the habitats that support sparrows. CSSSs are generally not found in communities dominated by dense sawgrass (*Cladium jamaicense*), cattail (*Typha* spp.) monocultures, long-hydroperiod wetlands with tall, dense vegetative cover, spike rush (*Eleocharis cellulosa*) marshes and sites supporting woody vegetation (Werner 1975, Kushlan and Bass 1983). Sparrows also avoid sites with permanent year-round water cover (Curnutt and Pimm 1993).

Sparrows do not regularly occupy burned areas for 2 to 3 years following fires (Pimm et al. 2002; Lockwood et al. 2005), though they can re-occupy areas after only 1 year post-fire under some conditions (Taylor 1983; Werner and Woolfenden 1983). This is probably because of the sparrow's dependence on some level of vegetation structural complexity that must develop to provide cover, support nests, and allow individuals to move through the habitat during wet periods. Fire is not uncommon within the areas occupied by sparrows, and nearly all areas where sparrows currently occur have been burned within the past 10 to 20 years (Lockwood et al. 2003). A combination of naturally ignited and human-ignited (both prescribed and arson/accidental ignitions) fires have resulted in different fire frequencies in different portions of the sparrow's range. Most of the vegetation species that occur within sparrow habitat are fire-adapted and respond quickly following fire (Snyder 2003). Several of the dominant grass species, including *muhlenbergia*, also flower primarily following fires during the growing season (Main and Barry 2002). Under normal conditions, fires do not kill the individual plants that make up the dominant species in sparrow habitat, and fires only remove the above-ground growth and leaf litter (Snyder and Schaeffer 2004). The plant species rapidly respond, sprout quickly following fire, and grow rapidly. Many of the dominant grasses may grow more than 15 inches after only a few weeks (Steward and Ornes 1975; Snyder 2003). For this reason, the species composition and even the general structural characteristics of the vegetation may be nearly indistinguishable from unburned areas only 2 to 3 years after burning (Lockwood et al. 2005).

The interaction of fire and flooding strongly influence the suitability of habitat for sparrows. In the most extreme case, vegetation that burns and is subsequently flooded within 1 to 3 weeks, either because of a natural rainfall event or human-caused flooding due to operations may not recover for up to 10 or more years (Ross 2006). Alternatively, if water levels overtop sprouting grasses after a fire, the grasses may die, resulting in an absence of vegetation. Recovery of vegetation from these circumstances has to result from seed germination, which requires a longer time for recovery than vegetative growth, and may result in a different plant species community (composition and structure) from the vegetation that was present prior to the fire. Under less extreme conditions, vegetation may recover following fire more quickly when water levels are near the soil surface, providing ample water for the plants to grow. In this particular case, the vegetation community (composition) does not change as a result of fire only the vegetation structure leading to a quicker recover of the affected vegetation.

Population Dynamics

Population Size and Variability

The use of helicopters to facilitate larger spatial-scale surveys for the sparrow was first accomplished in 1974 (Werner 1975). The first comprehensive, range-wide sparrow population survey was conducted in 1981, but was not repeated until 1992. Since that time, surveys have been conducted annually including twice in 1999 and 2000 (Pimm et al. 2002). The number of survey locations has changed through time, from a high of over 850 sites in 1992 to a low of 250 sites in 1995 (Cassey et al. 2007). Over this time period, there have been substantial demographic changes in most of the six subpopulations (Table 3). The 1981 sparrow survey provided a baseline on the distribution and abundance of sparrows at that time, and the 1992 survey results were similar, though there is no information available about how the populations may have changed during the intervening 12 years. In 1981, there were an estimated 6,656 sparrows distributed across six subpopulations, with the majority (86 percent) of the sparrows occurring within subpopulations A, B, and E. By comparison, the last complete CSSS population survey for all the subpopulations (2007) resulted in an estimate of 3,184 sparrows, with the majority of birds occurring within subpopulation B (79 percent) and subpopulation E (18 percent).

Subpopulation A inhabits the marl prairies west of SRS in ENP and in eastern Big Cypress National Preserve (BICY). This subpopulation supported over 40 percent of the estimated population total of 6,656 sparrows (approximately 2,688 birds) in 1981. Today, subpopulation A has far fewer birds. Subpopulation B contained 35 percent of the total population (approximately 2,352 sparrows) that inhabited the marl prairies southeast of SRS near the center of ENP in 1981. As of the 2013 survey, subpopulation B remains one of the most abundant subpopulations, with its population remaining relatively stable containing approximately 60 percent of the current population. Subpopulation E, north of subpopulation B and also east of SRS, contained over 10 percent of the total population (approximately 672 sparrows) in 1981, while subpopulation C, located near Taylor Slough and along the eastern boundary of ENP, contained over 6 percent (432) of the sparrows. Subpopulation D, just to the southeast of subpopulation C, also held approximately 6 percent (400) of the sparrows in 1981. Subpopulation F, located between SRS and the western edge of the Atlantic coastal ridge along the eastern boundary of ENP, was the smallest subpopulation in 1981, and contained an estimated 112 sparrows or just 2 percent of the total population. Overall, there have been population declines recorded among all of the subpopulations, and relatively few population increases since 1981. These population changes suggest that while declines can occur rapidly, it may take many years of favorable conditions to return to a stable population (Jenkins et al. 2003; Cassey et al. 2007; Lockwood et al. 2008).

Table 3. Cape Sable seaside sparrow counts (BC) and population estimates (EST) by year as recorded in the ENP range-wide survey. Sparrows not surveyed (NS).

	Subpopulation													
	A		B		C		D		E		F		Total	
Year	**BC**	**EST**	**BC**	**EST**	**BC**	**EST**	**BC**	**EST**	**BC**	**EST**	**BC**	**EST**	**BC**	**EST**
1981	168	2,688	147	2,352	27	432	25	400	42	672	7	112	416	6,656
1992	163	2,608	199	3,184	3	48	7	112	37	592	2	32	411	6,576
1993	27	432	154	2,464	0	0	6	96	20	320	0	0	207	3,312
1994	5	80	139	2,224	NS	NS	NS	NS	7	112	NS	NS	151	2,416
1995	15	240	133	2,128	0	0	0	0	22	352	0	0	170	2,720
1996	24	384	118	1,888	3	48	5	80	13	208	1	16	164	2,624
1997	17	272	177	2,832	3	48	3	48	52	832	1	16	253	4,048
1998	12	192	113	1,808	5	80	3	48	57	912	1	16	191	3,056
1999a**	25	400	128	2,048	9	144	11	176	48	768	1	16	222	3,552
1999b	12	192	171	2,736	4	64	NS	NS	60	960	0	0	247	3,952
2000a**	28	448	114	1,824	7	112	4	64	65	1,040	0	0	218	3,488
2000b	25	400	153	2,448	4	64	1	16	44	704	7	112	234	3,744
2001	8	128	133	2,128	6	96	2	32	53	848	2	32	204	3,264
2002	6	96	119	1,904	7	112	0	0	36	576	1	16	169	2,704
2003	8	128	148	2,368	6	96	0	0	37	592	2	32	201	3,216
2004	1	16	174	2,784	8	128	0	0	40	640	1	16	224	3,584
2005	5	80	142	2,272	5	80	3	48	36	576	2	32	193	3,088
2006	7	112	130	2,080	10	160	0	0	44	704	2	32	193	3,088
2007	4	64	157	2,512	3	48	0	0	35	560	0	0	199	3,184
2008	7	112	NS	NS	3	48	1	16	23	368	0	0	34	544*
2009	6	96	NS	NS	3	48	2	32	27	432	0	0	38	608*
2010	8	128	119	1904	2	32	4	64	57	912	1	16	191	3,056
2011	11	176	NS	NS	11	176	1	16	37	592	2	32	62	992*
2012	21	336	NS	NS	6	96	14	224	46	736	4	64	91	1,456*
2013	18	288	112	1,792	8	128	1	16	45	720	1	16	185	2,960

*These numbers do not reflect a significant decline in the CSSS population. Subpopulation B, the largest and most stable subpopulation, was not surveyed in 2008 or 2009. Adding the 2007 subpopulation B population estimate of 2,512 birds to those of the other subpopulations, the estimated total CSSS population size is 3,056 and 3,120 birds for 2008 and 2009, respectively. Adding the 2010 subpopulation B population estimate of 1,904 birds to those of the other subpopulations, the estimated total CSSS population size is 2,896 and 3,360 birds for 2011 and 2012, respectively.

**Multiple surveys were conducted in these years.

In 1981 and 1992, the area west of SRS, where subpopulation A occurs, supported nearly half of the total CSSS population (Table 3). Subpopulation A has experienced the most dramatic sparrow population change observed, declining from more than 2,600 birds in 1992 to 432 birds in 1993 a decrease of 84 percent (Pimm et al. 2002). This subpopulation has subsequently remained at a low level, less than 450 sparrows. The estimated population since 1993 has ranged from a high of 448 sparrows in 2000 to a low of 16 sparrows in 2004.

Subpopulation B has remained relatively constant over time. When first surveyed, subpopulation B contained an estimated 2,352 sparrows inhabiting the marl prairies southeast of SRS near the center of ENP. Subpopulation B remains one of the most abundant subpopulations, with the estimated size dropping slightly around 1,800 sparrows (Table 3). Estimated population size from 1981 to 2013 has ranged from 1,792 to 3,184 sparrows. While these numbers span a fairly wide range, there has been no consistent increasing or decreasing trends in population size in subpopulation B.

By the 1992 survey, subpopulation C, located in the vicinity of Taylor Slough and along the eastern boundary of ENP, declined to about 11 percent of its 1981 estimated size (Table 3). Since 1992, including 2 years with no sparrow detections, 48 sparrows were estimated in this area in 1996 and 1997, and 80 sparrows were estimated in 1998. Since 2007, the population has varied from at an estimated 32 to 176 sparrows.

Subpopulation D supported an estimated 400 sparrows in 1981, but declined to approximately 96 sparrows in 1993 (Table 3). Although no sparrows were detected in 1994, the population was estimated at 80 sparrows and 176 sparrows in 1995 and 1998, respectively. High water levels likely led to the decrease since 1999 (Slater et al. 2009) with 32 sparrows estimated in 2000. No sparrows were identified within subpopulation D from 2001 through 2003 and 2005 and 2006. The continual decline, since its 1981 estimate of 400 sparrows, has possibly left this subpopulation functionally extirpated with few sparrows detected during recent range-wide surveys (Lockwood et al. 2008). Surveys from 2007 through 2011 have documented a few sparrows in this subpopulation. Recent estimates indicate 224 and 16 sparrows in 2012 and 2013, respectively, although intensive ground surveys in this subpopulation give considerable reason to doubt the estimated number in 2012. This area, like subpopulation A, has suffered from persistent high water levels that may have precluded sparrows from nesting

Subpopulation E, like subpopulation B, has remained relatively stable (Table 3). However, this subpopulation has fluctuated more than subpopulation B.

Estimates for subpopulation F declined from 1981 to 1992, from 112 sparrows to 32 sparrows (Table 3). No sparrows were observed in 1993 or 1995. Only 16 sparrows were estimated for each year from 1996 to 1999. However, the population increased in 2000 to an estimated 112 sparrows, but only 16 sparrows were estimated in 2004, when on-the-ground surveys did not detect evidence of successful breeding, even late in the breeding season when females and young were readily detected in the larger subpopulations (ENP 2005). There have been few sparrows detected in this subpopulation since 2006.

Subpopulations A, C, D and F are the smallest in terms of number of sparrows and area, with the exception of A which has a large amount of potentially suitable available habitat. Subpopulations D and F have come close to extirpation, with recent surveys detecting few or no sparrows (Boulton et al. 2009; Slater et al. 2009). During the 2006-2008 nesting seasons, intensive ground surveys were conducted in subpopulations C, D, and F, and to the present in subpopulation D, to better understand these small subpopulations (Lockwood et al. 2006; Boulton et al. 2009;Virzi et al. 2013). Data collected in these surveys included territory size, fecundity, nest success and survival rates. Results indicate that the small subpopulations exhibit: (1) suppressed breeding; (2) an excess of single males; (3) nest survival comparable to larger subpopulations; (4) low hatch rate; and (5) larger territory sizes than birds in the larger subpopulations. Boulton et al. (2009) concluded that the small subpopulations are demographically dynamic and subject to the negative effects of low densities (*e.g.*, allee effects). In addition to C and D, subpopulation A was intensively surveyed for the first time in 2009 and positive results were reported for this imperiled subpopulation (Virzi et al. 2009, Virzi et al. 2013). A promising 19 breeding pairs were detected in A in 2009 with similar numbers in recent years, and the subpopulation exhibited similar traits to the larger subpopulations like the presence of few unmated males and comparable clutch sizes, adult return rates, and proportion of early to late nests (Virzi et al. 2009, 2013). The subpopulation was reported as extant and functional.

Overall, there has been large population declines recorded among most of the subpopulations and relatively few population increases. These population changes suggest that while declines can occur rapidly, it may take many years of favorable conditions to return a sparrow population that has declined to its previous status. Since the significant decline in sparrow numbers for subpopulation A in 1993, the overall population has varied from a low of 2,416 birds in 1994 to a high of 4,048 birds in 1997.

Population Stability

Recent information indicates that sparrow subpopulations C, D, and F may support fewer sparrows than previously estimated, and the demographics of these subpopulations may differ from the larger subpopulations (Lockwood et al. 2006). Because sparrows typically experience low nest survival, low juvenile survival, and have a relatively short life span, we cannot expect sparrow recovery to be rapid (Lockwood et al. 2001). The demographic attributes of sparrows preclude them from rapid recovery particularly when consistently faced with poor conditions (*i.e.*, high water levels and frequent fires) (Lockwood et al. 2008). This information affects assessment of the likelihood of the persistence of these subpopulations and the overall probability of persistence for the species.

With smaller population sizes in these subpopulations than previously assessed, the relative significance of subpopulations B and E with respect to maintaining a viable overall sparrow population is increased. Similarly, evaluations of the potential contributions of the small subpopulations to maintaining the overall sparrow population and buffering it from potential catastrophic events such as widespread fire are reduced (Lockwood et al. 2006). Pimm et al. (2002) and Walters et al. (2000) suggested that three breeding subpopulations are necessary for the continued long-term survival of the sparrow. However, Slater et al. (2009) emphasize the need to recover all subpopulations, noting that with 90 to 97 percent of sparrows concentrated within two subpopulations (B and E), the species' vulnerability to stochastic events is particularly acute.

Slater et al. (2009) observed that even though the overall sparrow population has remained stable since the massive decline it experienced in the early 1990s, the population has shown minimal signs of recovery. The Sustainable Ecosystems Institute (SEI) 2007a panel also concluded that, "More important than trying to delineate populations, is recognizing that protecting the subspecies from catastrophic events will require maintaining sparrows over as wide an area as possible. This recognition actually provides a more compelling rationale for maintaining subpopulation A than the need to maintain three populations did, since subpopulation A is the only subpopulation west of SRS. It also suggests more emphasis should be placed on maintaining subpopulation D as the southeastern-most subpopulation".

Status and Distribution

Range-wide Trend

The CSSS was first discovered in the cordgrass (*Spartina* spp.) marshes on Cape Sable in 1918 and was originally thought to be limited in distribution to Cape Sable (Howell 1919). On September 2, 1935, a severe hurricane struck the Keys and southern Florida, with the hurricane's center passing within a few miles of Cape Sable (Stimson 1956). Post-hurricane observations suggest that in the vicinity of Cape Sable water levels resulting from the storm surge rose about 8 feet above normal water levels, and the sparrow was thought to have disappeared from the area due to habitat degradation as a result of the storm surge, despite occasional reports of sparrows that could not be verified (Stimson 1956). Between 1935 and the 1950s, searches on Cape Sable failed to locate sparrows (Stimson 1956). Despite the fact that sparrows were again reported on Cape Sable in 1970 (Kushlan and Bass 1983; Werner and Woolfenden 1983), the habitat in the area had been changing significantly from cordgrass marshes to mangroves and mud flats since the 1935 hurricane, and sparrows were considered to have been extirpated from this area since 1981 (Kushlan and Bass 1983).

In 1972, CSSSs were discovered near Taylor Slough (Ogden 1972). Subsequent investigation revealed that a sparrow had been reported to ENP in this area in 1958, but the observation was never verified (Werner 1975; Pimm et al. 2002). Surveys conducted with the use of a helicopter by Werner in 1974 and 1975 sought to characterize the distribution and abundance of sparrows in this region. These initial surveys revealed that sparrows were widely distributed and abundant (Werner 1975). They occupied an area of about 21,745 to 31,629 acres, and the number of sparrows occurring within this area was estimated to range from 1,500 to 26,300 individuals (Werner 1975). Because of the magnitude of the area occupied and the large estimates of population size, ecologists concluded that sparrows probably occurred within this area for many years. The difficulty in accessing the areas and the vastness of the areas (Kushlan and Bass 1983), as well as the secretiveness of the sparrow, all contributed to the failure to document the sparrow's occurrence in the area previously. The sparrow populations within these areas probably fluctuated over time in response to changes in habitat suitability resulting from fires and hydrologic conditions (Taylor 1983; Kushlan and Bass 1983). These fluctuations may have also contributed to the lack of sparrow detections in these areas.

The 1981 sparrow survey provided a good baseline on the distribution and abundance of sparrows at that time, and the 1992 survey results were remarkably similar, though there is no information available about how the population may have changed over the intervening 12 years.

The overall sparrow population has declined since 1992, and there has been no evidence of significant improvements (Table 3). In addition to the decline in overall numbers, the distribution has declined. The sparrow subpopulations that have declined have also contracted toward the center of the remaining habitat patches (Cassey et al. 2007).

Threats to the Species

Small populations are particularly at risk from a catastrophic event or series of events, such as fire or major rainfall during the breeding season. About two-thirds of the remaining CSSSs currently occur within subpopulation B, which has remained relatively stable. However, if a large fire were to occur in this subpopulation, there is a possibility the entire remaining CSSS population may be reduced by 60 percent or more; the area has not burned in over a decade.

There is documented overlap of Burmese python (*Python molurus bivittatus)* populations and sparrow subpopulations. Burmese pythons, a non-native exotic species that now numbers in the thousands if not tens of thousands in ENP, are known to consume a wide variety of prey (Snow et al. 2007), including small birds. Although there has been no documented predation of CSSSs by pythons, it is possible a python would opportunistically prey upon a sparrow.

Climate change and sea level rise pose a threat to sparrows. Sea level rise has been estimated by three separate sources to potentially increase by as much as 0.6 to 6.6 feet by the end of the century (Intergovernmental Panel on Climate Change [IPCC] 2007; Rahmstorf 2007; Pfeffer et al. 2008). Because the entire population of CSSSs occurs in low lying areas in south Florida, the population may experience changes in habitat conditions or availability due to climate change and sea level rise over the next several decades.

Cape Sable Seaside Sparrow Critical Habitat

Critical habitat for the CSSS was initially designated on August 11, 1977 (42 FR 42840). The critical habitat designation was revised on November 6, 2007 (50 FR 62736) and the revised habitat included the following primary constituent elements (PCE), which are those physical and biological features essential for the conservation of the species:

1. Calcitic marl soils characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades. These soils support the unique vegetation community and probably many of the food items upon which sparrows depend. They also result from specific hydrologic conditions that are characteristic of the marl prairies. These soils are an integral component of sparrow habitat.
2. Herbaceous vegetation that includes greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species (when measured across an area of greater than 100 feet): Muhly grass, Florida little bluestem, black-topped sedge, and cordgrass. These plant species are largely characteristic of areas where sparrows occur. They act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Many other herbaceous plant species and low-growing forbs also occur within sparrow habitat (Ross et al. 2006), and some of these may have important roles in the life history of the sparrow. However, the species identified in the PCE consistently occur in areas occupied by sparrows (Sah et al. 2007).

3. Contiguous open habitat. Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. This PCE provides the space for population and individual growth, and also provides the open, contiguous habitat that sparrows prefer.
4. Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches longer than 30 days during the period from March 15 to June 30 more than 2 out of every 10 years.

Currently, critical habitat includes areas of land, water, and airspace in the Taylor Slough vicinity of Collier, Miami-Dade, and Monroe Counties. Much of this area is within the boundaries of ENP. The designated area encompasses about 84,865 acres and includes portions of subpopulations B through F (Figure 4).

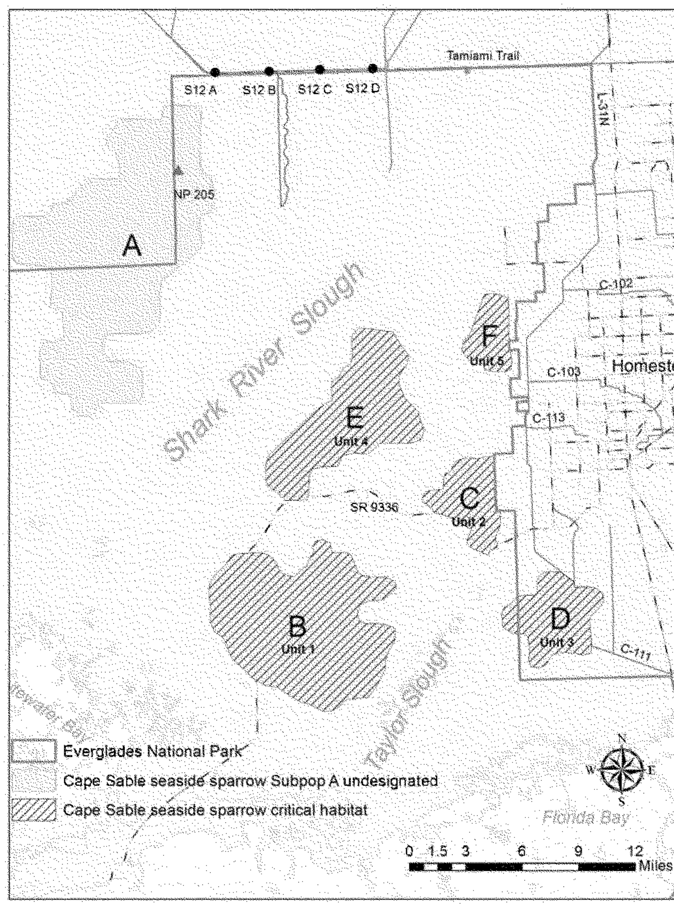

Figure 4. Cape Sable seaside sparrow designated critical habitat map.

Analysis of the Species/Critical Habitat Likely to be Affected

The proposed action has the potential to adversely affect CSSS adults, juveniles, nests, and nestlings within the action area. The effects of the proposed action on this species will be considered further in the remaining sections of this Programmatic Biological Opinion. Potential effects include injury, mortality, disturbance, nest abandonment, degradation, fragmentation, or loss of habitat, and prey reduction resulting from construction, operation, and maintenance of the CEPP.

The proposed action has the potential to adversely affect CSSS critical habitat within the action area. Potential effects include habitat degradation, fragmentation, or loss resulting from construction, operation, and maintenance of the CEPP.

Everglade Snail Kite

Species/Critical Habitat Description

The Everglade snail kite is one of three subspecies of snail kite, a wide-ranging New World raptor found primarily in lowland freshwater marshes in tropical and subtropical America from Florida, Cuba, and Mexico south to Argentina and Peru. The Everglade subspecies occurs in Florida and Cuba, though only the Florida population is listed. The Florida population was first listed under the Endangered Species Preservation Act in 1967, and protection was continued under the Endangered Species Conservation Act of 1969. The Everglade snail kite, and all the other species listed under the Endangered Species Conservation Act of 1969 were the first species protected under the Act of 1973, as amended, and all of these species were given the 'endangered' status.

Life History

Everglade snail kites are dietary specialists, a relatively rare foraging strategy among raptors. The Florida apple snail (*Pomacea paludosa*) is the kite's principal prey in Florida and makes up the great majority of the kites' diet (Sykes 1987a; Kitchens et al. 2002). Throughout the range of all subspecies of snail kites, *pomacea* snails consistently compose the primary prey of snail kites (Sykes 1987a; Beissinger 1990). Several species of non-native apple snails have become established recently within the kite's range in Florida and have been used to varying degrees by snail kites. Whether exotic apple snails are a threat to snail kites is not yet known (SEI 2007a,b). The close tie between the Everglade snail kite and the Florida apple snail require consideration of both species when developing management strategies and addressing potential impacts.

Everglade snail kites and their primary prey are both wetland-dependent species and rely on wetland habitats for all aspects of their life history. The primary wetland habitat types upon which kites rely consist of freshwater marshes and the shallow-vegetated littoral zones along the edges of lakes (natural and man-made) where apple snails occur in relatively high abundance and can be found and captured by kites.

While kites are capable of foraging successfully under a variety of habitat conditions, the preferred foraging habitat is typically a combination of relatively short-stature, sparse graminoid marsh vegetation less than 6.5 feet in height. The apple snail requires emergent aquatic plants to provide substrate that allows them to reach the water surface to breathe. However, for kites to feed, the emergent vegetation must be sparse enough that they are capable of locating and capturing snails (Kitchens et al. 2002). Marshes and lake littoral zones composed of interconnected areas of open water 0.6 to 4.3 feet deep which are relatively clear and calm and patches of herbaceous emergent wetland plants or sparse continuous growth of herbaceous wetland plants generally provide the appropriate balance of emergent vegetation and open water (Sykes et al. 1995; Kitchens et al. 2002). Marsh species that commonly occur within favorable kite foraging habitat include spike rush (*Eleocharis cellulosa*), maidencane (*Panicum hemitomon*), sawgrass, bulrush (*Scirpus* spp.), and/or cattails. Shallow open-water areas may also contain sparse cover of species such as white water lily (*Nymphaea odorata*), arrowhead (*Sagittaria lancifolia*), pickerel weed (*Pontederia lanceolata*), and floating heart (*Nymphoides aquatica*). Periphyton growth on the submerged substrate provides food source for apple snails, and submergent aquatic plants, such as bladderworts (*Utricularia* spp.) and eelgrass (*Vallisneria* spp), may contribute to favorable conditions for apple snails while not preventing kites from detecting snails (Sykes et al. 1995).

Using field data from 1995 to 2004, Darby et al. (2006) estimated that snail densities less than 0.14 individuals per square-meter are unable to support kite foraging. Darby et al. (2008) also reported that adult snails can survive dry downs lasting up to 12 weeks, although smaller snails survive at lower rates (<50 percent alive after 8 dry weeks). Snail recruitment may be truncated if dry downs occur during the peak breeding season when young snails can become stranded (Darby et al. 2008). Darby et al. (2009) recommended a range of water depths between 4 and 20 inches during the peak apple snail breeding period between April and June.

Foraging habitat conditions that differ substantially from those described above will result in either reduced apple snail density or reduced ability of snail kites to locate and capture snails. Vegetation cover that is either too dense or too sparse can result in reduction in the quality of the area as foraging habitat.

The Everglade snail kite breeding season in Florida varies from year-to-year and is probably affected by rainfall and water levels (Sykes et al. 1995). Ninety-eight percent of the nesting attempts are initiated from December through July, while 89 percent are initiated from January through June (Sykes 1987c; Beissinger 1988; Snyder et al. 1989), with the peak in nest initiation occurring from February to April (Sykes 1987c). Snail kites often re-nest following failed attempts early in the season as well as after successful attempts (Beissinger 1986; Snyder et al. 1989), but the actual number of clutches per breeding season is not well documented (Sykes et al. 1995).

Pair bonds are established prior to egg-laying and are relatively short, typically lasting from nest initiation through most of the nestling stage (Beissinger 1986; Sykes et al. 1995). Male kites select nest sites and conduct most nest-building, which is probably part of courtship (Sykes 1987c; Sykes et al. 1995). Unlike most raptors, snail kites do not defend large territories and frequently nest in loose colonies or in association with wading bird nesting colonies (Sykes

1987b; Sykes et al. 1995). Kites actively defend small territories extending about 4 miles around the nest (Sykes 1987b). Copulation can occur from early stages of nest construction, through egg-laying, and during early incubation, if the clutch is not complete. Egg-laying begins soon after completion of the nest, but may be delayed a week or more (Sykes 1987c). An average 2-day interval between laying each egg results in the laying of a 3-egg clutch in about 6 days (Sykes et al. 1995). The clutch size ranges from one to five eggs, with a mode of three (Sykes 1987c; Beissinger 1988; Snyder et al. 1989). Incubation may begin after the first egg is laid, but generally after the second egg (Sykes 1987c). In Florida, the incubation period lasts 24 to 30 days (Sykes 1987c). Incubation is shared by both sexes, but the contribution of incubation time between the male and female is variable (Beissinger 1987). Hatching success is variable from year-to-year and between areas. In nests where at least one egg hatched, hatching success averaged 2.3 chicks per nest (Sykes 1987c).

After hatching, both parents initially participate in feeding young, but there is variability in the contribution of each member of the pair (Beissinger 1987). The nestling period lasts about 23 to 34 days and fledging dates may vary by 5 days among chicks (Sykes et al. 1995). Following fledging, young are fed by one or both adults until they are 9 to 11 weeks old (Beissinger 1987). In total, snail kites have a nesting cycle that lasts about 4 months from initiation of nest-building through independence of young (Beissinger 1986; Sykes et al. 1995).

Snail kites also have a relatively unique mating system in Florida that is described as ambisexual mate desertion, in which either the male or female may abandon nests part way through the nestling stage (Beissinger 1986, 1987). This behavior appears to occur primarily under conditions when prey is abundant, and it may be an adaptation to maximize productivity during favorable conditions. Following abandonment, the remaining parent continues to feed and attend chicks through independence (Beissinger 1986). Abandoning parents presumably form new pair bonds and initiate a new nesting attempt. Snail kites mature early compared with many other raptors and can breed successfully the first spring after they hatch, when they are about 8 to 10 months old. However, not all kites breed at this age. Bennetts et al. (1998) reported that only 3 out of 9 first-year snail kites attempted to breed, while all 23 adults that were tracked attempted to breed. Of the 23 adult kites, 15 attempted to breed once, seven attempted to breed twice, and one individual attempted to breed 3 times. Only one adult kite successfully fledged two clutches (Bennett et al. 1998). Adult kites generally attempt to breed every year with the exception of drought years, when some kites may not attempt to nest (Sykes et al. 1995).

Nesting almost always occurs over water, which deters predation (Sykes 1987b). An important feature for snail kite nesting habitat is the proximity of suitable nesting sites to favorable foraging areas. Thus, extensive stands of contiguous woody vegetation are generally unsuitable for nesting, whereas suitable nest sites consist of single trees or shrubs or small clumps of trees and shrubs within or adjacent to an extensive area of suitable foraging habitat. Trees usually less than 32 feet tall are used for nesting include willow (*Salix* spp.), bald cypress (*Taxodium distichum*), pond cypress (*Taxodium ascendens*), *Melaleuca quinquenervia*, sweetbay (*Magnolia virginiana*), swamp bay (*Persea borbonia*), pond apple (*Annona glabra*), and dahoon holly (*Ilex cassine*). Shrubs used for nesting include wax myrtle (*Myrica cerifera*), cocoplum (*Chrysobalanus icaco*), buttonbush (*Cephalanthus occidentalis*), *Sesbania* sp, elderberry (*Sambucus simpsonii*), and Brazilian pepper (*Schinus terebinthifolius*). Nesting also can occur in herbaceous vegetation, such as sawgrass, cattail, bulrush, and reed (*Phragmites australis*) (Sykes et al. 1995). Nests are more often observed in herbaceous vegetation around Lake Kissimmee and Lake Okeechobee during periods of low water, when dry conditions beneath the willow stands (which tend to grow to the landward side of the cattails, bulrushes, and reeds) prevent snail kites from nesting in woody vegetation. Nests constructed in herbaceous vegetation on the waterward side of the lakes' littoral zone are more vulnerable to collapse due to the weight of the nests, wind, waves, and boat wakes and are more exposed to disturbance by humans (Chandler and Anderson 1974; Sykes and Chandler 1974; Sykes 1987b; Beissinger 1986, 1988; Snyder et al. 1989).

On average, adult snail kites have relatively high annual survival rates with estimated average rates ranging from 85 to 98 percent (Nichols et al. 1980; Bennetts et al. 1999; Martin et al. 2006). Adult survival is probably reduced in drought years (Takekawa and Beissinger 1989; Martin et al. 2006). However, adult survival appears to be relatively constant over time at a relatively high level (>80 percent) (Bennetts et al. 1999; Martin et al. 2006; Cattau et al. 2009). Adult longevity records indicate that kites may frequently live longer than 13 years in the wild (Sykes et al. 1995).

Everglade snail kites may roost communally outside of breeding season and, occasionally, roost in groups of up to 400 or more individuals (Bennetts et al. 1994). Roosting sites are also usually located over water. On average, in Florida, 91.6 percent are located in willows, 5.6 percent in *melaleuca*, and 2.8 percent in pond cypress. Roost sites are in taller vegetation among low profile marshes. Snail kites tend to roost around small openings in willow stands at a height of 5.9 to 20.0 feet in stand sizes of 0.05 to 12.35 acres. Roosting also has been observed in *melaleuca* or pond cypress stands with tree heights of 13 to 40 feet (Sykes 1985).

Snail kites are considered nomadic, and this behavior pattern is probably a response to changing hydrologic conditions (Sykes 1979). During breeding season, kites remain close to their nest sites until they fledge young or fail. Following fledging, adults may remain around the nest for several weeks, but once young are fully independent adults may depart the area. Outside of breeding season, snail kites regularly travel long distances within and among wetland systems in southern Florida (Bennetts and Kitchens 1997). While most movements may be in response to droughts or other unfavorable conditions, kites may also move away from wetlands when conditions appear favorable. Movements within large wetlands and movements among adjacent wetland units occurred frequently, while movements among spatially-isolated wetlands occurred less frequently (Martin et al. 2006). Fledgling kites also move frequently, but are more likely to move to immediately adjacent wetland units than adults, which may indicate a degree of familiarity with the availability of wetlands across the landscape that adult kites acquire through experience.

Snail kites are gregarious. In addition to nesting in loose colonies and roosting communally in large numbers, kites may also forage in common areas in proximity to other foraging kites.

Population Dynamics

From a demographic perspective, Everglade snail kites appear to exhibit high levels of variability in some demographic parameters, while others remain relatively constant. For example, distribution of nesting appears to fluctuate dramatically based on annual variability of specific environmental factors, most notably apple snail density and availability (which in turn are affected by current and previous year water levels). Similarly, productivity appears to be highly variable and heavily influenced by environmental conditions (Sykes 1979; Beissinger 1989, 1995; Sykes et al. 1995). Duration of breeding season and amount of double or triple-brooding are also variable (Beissinger 1986). Juvenile survival also appears to be highly variable among years, reaching a record low in 2000 (Figure 5; Beissinger 1995; Bennetts and Kitchens 1999; Martin and Kitchens 2003; Martin et al. 2006; Cattau et al. 2009). The observed variability in juvenile survival is related to variation in environmental conditions, including those hydrologic conditions that directly affect the survival and productivity of the apple snail. Because the apple snail is the primary source of food for the snail kite, hydrologic conditions that affect the survival and productivity of the apple snail have significant effects on snail kite nest success and the survival of juvenile snail kites. In contrast, adult survival appears to be relatively constant over time at a relatively high level (>80 percent) (Bennetts et al. 1999; Martin et al. 2006; Cattau et al. 2009), with the exception of appreciable drops from 2000 through 2002, and again from 2006 through 2008 (Figure 5). During these years, adult survival decreased by 16 percent from 2000 to 2002 (Martin et al. 2006), and by approximately 35 percent from 2006 to 2008 (Cattau et al. 2009). These temporary low adult survival rates coincided with significant declines in the overall population associated with region-wide droughts during 2001 and 2007 (Figure 6). During more localized droughts, their nomadic behavior allows kites to survive and even reproduce (at lower levels) in areas less affected by the unfavorable conditions. Under favorable environmental conditions, kites have the ability to achieve high reproductive rates (Beissinger 1986), and similarly, juvenile survival rates appear to be higher under more favorable conditions.

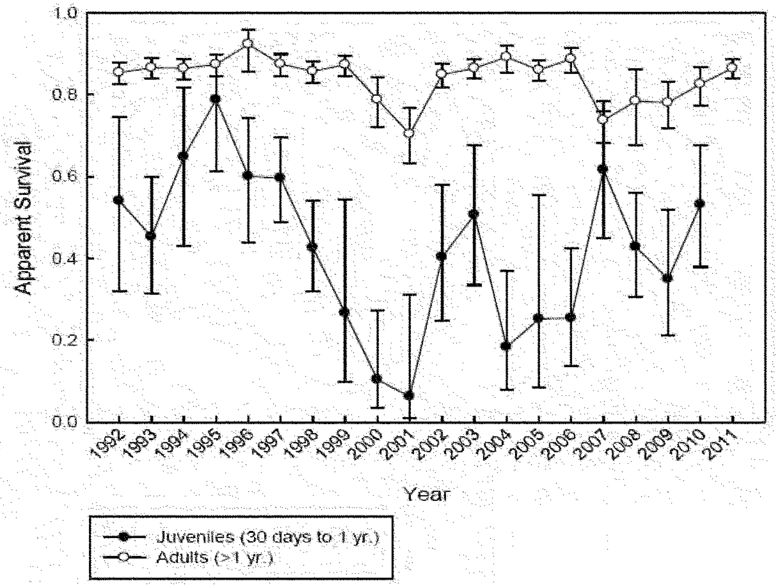

Figure 5. Model averaged estimates of adult (white circles) and juvenile (black circles) survival from 1992 to 2011 (Cattau et al. 2012). Error bars correspond to 95 percent confidence intervals.

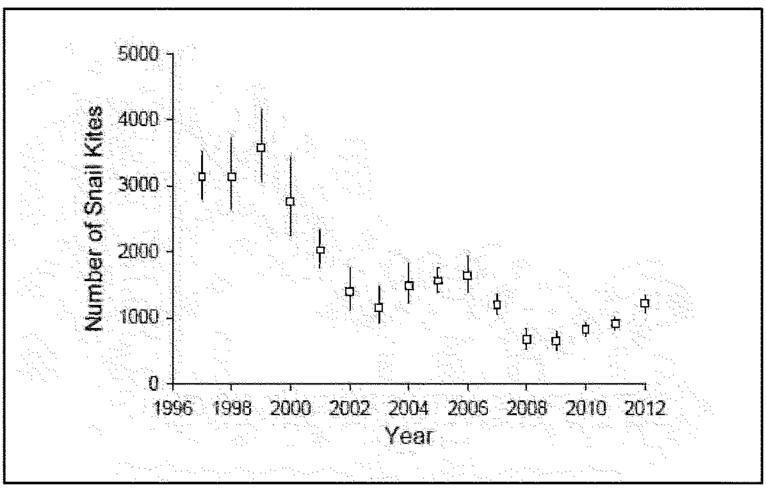

Figure 6. Estimated snail kite population size from 1997 to 2012 (Cattau et al. 2012) using the super-population approach.

Several authors (Nicholson 1926; Howell 1932; Bent 1937) indicated that the snail kite was numerous in central and southern Florida marshes during the early 1900s, with groups of up to 100 birds. Reports of snail kite population declines in the 1940s and 1950s suggested that as few as 6 to 100 individuals remained (Sykes 1979). When the snail kite was listed as endangered in 1967, the species was considered to be at an extremely low population level. In 1965, only 10 birds were found, 8 in WCA-2A, and 2 at Lake Okeechobee. A survey in 1967 found 21 birds in WCA-2A (Stieglitz and Thompson 1967). Relatively large fluctuations in the Everglade snail kite population size have been widely reported and generally attributed to environmental conditions (Beissinger 1986; Beissinger 1995; Martin et al. 2006; Cattau et al. 2008). It is unclear whether the reports of declines were completely from a loss in the number of individuals or a result of the kite's nomadic behavior, limited survey efforts, and the lack of biological knowledge of the species. As it was not known at the time that snail kites are nomadic in response to unfavorable hydrologic conditions (Sykes 1979), it is possible the surveys were documenting more the absence of snail kites from their usual locations, including Lake Okeechobee and the headwaters of the St. John's marsh (Sykes 1979), and not entirely from the actual loss of individual kites. In addition, limited resources were available at that time for researchers to reach potential snail kite habitats. As such, the resulting low level of survey effort may have biased these low snail kite population estimates. Rodgers et al. (1988) have stated that it is unknown whether decreases in reported snail kite numbers in the annual count are due to mortality, dispersal (into areas not counted), decreased productivity, or a combination of these factors. However, there is little doubt that the snail kite was endangered at the time of its listing and that its range had been dramatically reduced.

Prior to 1969, the snail kite population was monitored only through sporadic and inconsistent surveys (Sykes 1979, 1984). From 1969 to 1994, an annual quasi-systematic mid-winter snail kite count was conducted by a succession of principal investigators, with counts ranging from a low of 65 kites in 1972 to a high of 996 kites in 1994 (Sykes 1979; Sykes 1983; Beissinger 1986; Bennetts et al. 1999). Bennetts et al. (1993, 1994) cautioned that the 1993 and 1994 counts were performed with the advantage of having numerous birds radio-tagged. This likely increased the total count because radio-tagged birds could easily be located and often led researchers to roosts that had not been previously surveyed. Bennetts and Kitchens (1997) identified issues with the count surveys and recommended that they should not be the basis of population estimates or used to infer demographic parameters such as survival or recruitment. Bennetts et al. (1999) analyzed these counts and the sources of variation in these counts and determined that count totals were influenced by differences in observers, survey effort, hydrologic conditions, and site effects. While significant sources of error were identified, these data could provide a crude indication of trends if all influences of detection rates had been adequately taken into account. The sources of variation in the counts should be recognized prior to using these data in subsequent interpretations, especially in attempting to determine population viability and the risk of extinction.

Refined population estimates were generated for the Everglade snail kite using a mark-recapture method beginning in 1997 (Dreitz et al. 2002). These new population estimates, which incorporate detection probability (<1.0), are higher than those resulting from the previous counts. Population size estimates generated from mark-recapture estimates for 1997 to 2000 are approximately 2 to 3 times higher than previous count-based estimates (*e.g.*, 800 to

1,000 estimated snail kites based on count-based surveys in 1993 and 1995, compared to an estimated 2,700 to 3,500 kites based on mark-recapture analyses from 1997 to 2000) (Bennetts and Kitchens 1997; Dreitz et al. 2002). Confidence intervals can also be generated for population estimates generated using the new method, which increases the validity of comparing population estimates among years.

Since 1997, population estimates and estimates of demographic parameters have been generated exclusively employing mark-recapture methods that incorporate detection probabilities. From 1997 through 1999, the snail kite population was estimated to be approximately 3,000 birds (Dreitz et al. 2002). From 1999 through 2002, the population estimates declined each year until they reached a low level of approximately 1,400 birds in 2002 and 2003, then increased slightly to about 1,700 birds in 2004 and 2005 (Martin et al. 2006). The snail kite population exhibited steep declines in both 2007 and 2008, with estimates of 1,204 birds and 685 birds, respectively, but rebounded slightly starting in 2010. The 2012 population estimate was 1,218 birds (Cattau et al. 2012). At this time, there is no published estimate for 2013; however, preliminary indications are that it is similar or slightly lower than for 2012.

The observed declines in the kite population from 1999 to 2002 (Figure 6) coincided with a regional drought that affected central and south Florida during 2000 to 2001. During this period, nest success was generally low, and demographic parameters estimated using mark-recapture methods indicated low juvenile survival rates (Martin et al. 2006). Adult survival also declined during 2001 (Figure 5; Martin et al. 2006). Despite the return to normal or wetter-than-normal hydrologic conditions from 2002 to 2006, which generally provide favorable snail kite nesting conditions, population estimates remained low, and nest success and juvenile survival rates also remained low (Martin et al. 2006). Nest success and number of young fledged increased slightly in 2007 and 2008 (Cattau et al. 2009), despite severe drought conditions in 2007. Juvenile survival significantly increased from 0.226 in 2006 to 0.558 in 2007, then decreased again to 0.381 in 2008 (Cattau et al. 2009). Conversely, adult survival decreased significantly in 2007 from 0.834 to 0.538, then rebounded to 0.826 in 2008 (Cattau et al. 2009). These irregularities are likely a result of the increased utilization of the Kissimmee Chain of Lakes (KCOL), where a majority of young fledged in 2007. Historically, water levels in KCOL have been less affected by adverse drought conditions (Bennetts and Kitchens 1997).

In 2012 and 2013, conditions in Lake Okeechobee continued to improve for kites, and in WCA-3A there was a marked increase in nesting attempts (68 nests) although only 18 of these were successful. Hypotheses for this increase range from naturally occurring favorable hydrologic and climatic conditions to an observed increase in the abundance of exotic apple snails in southern WCA-3A. Environmental conditions in the KCOL continued to allow for the highest nest success rates. While the estimated population size for 2012 along with the increased number of fledglings counted during the 2011 and 2012 breeding seasons are encouraging trends, it remains unclear whether such trends signify the beginning of a recovery phase.

Based on demographic parameters generated using mark-recapture methodology, a population viability analysis (PVA) for the Everglade snail kites was conducted in 2006. This PVA indicated that there is a high probability of quasi-extinction (identified as $\leq$ 50 female snail kites) within the next 50 years if current reproduction, survival, and drought frequency rates remain the same as those observed from 1996 to 2006 (Martin et al. 2007; Cattau et al. 2008, 2009). Quasi-extinction risk is the probability of a population falling below a critical density – an extremely undesirable population level that may be unlikely to be recoverable even with drastic management steps, such as captive breeding. Snail kite researchers conducted a new PVA which updated the demographic parameters and incorporated effects of variable environmental (hydrologic) states. According to Cattau et al. (2012), the results from the PVA conducted in 2010 "predict a 95 percent probability of population extinction within 40 years." They further state, "These results are especially concerning, as they indicate an increased risk of extinction when compared to results from a previous PVA conducted in 2006. Recent analyses also provide indications of an aging population with problems inherent to older individuals, including increased adult mortality rates and decreased probabilities of attempting to breed, both of which have been shown to be exacerbated during times of harsh environmental conditions" (Cattau et al. 2012).

Status and Distribution

In Florida, the historic range of the snail kite was larger than at present. The current distribution of the snail kite in Florida is limited to central and southern portions of the State. Six large freshwater systems are located within the current range of the snail kite: Upper St. Johns marshes, KCOL, Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin (Beissinger and Takekawa 1983; Sykes 1984; Rodgers et al. 1988; Bennetts and Kitchens 1992; Rumbold and Mihalik 1994; Sykes et al. 1995; Martin et al. 2005). Habitats that have supported snail kites in the Upper St. Johns drainage include the East Orlando Wilderness Park, the Blue Cypress Water Management Area, the St. Johns Reservoir, and the Cloud Lake, Strazzulla, and Indrio impoundments, with most current nesting occurring within the Blue Cypress Water Management Area, also referred to as the St. Johns Marsh (Martin et al. 2006). In the KCOL, snail kites may occur within most of the lakes and adjacent wetlands, with the majority of kite nesting occurring within Lake Kissimmee, Lake Tohopekaliga, and East Lake Tohopekaliga. In the KCOL, kites have also nested in lower numbers on Lakes Hatchineha, Istokpoga, and Jackson.

Lake Okeechobee and surrounding wetlands represent significant snail kite nesting and foraging habitats that have historically supported kites. In the Loxahatchee Slough region of Palm Beach County, snail kites may occur in the Loxahatchee National Wildlife Refuge (NWR; WCA-1) and throughout the remaining marshes in the vicinity, most frequently nesting within Grassy Waters, also known as the West Palm Beach Water Catchment Area. Kites may occur within nearly all remaining wetlands of the Everglades region, with recent nesting occurring within WCA-2B, WCA-3A, WCA-3B, and ENP (Martin et al. 2006). Within the Big Cypress basin, snail kites may occur within most of the non-forested and sparsely forested wetlands. Nesting has not been regularly documented in this area in recent years, though some nesting likely occurs.

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 refugium, especially during droughts in the lake, may have significant demographic consequences (Takekawa and Beissinger 1989; Kitchens et al. 2002; Martin et al. 2006a). Once a productive breeding site, Lake Okeechobee made only minor contributions to the snail kite population in terms of reproduction from 1996 to 2006 (Cattau et al. 2008). The loss of suitable snail kite foraging and nesting areas within Lake Okeechobee was attributed to shifts in water management regimes (Bennetts and Kitchens 1997), along with habitat degradation due to hurricanes (Cattau et al. 2008). Most of the nesting in Lake Okeechobee prior to 2007 had occurred within the expansive marsh in the southwestern portion of the lake and the area southwest of the inflow of the Kissimmee River (Martin et al. 2006). However, there was no nesting within Lake Okeechobee from 2007 to 2009 and only limited nesting in 2010 within portions of the lake that are outside of the historic nesting areas.

The 2010 nesting occurred in two general areas: (1) the littoral zone from just west of where the Kissimmee River enters the lake northward to the city of Okeechobee, including Eagle Bay Marsh and (2) near Observation Island, located along the open water edge of the littoral zone in the southwest portion of the lake. However, since then, water levels in the lake have generally been lower and aquatic vegetation has improved in the lake. As a result, snail kite nesting attempts have increased. In 2011, there were 39 nest attempts, but only 16 were successful producing 26 nestlings. In 2012, there were 76 nest attempts, but only 23 were successful producing 43 nestlings. Okeechobee accounted for 25 percent of the range-wide nesting effort and produced 21 percent of the fledglings in 2012 (Cattau et al. 2012). Data have not yet been verified for 2013, but indications are that nesting attempts and success were similar to of 2012. It is important to note that there has been a large increase in the exotic apple snail population in the last few years in Lake Okeechobee. Snail kites are exploiting this population, but the long-term sustainability of this is unclear. The abundance of native apple snails seems still seems to be too low to support large numbers of nesting snail kites on Lake Okeechobee.

Water Conservation Area 3A, once an important snail kite foraging and nesting area, no longer supports high densities of snail kites. Historically, the WCAs, and WCA-3A in particular, have fledged, proportionally, the large majority of young in the region. No young were fledged in WCA-3A in 2001, 2005, 2007, 2008, or 2010. In 2012, only one successful nest, which fledged one young, was observed in WCA3A. The decline in breeding activity and success observed in WCA-3A over recent years may reflect deteriorating habitat quality. Although the overall trend in 3A has been down, recent upticks in successful nesting attempts in 2011 and 2013 may indicate a positive change in suitable habitat. In 2013, there were 68 nesting attempts predominately in southwestern 3A of which 18 were successful resulting in 27 fledged birds. It is unclear at this time why kites have increased their usage of 3A; however, it may just be the natural variation in favorable hydrologic and climatic conditions. An increase in exotic apple snail abundance in lower 3A may also be playing a role in increased usage. Nesting activity for the WCAs is summarized in Table 4 for the years 1994 to 2013.

The shift in dependence from Lake Okeechobee and WCA-3A to the KCOL is readily apparent as reproduction within this watershed has accounted for 52, 12, 89, 72, and 61 percent of the successful nesting attempts range-wide in 2005, 2006, 2007, 2008, and 2009, respectively (Cattau et al. 2009). Lake Toho accounted for 41 percent of all successful nests and 57 percent of all fledged young that were documented on a range-wide basis from 2005-2010. In 2012, Toho accounted for 25 percent and 24 percent of all successful nests and fledged young, respectively. In 2011, an unprecedented amount of breeding activity occurred on East Toho, which was utilized heavily by breeding kites again in 2012, accounting for 27 percent and 30 percent of all successful nests and fledged young, respectively.

Table 4. Number of active and successful snail kite nests, calculated nest success, number of young fledged, and general location (south [S], central [C], and north-central [NC]) of nesting within WCA- 3A from 1994 to 2013. Active nests are those with at least one egg laid; successful nests are those having at least one young fledged.

Year	Active Nests	Successful Nests	Nest Success	Number of Young Successfully Fledged	General Location of Nesting within WCA-3A
1994	41	19	0.46*	24	No location data
1995	66	21	0.32*	38	No location data
1996	79	35	0.44	63	S
1997	247	140	0.57	303	C-S
1998	221	84	0.38	176	NC-C-S
1999	70	14	0.20	19	C-S
2000	112	33	0.29*	56	NC-C-S
2001	0	0	NA	0	--
2002	60	21	0.35	35	S
2003	82	27	0.32*	34	C-S
2004	49	19	0.39*	29	C-S
2005	12	0	0.00	0	S
2006	61	13	0.22	13	C-S
2007	3	0	0.00	0	S
2008	0	0	NA	0	--
2009	11	1	0.09	2	C-S
2010	15	0	0.00	0	C-S
2011	23	11	0.48	11	W
2012	7	1	0.15	1	W
2013**	68	18	0.26	27	W-S

*Survey data during 1994, 1995, 2000, 2003, and 2004 include many nests with undetermined fate, some of which may have been successful. Thus, calculated estimates of nest success for these years are minimums that would increase if any nests of undetermined fate were actually successful.
**Unverified data

In addition to the primary wetlands discussed above, there are numerous records of kite occurrence and nesting within isolated wetlands throughout the region. In the 1990's, Sykes et al. (1995) observed snail kites using smaller, more isolated wetlands including the Savannas State Preserve in St. Lucie County, Hancock Impoundment in Hendry County, and Lehigh Acres in Lee County. Takekawa and Beissinger (1989) identified numerous wetlands that they considered drought refugia, which may provide kite foraging habitat when conditions in the larger more traditionally occupied wetlands are unsuitable. Radio tracking of snail kites has also revealed that the network of habitats used by the species includes many smaller, widely dispersed wetlands within this overall range (Bennetts and Kitchens 1997). Everglade Snail kites may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. For example, 2010 snail kite nesting surveys documented nesting in surprisingly high numbers in peripheral areas such as Harns Marsh, in Lehigh Acres, and STA 5. A kite nest and juveniles were also observed for the first time in the S-332D detention area in eastern ENP, also known as the Frog Pond. However, the majority of nesting continues to be concentrated within the large marsh and lake systems of the Greater Everglades, the Kissimmee basin, and the Upper St. John's marshes.

Recent population estimates are 2 to 3 times more accurate than those produced prior to 1997 owing to the improved mark-resighting method first applied in 1997 to 2000 and refined in 2002 (Dreitz 2000; Dreitz et al. 2002). While it is not possible to compare the current population size to those recorded from the 1970s through 1997 due to differences in sampling methods, several lines of evidence suggest that the current kite population has declined and may continue to decline. Two major reductions in numbers occurred following region-wide droughts in 2001 and 2007 (Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008). The kite population dropped by more than 75 percent from an estimate of approximately 3,400 birds in 1999 to fewer than 700 in 2008 and 2009 (Figure 6; Cattau et al. 2009). In addition to negative effects of regional droughts on adult and juvenile survival, the distribution of nesting activity prior to 2011 suggests that several of the traditional nesting areas (Lake Okeechobee and WCA-3A) had suffered from a decreased forage base and the loss of suitable foraging and nesting habitat. Low productivity, both in terms of low rates of nest initiation and low success rates from those nests initiated, suggests that conditions were poor for kite nesting in those years.

More recently, conditions in Lake Okeechobee have improved but not in WCA-3A. Relatively low juvenile survival rates in recent years also support the conclusion that conditions for kites in the recent past have been relatively unfavorable due to a variety of factors. Recent studies implicate low recruitment and a decline in the species' nearly exclusive food source, the apple snail, as factors in the pre-2011 population decline (Cattau et al. 2008). The increase in abundance and distribution of exotic apple snails since then has seemed to be one of the reasons for the recent kite population increase. The existing water management system, especially during extreme meteorological conditions, contributes to unnatural water levels and altered marsh recession rates that are hypothesized causes for the decline in snail kites and their native prey. Because apple snails are the primary food source for the snail kite, changes in hydrology that affect the survival and productivity of the apple snail and their availability to snail kites have a direct effect on the survival and productivity of the snail kite (Mooij et al. 2002).

Studies of native apple snail abundance and occurrence within traditional snail kite nesting areas also support conclusions that foraging conditions may have been poor in some of those areas. Darby (2005a, b) reported that native apple snail abundance was relatively low in areas of traditional snail kite use within Lakes Kissimmee, Tohopekaliga, and Okeechobee. Wight et al. (2013) reported finding no native adult apple snails in the northern and northwestern sections of Lake Okeechobee in 2012 (native snail egg masses were observed); however, they reported densities of exotic apples snails ranging from 0.17 to 8.5 snails/m2. The size distribution for these exotic snails were similar to native snails that kites typically target for foraging (*i.e.*, 75 percent were 30-50 mm in size; average size 29 ± 10 mm StdDev).

In 2002 and 2003, Darby et al. (2005) found high snail densities (*e.g.*, > 1.0 snail per m^2) at sampled sites in southern WCA-3A. In 2004, they documented an 80 percent reduction in snail densities at these same sites. This dramatic decline followed a wet spring during 2003, in which water depths remained above 1.3 to 2.0 feet during the peak snail reproductive season (April to June) and snail egg cluster production was both delayed and reduced (Darby et al. 2005). Relatively low snail densities (0.02 to 0.40 snails per m^2) continued at sampled sites into 2005 to 2007 (Darby et al. 2009). Calculated annual per capita egg production (total number of egg clusters for the year divided by snail density) at these sites ranged from 4 to 45. Darby et al. (2009) concluded that an annual per capita egg production of approximately 15 to 20 would result in a stable or increasing snail population in the following year. Conversely an annual per capita egg production ≤ 5 would result in a substantial decline in the snail population the following year (Darby et al. 2009). Sampling conducted at a subset of these sites in 2010 indicates that snail densities remain low (0.06 to 0.08 snails per m^2) and recovery following the 2003 high water year will be slow (Darby 2010). Comparing the data collected in the 2002 to 2004 study with the data collected in the 2005 to 2007 study revealed that snail demography is directly impacted by temporal and spatial variations in hydrologic conditions – specifically, minimum and maximum water depths during the dry (breeding) season (Darby et al. 2009).

Currently, snail densities in WCA-3A have still not recovered compared to densities found in 2002-2003 (Wight et al. 2013). In all sites sampled in WCA3A in 2010-2012, snail densities were <0.2 snails/ m^2 and in many sites, no snails were found (Wight et al. 2013). Overall snail densities in WCA3A were relatively low compared to sites sampled in 2003 in which most sites had snail densities >0.5 snails/m^2. No exotic snails were found in any sites in WCA-3A in 2002-2007; however, in 2011, exotic snails were found in several sites in southwestern WCA-3A. Native snails found in WCA-3A from 2011-2012 had an average size of 28 mm. Exotic snails had an average size of 53 mm, and in general overlapped with the native snails at sizes >30 mm. In WCA-3B, densities were similar between 2006 and 2012, and very low (<0.1 snail/ m^2). No exotic snails were found in WCA-3B in 2010 or 2012 (Wight et al. 2013).

Threats to the Species

There are a variety of threats that have been identified which affect kite nesting, kite foraging, and survival. These threats include loss of wetland habitats, degradation of wetland habitat, changes in hydrologic conditions, and impacts to prey base.

The principal threat to the snail kite is the loss, fragmentation, and degradation of wetlands in central and southern Florida resulting from urbanized and agricultural development and alterations to wetland hydrology through ditching, impoundment, and water level management. Nearly half of the Everglades have been drained for agriculture and urban development (Davis and Ogden 1994; Corps 1999). The EAA alone eliminated 3,100 square-miles of the original Everglades and the urban areas in Miami-Dade, Broward, and Palm Beach Counties have contributed to the reduction of habitat. North of ENP, which has preserved only about one-fifth of the original extent of the Everglades, the remaining marsh has been fragmented into impoundments (*i.e.*, WCAs). The Corps' Central and Southern Florida (C&SF) Project encompasses 18,000 square-miles from Orlando to Florida Bay and includes about 994 miles each of canals and levees, 150 water control structures, and 16 major pump stations. This system, which was originally designed and constructed to serve flood control and water supply purposes, has disrupted the volume, timing, direction, and velocity of freshwater flow and has resulted in habitat loss and degradation in the WCAs and other portions of the historic Everglades. Drainage of Florida's interior wetlands has reduced the extent and quality of habitat for both the apple snail and the snail kite (Sykes 1983b). Widespread drainage has permanently lowered the water table in some areas. This drainage permitted development in areas that were once kite habitat.

Habitat loss and fragmentation are also factors influencing survival during droughts, despite the species' dispersal ability (Martin et al. 2006). As was discussed previously, the snail kite may use nearly any wetland within southern Florida under some conditions and during some portions of their life history. In dry years, snail kites depend on water bodies that normally are suboptimal for feeding, such as canals, impoundments, or small marsh areas, remote from regularly used sites (Beissinger and Takekawa 1983; Bennetts et al. 1988; Takekawa and Beissinger 1989). The fragmentation or loss of wetland habitat significantly limits the snail kites' ability to be resilient to disturbance events such as various climatic events. As wetland habitats become more fragmented, the dispersal distances become greater putting increased stress on dispersing kites that may not be able to replenish energy supplies.

Degradation of wetland habitat, particularly due to degradation in water quality primarily through runoff of phosphorus from agricultural and urban sources, is another concern for the snail kite. The Everglades was historically an oligotrophic system, but major portions have become eutrophic, primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Most of this increase has been attributed to non-point source runoff from agricultural lands north of Lake Okeechobee, in the Kissimmee River, Taylor Slough, and Nubbin Slough drainages (Federico et al. 1981). Elevated phosphorus concentrations and loads in the Everglades have long been associated with increases in cattail expansion, which may influence the critical habitat for the snail kite. In limnetic environments, cultural eutrophication also is a concern, especially in the KCOL. Nutrient enrichment leads to growth of dense stands of herbaceous emergent vegetation, floating vegetation (primarily water hyacinth [*Eichhornia crassipes*] and water lettuce [*Pistia stratiotes*]), which inhibits the ability of snail kites to forage along the shorelines of lake areas. Large areas of marsh are also heavily infested with water hyacinth, which inhibits the kite's ability to see its prey (Service 2007d). Regulation of water stages in lakes and the WCAs is particularly important to maintain the balance of vegetative communities required to sustain snail kites.

Although there are no direct scientific investigations that we are aware of that directly relate effects of differing nutrient concentrations to success of snail kites, snail kite habitat, apple snails, or apple snail habitat, there is a weight of evidence that indicates that most of these lakes, and large areas of Everglades wetlands within the snail kites range have received nutrient inputs higher than normal and at levels which requires various governmental agencies to perform habitat management. These attempts to control, reduce, and eliminate the spread of invasive and exotic species have also had negative effects on snail kites. Rodgers et al. (2001) described a program to reduce impacts of aquatic plant management on snail kites. They found that the actions of several agencies in controlling aquatic plants have caused nest collapse, particularly in herbaceous vegetation such as cattail and bulrush. They state that these impacts in Lake Okeechobee and the KCOL were reduced through cooperation and improved communication between agencies. In addition to the potential collapse of nests, the Service is concerned about any excessive application of herbicides because this would reduce available habitat for apple snails. The Service has expanded on these coordination efforts to notify aquatic plant management groups during the kite nesting season on the location of active snail kite nests (Service 2006) to assist them in avoiding or minimizing effects.

The snail kite has experienced population fluctuations associated with hydrologic influences, both man-induced and natural (Sykes 1983a; Beissinger and Takekawa 1983; Beissinger 1986; Dreitz et al. 2002; Martin et al. 2007; Cattau et al. 2008), but the amount of fluctuation is debatable. Of particular concern are the water management strategies that have affected the snail kites' success in utilizing the WCAs and Lake Okeechobee as nesting and foraging habitat. Water management activities have increased water stages and hydroperiods in WCA-3A as well as some of the other WCAs, converting significant areas within these impoundments from wet prairie habitats to slough-type habitats. Within the Everglades, wet prairie adjacent to suitable nesting habitat provides the foraging habitat necessary for successful snail kite nesting and juvenile recruitment. Similarly, water management activities within Lake Okeechobee have rendered unsuitable large areas that were once productive breeding grounds. From 1996 to 2006, the Clewiston Flats was the primary area within Lake Okeechobee which provided suitable nesting and foraging habitat for snail kites. However, that area becomes unusable by nesting snail kites at water stages below 15-feet National Geodetic Vertical Datum (NGVD) (Cattau et al. 2009). The water stages in 2006 to 2009 were too low to allow successful nesting and foraging in the Clewiston Flats. Despite higher stages in 2010, the habitat within the Clewiston Flats does not currently support kite nesting or foraging as it has become too thick to support sufficient numbers of apple snails.

Changes in kite foraging habitat that have resulted from hydrologic management have occurred within the littoral zone of Lake Okeechobee. In this area, prolonged deep water caused changes in vegetation that affect kites' ability to forage, and prolonged periods of high and low water impacted the apple snail populations that the kites rely upon for food. They also affected growth and survival of woody plants that kites use as perches. These changes represented a reduction in the quality of foraging habitat for snail kites, and a reduction in the suitability of habitat to support abundant apple snails. Subsequent to 2010, relatively lower lake levels coupled with improvements to the aquatic vegetation and an increase in the exotic apple snail population have allowed kites to nest in other areas of the lake (Moonshine Bay, Observation Island, Okeetantie, and Eagle Bay Marsh). The negative effects of water management within WCA-3A have been similar, and these are discussed at length in the Environmental Baseline section of this Programmatic Biological Opinion. Restoration of habitat, including the management of appropriate water levels within the WCAs and Lake Okeechobee, as suggested by several researchers, is key to successful recovery of the snail kite as it is predicated on their ability to successfully nest in these areas.

In addition to habitat effects, hydrologic conditions, and thus water management actions, may also adversely affect snail kite nest success and juvenile survival both directly (*e.g.*, increased predation) and indirectly (*e.g.*, decreased foraging opportunities). 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 higher for kites nesting near land (*i.e.*, in lakes or reservoirs) compared than those nesting in expansive marsh systems such as WCA-3A. Collapse of nests constructed in herbaceous vegetation is also cited as a cause of increased nest failure during low-water years. This is because the water table is usually below the ground surface at willow heads and other stands of woody vegetation during drought, causing snail kites to nest in herbaceous vegetation, where the nests are more vulnerable to collapse. This effect is also more prevalent in lake environments than in the Everglades.

The abundance of the snail kites' primary prey, apple snails, has been definitively linked to water regimes (Kushlan 1975; Sykes 1979, 1983a; Darby et al. 2005). Extremely low water levels and rapid recession rates can limit foraging opportunities for juvenile snail kites and nesting adults, both of which require a sufficient forage base in the vicinity of the nest (Mooij et al. 2002). Water levels which are too high or too low during the snail breeding season can delay, curtail, or entirely preclude egg cluster production in a given year, thereby resulting in decreased snail abundance and density in the following year(s). Within a given year and at a given location, the availability of apple snails is also dependent on hydrologic conditions (Darby et al., 2006), including water levels and recession rates, and thus water management actions.

Additional potential threats to snail kites include exposure to bioaccumulated contaminants in their prey, the proliferation of exotic snails, and naturally occurring but extreme weather conditions. Copper, used in fungicide applications and commonly found in disturbed areas of Everglades wetlands, has been shown to bioaccumulate in apple snails and may lead to birth defects in snail kite nestlings (Frakes et al. 2008). Uptake of copper through sediments and diet has been demonstrated, with uptake from the latter, as being the primary exposure route for the Florida apple snail (Frakes et al. 2008; Hoang et al. 2008a). The ability of Florida apple snails to bioaccumulate copper has implications for the successful survival and recruitment of the Florida apple snail and its predator, the snail kite, at STAs and water reservoirs created for Everglades restoration projects; however, there is still uncertainty regarding the amount of copper that is actually bioavailable to snail kites. Additional information on Florida apple snail bioaccumulation of copper, copper bioavailability, and average exposure patterns of snail kites under various environmental conditions may be necessary to identify appropriate risk management scenarios for Everglades restoration projects.

Although weather is not under human control, it too affects snail kite nesting success and survival. Inclement weather can result in the decreased kite nesting success. Wind storms can cause toppling of nests, particularly on Lake Okeechobee and Lake Kissimmee due to the long wind fetch across these large lakes. Cold weather can also produce nest failure, either through decreased availability of apple snails or mortality of young due to exposure. Abandonment of nests before egg-laying is also common, particularly during drought or following passage of a cold front.

Everglade Snail Kite Critical Habitat

In total, about 841,635 acres of critical habitat (Figure 7) for the Everglade snail kite was designated in 1977 (50 CFR 17.95). Because this designation was one of the earliest under the Act, PCEs were not defined. The designation identified nine critical habitat units (HU) (Table 5) that included 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 critical HUs by snail kites as productive nesting areas has varied significantly and has also included areas that were not designated as critical habitat. Most recently, the KCOL, Lake Tohopekaliga in particular, now supports the greatest number of snail kites in Florida. This shift in productive nesting areas has been 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.

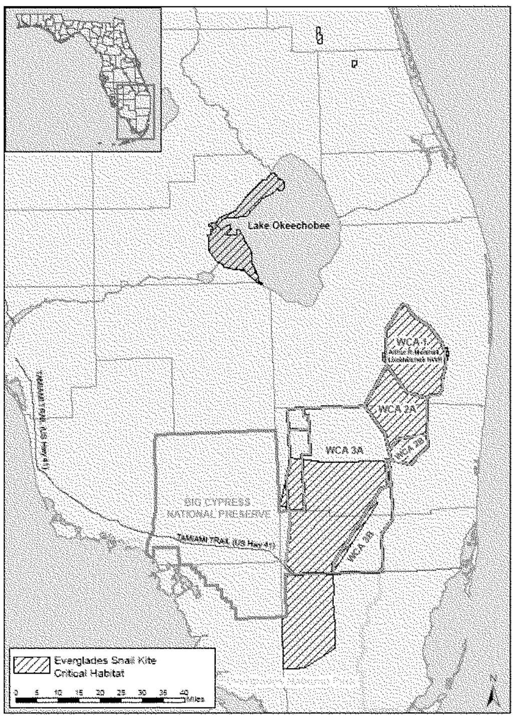

Figure 7. Everglade snail kite designated critical habitat.

Table 5. Everglade snail kite critical HUs and acreage.

Critical Habitat Unit Description	**Acres**
St. Johns Reservoir, Indian River County	2,075
Cloud Lake and Strazzula Reservoirs, St. Lucie County	816
Western Lake Okeechobee, Glades and Hendry Counties	85,829
Loxahatchee NWR, Palm Beach County	140,108
WCA-2A, Palm Beach and Broward Counties	106,253
WCA-2B, Broward County	28,573
WCA-3A. Broward and Miami-Dade Counties	319,078
ENP, Miami-Dade County	158,903
Total	841,635

Habitat degradation in WCA-3A, specifically loss of woody vegetation and conversion of wet prairies to open water sloughs due to prolonged high water conditions and increased hydroperiods, is discussed in detail in the Environmental Baseline section of this Programmatic Biological Opinion. High water levels and extended hydroperiods have resulted in vegetation shifts within WCA-3A, degrading snail kite habitat. The extended deep water conditions from September into January or beyond, whether resulting from meteorological conditions, regulation schedules, or a combination of both, appear to have reduced the amount of woody vegetation in the area and contributed to the transition of wet prairies to open water sloughs (Zweig 2008; Zweig and Kitchens 2008). In addition to deeper water conditions, hydroperiods in WCA-3A have increased, lengthening the time between drying events and further contributing to the conversion of wet prairie.

Analysis of the Species/Critical Habitat Likely to be Affected

The proposed action has the potential to adversely affect Everglade snail kite adults, juveniles, nests, and nestlings within the action area. The effects of the proposed action on this species will be considered further in the remaining sections of this Programmatic Biological Opinion. Potential effects include injury, disturbance, nest abandonment, mortality of nestlings, degradation or loss of habitat, and prey reduction resulting from construction, operation, and maintenance of the CEPP.

The proposed action has the potential to adversely affect Everglade snail kite critical habitat within the action area. Potential effects include habitat degradation, fragmentation, or loss resulting from construction, operation, and maintenance of the CEPP.

Wood Stork

Species/Critical Habitat Description

The wood stork is a long-legged wading bird. The wood stork was listed under the Act as endangered on February 28, 1984 (49 FR 7332). No critical habitat is designated for the wood stork; therefore, none will be affected. The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. Wood storks fly with their neck and legs extended. On adults, the rough scaly skin of the head and neck is unfeathered and blackish in color, the legs are dark, and the feet are dull pink. The bill color is also blackish. Immature wood storks, up to the age of about 3 years, have yellowish or straw-colored bills and varying amounts of dusky feathering on the head and neck (Coulter et al. 1999).

Life History

Wood stork nesting habitat consists of mangroves as low as 3 feet, cypress as tall as 100 feet, and various other live or dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962, Rodgers et al. 1987, Ogden 1991, Coulter et al. 1999). Wood storks nest colonially, often in conjunction with other wading bird species, and generally occupy the larger-diameter trees at a colony site (Rodgers et al. 1996). The same colony site will be used for many years as long as the colony is undisturbed and sufficient feeding habitat remains in surrounding wetlands. However, not all storks nesting in a colony will return to the same site in subsequent years (Kushlan and Frohring 1986). Natural wetland nesting sites may be abandoned if surface water is removed from beneath the trees during the nesting season (Rodgers et al. 1996). In response to this type of change to nest site hydrology, wood storks may abandon that site and establish a breeding colony in managed or impounded wetlands (Ogden 1991). Wood storks that abandon a colony early in the nesting season due to unsuitable hydrological conditions may re-nest in other nearby areas (Borkhataria et al. 2004, Crozier and Cook 2004). Between breeding seasons or while foraging wood storks may roost in trees over dry ground, on levees, or on large patches of open ground. Wood storks may also roost within wetlands while foraging far from nest sites and outside of the breeding season (Gawlik 2002).

While the majority of stork nesting occurs within traditional rookeries, a handful of new stork nesting colonies are discovered each year and each year a number of colonies also become inactive depending on local environmental conditions and sometimes remain inactive (Meyer and Frederick 2004). These new colony locations may represent temporary shifts of historic colonies due to changes in local conditions, or they may represent formation of new colonies in areas where conditions have improved.

Wood storks forage in a wide variety of wetland types, where prey are available and the water is shallow and open enough to hunt successfully (Ogden et al. 1978, Browder 1984, Coulter 1987). Calm water, about 2 to 16 inches in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993). 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 and Bryan 1993, Coulter et al. 1999).

Several factors affect the suitability of potential foraging habitat for wood storks. Suitable foraging habitats must provide both a sufficient density and biomass of forage fish and other prey, and have vegetation characteristics that allow storks to locate and capture prey. During nesting, these areas must also be sufficiently close to the colony to allow storks to efficiently deliver prey to nestlings. Hydrologic and environmental characteristics have strong effects on fish density, and these factors may be some of the most significant in determining foraging habitat suitability, particularly in southern Florida.

Within the wetland systems of southern Florida, the annual hydrologic pattern is very consistent, with water levels rising over 3 feet during the wet season (June-November), and then receding gradually during the dry season (December-May). Storks nest during the dry season and rely on the drying wetlands to concentrate prey items in the ever-narrowing wetlands (Kahl 1964). Because of the continual change in water levels during the stork nesting period, any one site may only be suitable for stork foraging for a narrow window of time when wetlands have sufficiently dried to begin concentrating prey and making water depths suitable for storks to access the wetlands. Once the wetland has dried to where water levels are near the ground surface, the area is no longer suitable for stork foraging and will not be suitable until water levels rise and the area is again repopulated with fish. Consequently, there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with the short hydroperiod wetlands being used early in the season, the mid-range hydroperiod sites being used during the middle of the nesting season, and the longest hydroperiod areas being used later in the season (Kahl 1964, Gawlik 2002).

In addition to the concentration of fish due to normal drying, several other factors affect fish abundance in potential foraging habitats. Longer hydroperiod areas generally support more fish and larger fish (Loftus and Ecklund 1994, Jordan et al. 1998, Turner et al. 1999, Trexler et al. 2002). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential stork foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites, also affect fish density and biomass in southern Florida.

Across the highly modified landscape of southern Florida, fish availability varies with respect to hydrologic gradients and nutrient availability gradients and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a wide variety of hydroperiod classes, nutrient conditions, and spatial variability. Dense submerged and emergent vegetation may reduce foraging suitability by preventing storks from moving through the habitat and interfering with prey detection (Coulter and Bryan 1993). Some submerged and emergent vegetation does not detrimentally affect stork foraging and may be important to maintaining fish populations. Average submergent and emergent vegetation cover at foraging sites was 26 and 29 percent, respectively, at foraging sites at a Georgia colony but ranged from 0 to100 percent (Coulter and Bryan 1993). These cover values did not differ significantly from random wetland sites. Similarly, densely forested wetlands may preclude storks from accessing prey within the areas (Coulter and Bryan 1993). Storks tend to select foraging areas that have an open canopy, but occasionally use sites with 50 to 100 percent canopy closure (Coulter and Bryan 1993, O'Hare and Dalrymple 1997, Coulter et al. 1999).

Carlson and Duever (1979) also noted in their study that long distance movement of fish into deeper habitats is not a regular occurrence in the Big Cypress watershed communities. They also noted in their study that the preponderance of obstacles and plant debris all contribute to hindering mobility and limiting movement across the site. In addition, Chapman and Warburton's (2006) studies on Gambusia, noted that movement between drying pools was limited. Carlson and Duever (1979) concluded in their study that "density and biomass of both wet and dry season fish populations are dependent primarily on the production of the particular site and not of adjacent habitats from which fish may have migrated."

Wood storks feed almost entirely on fish between 1 to 10 inches in length (Kahl 1964, Ogden et al. 1976, Coulter 1987), but may consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Lauritsen (2007; 2009) observed wood stork foraging on crayfish. Studies by Depklin et al. (1992) of wood stork foraging at colonies in east-central Georgia also noted the presence of crayfish in the diets of wood storks. In their analysis, crayfish represented 1 percent of the biomass and 1.9 percent of the prey items. Fish represented 92 percent of all individual prey items and 93 percent of the biomass. A similar study conducted by Bryan and Gariboldi (1997) also noted the presence of crayfish in wood stork diets and noted a similar frequency of occurrence. In the foraging studies conducted by Ogden et al. (1976), Coulter et al. (1999), Carlson and Duever (1979), Turner et al. (1999) and Trexler et al. (2002), little information is provided on consumption of invertebrates. Ogden et al. (1976) summarized information from Kahl's publications (1962, 1964) on stomach contents of wood storks sampled in south Florida and southwest Florida and noted that all individuals examined contained only fish. Ogden et al.'s (1976) study also noted that the prey consumed were fish, although the average density of prawns was 2.5 times the density of the most abundant fish.

Wood storks generally use a specialized feeding behavior called tactilocation, or grope feeding, but also forage visually under some conditions (Kushlan 1979). Storks typically wade through the water with the beak immersed and open about 2.5 to 3.5 inches. When the wood stork senses prey within its bill, the mandibles snap shut and the head is raised and the food is swallowed (Kahl 1964). Occasionally, wood storks stir the water with their feet in an attempt to startle hiding prey (Rand 1956, Kahl 1964, Kushlan 1979). This foraging method allows them to forage effectively in turbid waters, at night, and under other conditions when other wading birds that employ visual foraging may not be able to forage successfully.

Gawlik (2002) characterized wood storks foraging in the Everglades as "searchers" that employ a foraging strategy of seeking out areas of high-density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold, although prey was still sufficiently available that other wading bird species were still foraging in large numbers. Wood stork choice of foraging sites in the Everglades was significantly related to both prey density and water depth (Gawlik 2002). Because of this strategy, wood stork foraging opportunities are more constrained than many of the other wading bird species (Gawlik 2002).

Breeding wood storks are believed to form new pair bonds every season. Eggs are laid as early as October in south Florida and as late as June in north Florida (Rodgers 1990). A single clutch of two to five (average three) eggs is laid per breeding season, but a second clutch may be laid if a nest failure occurs early in the breeding season (Coulter et al. 1999). There is variation among years in the clutch sizes, and clutch size does not appear to be related to longitude, nesting density, or nesting numbers, and may be related to habitat conditions at the time of egg-laying. Egg-laying is staggered and incubation, which lasts about 30 days, begins after the first egg is laid. Therefore, hatching is asynchronous resulting in nestlings of varying size (Coulter et al. 1999). The younger, smaller chicks are first to die during times of scarce food.

The young fledge in about 8 weeks, but will stay at the nest for 3 to 4 more weeks to be fed. The total nesting period, from courtship and nest building through independence of young, lasts about 100 to 120 days (Coulter et al. 1999). Within a colony, nest initiation may be asynchronous and, consequently, a colony may contain active breeding wood storks for a period significantly longer than the 120 days required for a pair to raise young to independence. Adults and independent young may continue to forage around the colony site for a relatively short period following the end of the nesting season.

Wood stork colonies experience considerable variation in production among colonies and years in response to local habitat conditions and food availability (Holt 1929, Kahl 1964, Ogden et al. 1978, Clark 1978, Hopkins and Humphries 1983, Rodgers and Schwikert 1997). Recent studies (Rodgers et al. 2008, Bryan and Robinett 2008, Winn et al. 2008, Murphy and Coker 2008) documented production rates to be similar to rates published between the 1970s and 1990s. Rodgers et al. (2008) reported a combined production rate for 21 north and central Florida colonies from 2003 to 2005 of 1.19$\pm$ 0.09 fledglings per nest attempt (n=4,855 nests). The Palm Beach County Solid Waste Authority colony (M. Morrison 2008) has documented 0.86 fledglings per nesting attempt (2003 to 2008) with annual rates ranging from 0.25 to 1.49.

During the period when a nesting colony is active, storks are dependent on consistent foraging opportunities in wetlands within about 12.4 to 18.6 mi of the nest site (Kahl 1964 and Coulter and Bryan 1993) with the greatest energy demands occurring during the middle of the nestling period, when nestlings are 23 to 45 days old (Kahl 1964). The average wood stork family requires 443 pounds of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). Receding water levels are necessary in south Florida to concentrate suitable densities of forage fish (Kahl 1964, Kushlan et al. 1975).

Fleming et al. (1994) as well as Ceilley and Bortone (2000) believe the short hydroperiod wetlands in south Florida provide an important pre-nesting foraging food source and have a greater effect on early nestling.

Although the short hydroperiod wetlands support fewer fish and lower fish biomass per unit area than long hydroperiod wetlands, these short hydroperiod wetlands were historically more extensive and provided foraging areas for storks during colony establishment, courtship, and nest-building, egg-laying, incubation, and the early stages of nestling provisioning. This period corresponds to the greatest periods of nest failure (*i.e.*, 30 percent and 8 percent, respectively, from egg-laying to hatching and from hatching to nestling survival in 2 weeks) (Rodgers and Schwikert 1997).

Following the completion of the nesting season, both adult and fledgling wood storks generally begin to disperse away from the nesting colony. Fledglings have relatively high mortality rates within the first 6 months following fledging, most likely because of their lack of experience, including the selection of poor foraging locations (Hylton et al. 2006). Post-fledging survival also appears to be variable among years, probably reflecting the environmental variability that affects storks and their ability to forage (Hylton et al. 2006).

In southern Florida, both adult and juvenile storks consistently disperse northward following fledging in what has been described as a mass exodus (Kahl 1964). Storks in central Florida also appear to move northward following the completion of breeding, but generally do not move as far (Coulter et al. 1999). Many of the juvenile storks from southern Florida move far beyond Florida into Georgia, Alabama, Mississippi, and South Carolina (Coulter et al. 1999; Borkhataria et al. 2004; Borkhataria et al. 2006b). Some flocks of juvenile storks have also been reported to move well beyond the breeding range of storks in the months following fledging (Kahl 1964). This post-breeding northward movement appears consistent across years.

Adult and juvenile storks return southward in the late fall and early winter months. In a study employing satellite telemetry, Borkhataria et al. (2006b) reported that nearly all storks that had been tagged in the southeastern U.S. moved into Florida near the beginning of the dry season, including all subadult storks that fledged from Florida and Georgia colonies. Adult storks that breed in Georgia remained in Florida until March, and then moved back to northern breeding colonies (Borkhataria et al. 2006a). Overall, about 75 percent of all locations of radio-tagged wood storks occurred within Florida (Borkhataria et al. 2006a). Range wide occurrence of wood storks in December, recorded during the 1995 to 2008 Audubon Society Christmas Bird Counts for the Southeast U.S. (Audubon 2009a) suggests that the majority of the southeastern United States wood stork population occurs in central and southern Florida. Relative abundance of storks in this region was 10 to 100 times higher than in northern Florida and Georgia (Service 2007b). As a result of these general population-level movement patterns during the earlier period of the stork breeding season in southern Florida, the wetlands upon which nesting storks depend are also being heavily used by a significant portion of the southeastern United States wood stork population, including storks that breed in Georgia and the Carolinas, and subadult storks from throughout the stork's range. In addition, these same wetlands support a wide variety of other wading bird species (Gawlik 2002).

Population Dynamics

The United States' breeding population of wood storks declined from an estimated 20,000 pairs in the 1930s to about 10,000 pairs by 1960 and a low of 2,500 pairs during a severe drought conditions in 1978 (49 FR 7332). The total number of nesting pairs in 1995 was 7,853 with 11 percent in South Carolina, 19 percent in Georgia, and 70 percent in Florida (Service 1997). In general, the population trend has been increasing since 1982 with periodic spikes in nesting attempts presumably during years with extremely favorable conditions. More than 11,000 wood stork pairs nested within their breeding range in the southeastern United States in 2006 (Service 2007b). Likewise, 2009 was a favorable nesting year with 12,720 nesting pairs recorded range-wide. Both of these years included high numbers of nesting pairs in Florida (50 CFR §17 Vol 77, No. 247). The Florida nesting population appears to fluctuate yearly with the 3-year running average ranging from approximately 3,535 to 6,182 for 23 to 63 colonies monitored. Many south Florida colonies have been monitored since listing and south Florida nesting data show a significant drop in nesting pairs from 2,710 (2006) to 770 (2007), and 704 (2008) (Cook and Herring 2007; Cook and Kobza 2008). Researchers attribute this drop to the severe drought conditions present in south Florida during these nesting years.

Nesting pairs range-wide in Florida increased in 2009 potentially due to the extremely favorable conditions in that year similar to 2006. During the 2009 nesting season, Corkscrew Rookery produced 1,120 nests and 2,570 nestlings (Audubon 2009b). Similar rebounds in nest production were recorded for other south Florida rookeries as well, with probably the largest number of nest starts since 2004 (Cook and Kobza 2009). Approximately 3,000 nest starts were estimated within colonies throughout the WCA (Cook and Kobza 2009). Data reported by Cook and Kobza (2009) noted approximately 6,452 nests in south Florida during the 2009 breeding season. Reports of breeding during 2009 from rookeries in north Florida also noted record numbers of wood stork nests (Brooks 2009). For additional information on the wood stork, please see the Multi-species Recovery Plan (MSRP) (Service 1999) and the Service's reclassification proposal (50 CFR §17 Vol 77, No. 247).

Status and Distribution

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; Dusi and Dusi 1968; Cone and Hall 1970; Oberholser and Kincaid 1974). Dahl (1990) estimates these states lost about 38 million acres (15.4 million hectares), or 45.6 percent, of their historic wetlands between the 1780s and the 1980s. Hefner et al. (1994) estimated 55 percent of the 2.3 million acres (0.93 million hectares) 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 occurs in Florida, Georgia, South Carolina, and North Carolina. Breeding colonies of wood storks are documented in all southern Florida counties, except for Okeechobee County.

The primary causes of the wood stork population decline in the United States are loss of wetland habitats and loss of wetland function resulting in reduced prey availability. Almost any shallow wetland depression where fish become concentrated, through either 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 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 from 1900 through 1973. We 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 sawgrass marshes) and found these south Florida wetland habitat types have been reduced by about 35 percent since 1900.

The alteration of wetlands and the manipulation of wetland hydroperiods to suit human needs have also reduced the amount of habitat available to wood storks. The decrease in wood storks nesting on Cape Sable was related to the construction of the drainage canals during the 1920s

(Kushlan and Frohring 1986). Water level manipulation may decrease food production if the water levels and length of inundation do not match the breeding requirements of forage fish. Dry-downs of wetlands may selectively reduce the abundance of the larger forage fish species that wood storks tend to utilize, while still supporting smaller prey fish. Water level manipulation can also facilitate raccoon predation of wood stork nests when water is kept too low (alligators deter raccoon predation when water levels are high). Artificially high water levels may retard nest tree regeneration since many wetland tree species require periodic droughts to establish seedlings.

During the 1970s and 1980s, wood storks were observed to shift their nest sites to artificial impoundments or islands created by dredging activities (Ogden 1991). The percentage of nests in artificial habitats in central and north Florida increased from about 10 percent of all nesting pairs during 1959 and 1960 to 60 to 82 percent from 1976 through 1986 (Ogden 1991). Nest trees in these artificially impounded sites often include exotic species such as Brazilian pepper or Australian pine (*Casuarina equisetifolia*). Ogden (1996) has suggested the use of these artificial wetlands indicates wood storks are not finding suitable conditions within natural nesting habitat or they are finding better conditions at the artificial wetlands. The long-term effect of these nesting areas on wood stork populations is unclear.

Human disturbance is a factor known to have a detrimental effect on wood stork nesting (Service 1997). Wood storks have been known to desert nests when disturbed by humans, thus exposing eggs and young birds to the elements and to predation by gulls and fish crows.

Wood storks forage in a wide variety of wetland types. Wetland habitat types used include freshwater marshes, ponds, hardwood and cypress swamps, narrow tidal creeks or shallow tidal pools, and artificial wetlands such as stock ponds, shallow and seasonally flooded roadside or agricultural ditches, and managed impoundments (Coulter and Bryan 1993; Coulter et al. 1999). Optimal foraging habitat consists of shallow-water wetlands (2 to 16 inches [5 to 40 centimeters (cm)] in depth) that are sparsely vegetated (Ogden et al. 1978; Browder 1984; Coulter 1987; Coulter and Bryan 1993).

Hydrological patterns of wetlands in south Florida affect wood stork foraging. The annual hydrological pattern of wetland systems consists of water levels rising and peaking during the wet season (June to November) when the majority of the yearly total precipitation occurs, and gradually receding during the dry season (December to May). Shallow water levels within wetlands concentrate prey items (*i.e.*, fish) as they dry out and this is of particular importance during the wood stork nesting season (Kahl 1964). Therefore, a wetland site in south Florida may only provide suitable foraging conditions during part of the year when the water level has receded sufficiently to allow access and concentrate prey items. Consequently, during the nesting season there is a general progression in the suitability of wetlands for foraging based on their hydroperiods, with short hydroperiod wetlands used early in the season, mid-range hydroperiod wetlands used during the middle of the nesting season, and long hydroperiod wetlands used during the latter part of the nesting season (Kahl 1964; Gawlik 2002).

Several other factors affect the suitability of foraging habitats for wood storks. Suitable foraging habitats must provide a sufficient density and biomass of forage fish or other prey species, and have vegetation characteristics that allow storks to locate and capture prey. Wetlands that contain deep water may not be accessible to wood storks for foraging. Conversely, wetlands with too little water may not provide adequate habitat for fish or other prey species. Longer hydroperiod wetlands are generally observed to support more fish and larger fish than shorter hydroperiod wetlands (Loftus and Ecklund 1994; Jordan et al. 1997 and 1998; Turner et al. 1999; Trexler et al. 2002). In addition, nutrient enrichment (primarily phosphorus) within the oligotrophic Everglades wetlands generally results in increased density and biomass of fish in potential stork foraging sites (Rehage and Trexler 2006). Distances from dry-season refugia, such as canals, alligator holes, and similar long hydroperiod sites, may also affect fish density and biomass in southern Florida. However, across the highly modified landscape of southern Florida, fish availability varies with respect to hydrologic gradients and nutrient availability gradients and it becomes very difficult to predict fish density. The foraging habitat for most wood stork colonies within southern Florida includes a wide variety of hydroperiod classes, nutrient conditions, and spatial variability.

During nesting, foraging areas must be sufficiently close to the colony to allow wood storks to efficiently capture prey and deliver prey to nestlings. In Georgia, wood storks generally forage in wetlands within 50 kilometer (km) (31 miles) of the colony site (Bryan and Coulter 1987), but forage most frequently within 20 km (12 miles) of the colony (Coulter and Bryan 1993). Herring (2007) noted similar foraging patterns for wood storks in south Florida with most frequent foraging within 10.29 km (6.4 miles). Maintaining this wide range of feeding site options ensures sufficient wetlands of all sizes and varying hydroperiods are available to support wood storks during shifts in seasonal and annual rainfall and surface water patterns. Storks forage the greatest distances from the colony at the beginning of the nesting season, before eggs are laid, and near the end of the season when the young are large. Wood storks feed nearest the colony during incubation (Browder 1984; Mitchell 1999). In south Florida, wood storks generally use wet prairie ponds early in the dry season and shift to slough ponds later in the dry season following receding water levels (Browder 1984).

Gawlik (2002) characterized wood storks foraging in the Everglades as "searchers" that employ a foraging strategy of seeking out areas of high-density prey and optimal (shallow) water depths, and abandoning foraging sites when prey density begins to decrease below a particular efficiency threshold. The wood storks' choice of foraging sites in the Everglades was significantly related to both prey density and water depth (Gawlik 2002). Based on this strategy, wood stork foraging opportunities are more constrained than many other wading bird species (Gawlik 2002).

Nesting and Reproduction

Wood stork nesting habitat consists of a variety of wooded habitat types including mangroves, cypress (as tall as 30.5 m [100 feet]), and various other live or dead shrubs or trees located in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962; Rodgers et al. 1987; Ogden 1991; Coulter et al. 1999). The majority of wood stork nesting generally occurs within a core of established rookeries that are used annually. However, each year a few new nesting colonies may be established or abandoned (Meyer and

Frederick 2004). Abandoned nesting colonies may remain inactive permanently (Meyer and Frederick 2004). The establishment or abandonment of colony sites is likely related to the environmental conditions at the site (*e.g.*, prey availability, water levels, etc.) that make site conducive to successful nesting (Meyer and Frederick 2004).

During nesting, wood storks are dependent on consistent foraging opportunities with the greatest energy demands occurring during the middle of the nestling period (*i.e.*, when nestlings are 23 to 45 days old) (Kahl 1964). The average wood stork family requires 201 kilogram (kg) (443 pounds) of fish during the breeding season, with 50 percent of the nestling stork's food requirement occurring during the middle third of the nestling period (Kahl 1964). As discussed, receding water levels are necessary in south Florida to concentrate suitable densities of forage fish for wood storks (Kahl 1964; Kushlan et al. 1975).

Short hydroperiod wetlands in south Florida are an important source of forage for wood storks during pre-nesting activities (Fleming et al. 1994; Ceilley and Bortone 2000) and immediately following hatching. Based on Kahl's (1964) estimate that 201 kg (443 pounds) of forage are required for successful nesting, about 50 kg (110.2 pounds) are needed to meet the foraging needs of the adults and nestlings in the first third of the nesting cycle. Large acreages of short hydroperiod wetlands are required to meet this need because short hydroperiod wetlands produce fewer fish and have lower fish biomass per unit area than long hydroperiod wetlands. Loftus and Eklund (1994) estimated 50 fish per m^2 for long hydroperiod wetlands and 10 fish per m^2 for short hydroperiod wetlands in the Everglades. The disproportionate reduction (85 percent) of this wetland type due to development and over drainage has been proposed as a major cause of late colony formation and survivorship reduction in early nestling survival rates (Fleming et al. 1994).

Threats to the Species

The loss or degradation of wetlands in central and South Florida is one of the principal threats to the wood stork. Nearly half of the Everglades has been drained for agriculture and urban development (Davis and Ogden 1994). The EAA alone eliminated 802,900 ha of the original Everglades, and the urban areas in Miami-Dade, Broward and Palm Beach counties have contributed to the loss of spatial extent of wood stork habitat. ENP has preserved only about one-fifth of the original extent of the Everglades, and areas of remaining marsh outside of the ENP have been dissected into impoundments of varying depths.

Although the major drainage works completed the conversion of wetlands to agriculture in the EAA by about 1963, loss of wetlands continues to the present at a slower, but significant rate. In the entire State of Florida between the mid-1970s to the mid-1980s, 105,000 ha of wetlands (including marine and estuarine offshore habitats) were lost; we do not have an estimate for freshwater wetlands in central and south Florida (Hefner et al. 1994).

Analysis of the Species Likely to be Affected

The proposed action has the potential to adversely affect wood storks within the action area. The primary cause of wood stork population decline throughout its range in the United States is loss or degradation of wetland habitats or loss of wetland function resulting in reduced prey availability. The effects of the proposed action on wood storks will be considered further in the remaining sections of this Programmatic Biological Opinion. Potential effects include nest abandonment, mortality of nestlings, degradation or loss of habitat, and prey reduction. Critical habitat has not been designated for the wood stork; therefore, none will be affected.

Eastern Indigo Snake

Species/Critical Habitat Description

The eastern indigo snake is the largest non-venomous snake in North America, reaching lengths of up to 8.5 feet (2.6 meters; Moler 1992). Its color is uniformly lustrous-black, dorsally and ventrally, except for a red or cream-colored suffusion of the chin, throat, and sometimes the cheeks. Its scales are large and smooth (the central 3 to 5 scale rows are lightly keeled in adult males) in 17 scale rows at mid-body. The anal plate is undivided. In the Florida Keys, adult eastern indigo snakes seem to have less red on their faces or throats compared to most mainland specimens (Lazell 1989). Several researchers have informally suggested Lower Keys eastern indigo snakes may differ from mainland snakes in ways other than color.

Life History

Depending on the time of year and environmental conditions, eastern indigo snakes may actively spend much time foraging and searching for mates. They may also spend much time in burrows and other cavities underground and move very little. They are one of the few snake species that may be active during the day but rest at night. The eastern indigo snake is a generalized predator and will eat any vertebrate small enough to be overpowered. They swallow their prey alive. Food items include fish, frogs, toads, snakes (venomous, as well as non-venomous), lizards, turtles, turtle eggs, small alligators, birds, and small mammals (Keegan 1944; Babis 1949; Kochman 1978; Steiner et al. 1983).

Population Dynamics

Eastern indigo snakes need a mosaic of habitats to complete their annual life cycle. Over most of its range, the eastern indigo snake frequents several habitat types, including pine (*Pinus* spp.) flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats. Eastern indigo snakes also use some agricultural lands (such as citrus) and various types of wetlands (Service 1999). A study in southern Georgia found that interspersion of tortoise-inhabited sandhills and wetlands improve habitat quality for the eastern indigo snake (Landers and Speake 1980; Service 2004). Eastern indigo snakes are known to shelter in gopher tortoise (*Gopherus polyphemus*) burrows, hollowed root channels, hollow logs, ground litter, or the burrows of rodents, armadillos, or land crabs (Lawler 1977; Moler 1985a; Layne and Steiner 1996). Throughout peninsular Florida, this species may be found in all terrestrial habitats which have not experienced high density urban development. They are especially common in the hydric hammocks throughout this region (Service 1999).

In central and coastal Florida, eastern indigo snakes are mainly found within many of the State's high, sandy ridges. In extreme south Florida (*i.e.*, the Everglades and Florida Keys), eastern indigo snakes are found in tropical hardwood hammocks, pine rocklands, freshwater marshes, abandoned agricultural land, coastal prairie, mangrove swamps, and human-altered habitats (Steiner et al. 1983; Service 1999). It is thought that they prefer hammocks and pine forests, since most observations occur there and use of these areas is disproportionate compared to the relatively small total area of these habitats (Steiner et al. 1983). Observations over the last 50 years made by maintenance workers in citrus groves in east-central Florida indicate that eastern indigo snakes are occasionally observed on the ground in the tree rows and more frequently near the canals, roads, and wet ditches (Zeigler 2006). Ceilly (2013) used radio tracking of six indigo snakes in a former citrus grove at the C-44 Reservoir and STA Project site to determine home ranges and seasonal movements. In the sugar cane fields at the A-1 Reservoir Project site in the EAA, eastern indigo snakes have been observed (including one mortality) during earthmoving and other construction-related activities (District 2008).

Eastern indigo snakes range over large areas and use various habitats throughout the year, with most activity occurring in the summer and fall (Smith 1987; Moler 1985a). Adult males have larger home ranges than adult females and juveniles; their ranges average 554 acres, decreasing to 390 acres in the summer (Moler 1985b). In contrast, a gravid female may use from 3.5 to 106 acres (Smith 1987). In Florida, home ranges for females and males range from 5 to 371 ac and 4 to 805 acres, respectively (Smith 2003). At Archbold Biological Station (ABS), average home range size for females was determined to be 46 acres (19 hectares [ha]) and overlapping male home ranges to be 184 acres (74 ha) (Layne and Steiner 1996). Ceilly (2013) reported home ranges of 111 and 163 acres for two males (over 1 year) and 33 acres for one female (over 16 months) at the C-44 site.

Status and Distribution

Effective law enforcement has reduced pressure on the species from the pet trade. However, because of its relatively large home range, the eastern indigo snake is vulnerable to habitat loss, degradation, and fragmentation (Lawler 1977; Moler 1985a). The primary threat to the eastern indigo snake is habitat loss due to development and fragmentation. In the interface areas between urban and native habitats, residential housing is also a threat because it increases the likelihood of snakes being killed by property owners and domestic pets. Extensive tracts of undeveloped land are important for maintaining eastern indigo snakes. In citrus groves, eastern indigo snake mortality occurs from vehicular traffic and management techniques such as pesticide usage, lawn mowers, and heavy equipment usage (Zeigler 2006). Within the 2000 to 2005 timeframe, due to the spread of citrus canker, Zeigler (2006) reported seeing at least 12 dead eastern indigo snakes that were killed by heavy equipment operators in the act of clearing infected trees.

Additional information on the eastern indigo snake is available in the MSRP (Service 1999) and the 5-year review (Service 2008) located at
http://www.fws.gov/southeast/5yearReviews/5yearreviews/easternindigofinal.pdf

Threats to the Species

The indigo snake was listed as threatened on January 31, 1978 (43 Federal Register 4028), due to population declines caused by habitat loss, over-collecting for the domestic and international pet trade, and mortality caused by rattlesnake collectors who gassed gopher tortoise burrows to collect snakes

Analysis of the Species/Critical Habitat Likely to be Affected

The proposed action has the potential to adversely affect eastern indigo snake adults, juveniles, nests, and hatchlings within the action area. The effects of the proposed action on this species will be considered further in the remaining sections of this Programmatic Biological Opinion. Potential effects include injury, mortality, and disturbance resulting from construction, operation, and maintenance especially of the A-2 FEB and Miami Canal backfill.

Critical habitat has not been designated for the indigo snake; therefore, none would be affected.

ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area. The environmental baseline does not include the effects of the action under review in this Programmatic Biological Opinion.

Climate change

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Report (2007). The IPCC Report describes natural ecosystem changes with potential wide-spread effects on organisms from marine mammals to migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007c).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and by local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean. Temperatures are predicted to rise from 2°C to 5°C for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current predictive models offer a wide range of predicted changes.

Prior to the 2007 IPCC Report, Titus and Narayanan (1995) modeled the probability of sea level rise based on global warming. They estimated that the increase in global temperatures could likely raise sea level 6 inches by 2050 and 13 inches by 2100. While these estimates are lower than the estimates described in the IPCC Report (2007), Titus and Narayanan's (1995) modeling efforts developed probability-based projections that can be added to local tide-gauge trends to estimate future sea level at specific locations.

Climatic changes in south Florida could exacerbate current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2007c).

Status of the Species within the Action Area

Cape Sable Seaside Sparrow

The entire range of the sparrow occurs within the action area; therefore, the discussions under the Status of the Species section of this Programmatic Biological Opinion also apply to the status of the species in the action area.

The Interim Structural and Operational Plan (ISOP), and its predecessor Interim Operational Plan (IOP) in the early 2000s, were emergency actions for protection of the CSSS and were a direct result of the Jeopardy Biological Opinion issued by this office in 1999. The desired effect was to immediately shift water eastward, back into the historic flow path, into Northeast Shark River Slough (NESRS). The primary goals were to make CSSS-A drier during the breeding season and reduce annual hydroperiods while rehydrating the habitat in CSSS-C, D, and F to prevent over-drying which was causing adverse habitat change and direct harm from increased fire frequencies. More specifically, the purpose of IOP was to provide improved opportunity for nesting in subpopulation A by maintaining water levels below ground level for a minimum of 60, and preferably 90 or more, consecutive days between March 1 and July 15 during the sparrow breeding season. Additionally, by shifting flows eastward, the IOP was to allow sparrow habitat west of SRS to recover from prolonged annual hydroperiods which started during the mid-1990s and have persisted ever since. The best available mechanism by which this action could be implemented was the annual closure of the S-12 structures and increased S-333 discharge to the east. It was recognized in the 1999 Biological Opinion that there could be times when unseasonable rainfall events could overwhelm the ability of the water management system to provide the necessary dry conditions. Direct rainfall on CSSS-A likely contributed to not meeting the recommendations in 2003, 2005, 2007, and 2010 (Corps 2010a). Since implementation of the IOP, the recommendations for protection of the sparrow in subpopulation A were met in 2002, 2004, 2006, 2008, 2009, 2011 and 2012.

The 2013 sparrow breeding season was the first year under the new operating regime ERTP, which allows the Corps year-round use of the S-12 C structure. The main goal of ERTP was to provide the Corps with increased flexibility to manage WCA-3A water levels for the benefit of natural resources and the Miccosukee Tribal lands within that area while simultaneously maintaining conditions in CSSS-A until future CERP projects could shift more water into NESRS. Although the minimum of 60 consecutive days was met during the 2013 nesting season, it should be noted that sparrows were not observed nesting until 30 days after the count began which in-effect made the breeding window much smaller. Although the data is unverified at this time, preliminary numbers indicate a total of 8-10 nests were observed in CSSS-A by field crews, of which 1-2 were successful in fledging 2-4 young. Additionally, the hydroperiod in subpopulation A was too long again this year (exceeding 240 days) which exacerbates the shift of habitat away from being suitable for CSSS.

Another factor affecting sparrows in the action area is the loss of suitable habitat due to extended flooding or high water levels which causes a shift in the vegetative community away from the less-flood tolerant short-hydroperiod marl prairie species to more flood-tolerant marsh-type species. Based on several years of vegetation studies (2003 to 2009) within sparrow habitat, researchers concluded that the direction and magnitude of short-term vegetation change within marl prairie is dependent upon the position of the habitat within the landscape (Ross et al. 2003, 2004, 2006; Sah et al. 2007, 2010a). Efforts to regulate the S-12 structures under ISOP and IOP to protect subpopulation A and its habitat west of SRS have resulted in increased available habitat for nesting (*e.g.*, 60 or more days below 6.0 feet); however, this has not resulted in an adequately shortened annual hydroperiod sufficient to maintain suitable marl prairie habitat throughout the entire historical expanse of subpopulation A. This is especially evident in the lower-elevated peripheral portions of subpopulation A (*e.g.*, at the P-34 gauge) where the average annual hydroperiods range from 260-320 days. This may have limited the recovery of the sparrow in subpopulation A and possibly suggests a source of water to the west of the S-12s that has not previously been identified. It is not precisely known where, when, or how this "additional" water reaches the P-34 gauge. Consequently, subpopulation A has not recovered under IOP nor has it been extirpated, but the estimated population has remained relatively stable since its implementation.

Vegetation change is influenced by the interaction of fire and hydrology. Studies by Sah et al. (2010a) revealed that not only did post-fire flooding delay the vegetation recovery process, but also caused it to follow a different trajectory in terms of species composition. This, in turn, could potentially impede recolonization by the sparrow (Sah et al. 2010a). The transition from one vegetation type to another (*e.g.*, prairie to marsh) in response to hydrology may take place in as little as 3 to 4 years (Armentano et al. 2006); however, the transition from marsh to prairie may take longer (Ross et al. 2006; Sah et al. 2010a). Sah et al. (2007) documented a conversion of habitat type in subpopulation D, from shorter hydroperiod plant species (less-flood tolerant) to those indicative of longer hydroperiod conditions (more flood-tolerant) not preferred by sparrows. Vegetation studies within sparrow habitat (Ross et al. 2004) have shown that sparrows occupy prairies with a hydroperiod ranging between 90 and 240 days. However, solely attaining this hydroperiod requirement may not be enough to promote a transition from marsh to prairie habitat, as this process likely requires a fire frequency regime in the landscape defining process (Ross et al. 2006; Sah et al. 2010a).

As a result of recent projects (*i.e.*, C-111SC) subpopulation C will experience increased hydroperiod beyond the optimal condition (90 to 210 days) on 1,320 acres during a wet year, but would experience improved hydroperiod on 1,442 acres during an average year and would experience no change in hydroperiod in a dry year. Subpopulation D will experience increased hydroperiod and approximately 1,606 acres would have inundation durations longer than the optimal condition of 180 days. However, none of the acreage currently drier than a 180-day hydroperiod would extend beyond a 192-day hydroperiod, with the greatest change (875 acres) being from 152 to 183 days. These increased hydroperiods would degrade sparrow habitat by potentially altering the vegetative community and composition of preferred graminoid species (muhly grass, Florida little bluestem, and black-topped sedge) which would likely result in changes in how sparrows use that habitat. However, the Service does not anticipate a complete loss of preferred grasses from the site and there would not be a complete conversion to a sawgrass dominated habitat. The sparrow's ability to feed, breed, and shelter would be reduced but not eliminated and the changes are not expected to render the habitat unsuitable or unusable by sparrows. Lastly, the C-111SC Project team recently completed a Conceptual Habitat Improvement Plan for the CSSS subpopulation D and environs. This document provides a conceptual framework for improving up to 1,600 acres of habitat for the sparrow in and around subpopulation D (District 2010).

Factors Affecting the Species Environment within the Action Area

Hydrology

The C&SF Project is a system-wide network of canals and water-control structures. The Corps and District operate the C&SF Project to achieve a variety of local and regional objectives including flood protection, water supply, and environmental benefits. Operations of the C&SF Project affect the hydrologic conditions of nearly all the wetland systems within southern Florida to some degree, including the habitat supporting the CSSS. In general, the closer wetland habitat is located to water control infrastructure, the greater the potential affect may be. The Service's 2002 Biological Opinion prescribed IOP as a second RPA with qualifications which included a hydrologic management regime to protect sparrow breeding by reducing water deliveries in western marl prairies that are too wet and increasing water deliveries to the eastern marl prairies that have been historically over drained prior to the expansion of ENP.

Under IOP, hydrologic management provided reduced flows during the breeding season to sparrow habitat located in the western marl prairies. Construction and operation of several detention areas adjacent to sparrow habitat in the eastern subpopulations increased hydroperiods in some over-drained habitats such as subpopulation C. Many other hydrologic operations throughout the C&SF system that routinely occur have resulted in changes to hydrologic conditions in and adjacent to sparrow habitat. Pre-storm and post-storm operations, testing of hydrologic management operations, and other similar activities conducted by the Corps and District have also affected hydrologic conditions within sparrow habitat, mainly through alteration of the natural timing of wetting and drying events.

Fire

Fire is a natural or human-related factor that affects marl prairies occupied by the sparrow and most sparrow habitats have burned at some point during the past 30 to 40 years. The ENP, BICY, and FWC have all conducted prescribed burns within sparrow habitat on lands within their respective jurisdictions. Fire management on Department of Interior land (ENP and BICY) combines fire operations, prescribed fire, and fire ecology in order to maintain fire in the natural ecosystems while adequately considering impacts on nearby human population centers as well as threatened and endangered species habitat. The Service has consulted with ENP on several fire management plans as well as participates in the annual sparrow/fire symposium held at ENP by their fire management staff. In addition, these agencies and the Florida Division of Forestry conduct wildfire suppression and management within sparrow habitat. In the short-term, fire typically renders sparrow habitat unsuitable for occupancy because it removes the vegetation that sparrows rely upon for cover and refugia especially during the breeding season. Following fire, vegetation normally begins to regenerate rapidly and reaches pre-burn density and species composition about 2 years later. Sparrows do not regularly occupy burned areas for 2 to 3 years after fire (La Puma et al. 2007). ENP conducted a prescribed fire in former sparrow habitat within the western marl prairies to facilitate habitat restoration. Within sparrow subpopulations, ENP has conducted wildfire suppression that was intended specifically to reduce potential impacts to sparrows and sparrow habitat within subpopulation B. Prescribed burns have also been conducted along the eastern ENP boundary to reduce the likelihood of human-ignited fires spreading into sparrow habitat near subpopulations C, E, and F. Fires, prescribed, natural, and human-ignited, have occurred within and in the vicinity of subpopulation D. Because fires reduce habitat suitability for up to 3 years, prescribed fires, human-induced fires and wildfires can all have adverse effects on sparrow populations, but also may be necessary in the long-term for the maintenance of habitat (Taylor 1983; Pimm et al. 2002; Lockwood et al. 2003, 2005; LaPuma et al. 2007).

Several fires burned within sparrow habitat during the 2008 dry season. Among these were the West Camp Fire and Mustang Corner Fire, which was the largest fire to have burned in ENP since the Ingraham Fire in 1989. Unlike previous burned areas, pre-fire vegetation data was available for these fires and Sah et al. (2010) provide a preliminary evaluation of 1 year after the fire. Post-fire hydrology in these areas was favorable for normal recovery with a gradual increase in water depth. This is in contrast to a subset of sites burned in 2005 that were flooded within 7 to 14 days of the fires, and remain significantly different from pre-burn vegetation composition even 4 years post fire. Continued monitoring of vegetation recovery at sites burned in 2008 could help inform sparrow habitat management. Specifically, it may allow us to better understand if fire in conjunction with water management and other techniques could be used to help restore altered sparrow habitat (Hanan et al. 2009; Sah et al. 2010a).

Changes in vegetation composition can result from changes in hydrologic conditions, changes in fire frequency, and change in management actions. Many areas of sparrow habitat have experienced vegetation change since monitoring was initiated. Over drying that results from maintaining artificially low water levels within areas of sparrow habitat, such as those that occur along the eastern boundary of ENP, are subject to woody vegetation encroachment, which reduces the suitability of the habitat for sparrow occupancy. Extended hydroperiods and deep water depths can occur from managed water releases in combination with wet-season rainfall which can lead to vegetation changes from marl prairie species to marsh species, resulting in reduced habitat suitability.

Invasive and Exotic Species

Invasive and exotic species may also affect sparrows. Invasive plant species such as *melaleuca* also known as punk tree or paperbark tea tree, Australian pine, Brazilian pepper, and other woody species can become established in sparrow habitat and reduce habitat suitability. While limited information is available on the effects of invasive exotic plants and animals on sparrows, species like the Burmese python have become established in sparrow habitat and may depredate sparrows.

Management of invasive woody plants has been conducted by the ENP, FWC, and District in and adjacent to sparrow habitat to reduce impacts of these species on sparrow habitat suitability. Herbicide treatment of large stands of exotic trees has reduced the spread of these species and has improved sparrow habitat in some areas. These invasive plant species regenerate rapidly requiring continued maintenance controls. Efforts to remove invasive exotic animals like the Burmese python have also been initiated, but to date these efforts have largely been opportunistic.

While direct physical disturbance to sparrow habitat and disturbance resulting from construction activities is limited because nearly all available sparrow habitats occurs within ENP and other conservation lands, some construction activities have affected sparrows and sparrow habitat. Indirect effects of construction activities could have included noise and vibration disturbance from heavy earth moving equipment and a general increase in human presence in the project area. Construction and maintenance of roads, canals, and embankments near sparrow habitat can likely resulted in some localized effects to sparrows through loss or degradation of habitat or disturbance.

Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species.

Status of Critical Habitat within the Action Area

Cape Sable Seaside Sparrow Critical Habitat

The Service designated five units as critical habitat for the CSSS, as amended in 2007 (50 FR 62736). These critical HUs represent the areas determined to be occupied at the time of listing that contain one or more of the characteristics that are essential for the conservation of the species (PCEs) and that may require special management (Figure 4). The units designated as CSSS critical habitat in the action area are: (Unit 1) marl prairie habitats that support sparrow subpopulation B and lie exclusively within ENP in the vicinity of the Main Park Road (State Road 9336), between SRS and Taylor Slough; (Unit 2) marl prairie habitat that supports sparrow subpopulation C within ENP along its eastern boundary in the vicinity of Taylor Slough; (Unit 3) marl prairie habitats that support sparrow subpopulation D in the state-owned and managed Southern Glades Wildlife and Environmental Area to the east of Taylor Slough and ENP; (Unit 4) marl prairie habitat that supports subpopulation E within ENP located on the eastern edge of SRS; and (Unit 5) marl prairie habitat that supports subpopulation F within ENP located just west of the S-332 B pump station and detention area and L-31 N canal. The following descriptions summarize baseline conditions in critical HUs 1, 2, 3, 4, and 5.

Unit 1 (Subpopulation B)

Unit 1 consists of 39,029 acres of marl prairie and lies exclusively within ENP. The unit is bounded on the south by the long hydroperiod *Eleocharis*-dominated wet prairie and mangrove zone just inland of Florida Bay, on the west by the sawgrass marshes and deepwater slough communities of SRS, on the north by the pine rockland vegetation communities that occur within ENP on Long Pine Key, and on the east by the sawgrass marshes and deepwater slough vegetation communities of Taylor Slough. There is a continuous topographical gradient across the site, from the slightly higher elevated pine rocklands north of the unit down to the lower-lying mangroves in the south. The area is bisected by the Main Park Road, which serves as the primary public access route from Homestead to Flamingo and Florida Bay. It is also bisected by the Old Ingraham Highway, which is the original and now abandoned and partially restored historical roadway that provides alternate access to Florida Bay. Much of the western portion of this roadway was removed and restored to grade, but the eastern portions of the road, with its associated borrow canal and woody vegetation encroachment, interrupt the contiguity of the prairies within the eastern portion of this unit. Besides the road, borrow canal, and woody vegetation, which are not critical habitat, the area consists of one large, contiguous expanse of marl prairie that contains all of the PCEs for the sparrow.

When sparrows were first recorded in the area during the 1974 to 1975 surveys, they were abundant and widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. Consequently, the Service considered the unit to be occupied at the time of listing. The area is the largest contiguous patch of marl prairie east of SRS. It is currently occupied, and has consistently supported the largest sparrow subpopulation since 1992 (Pimm and Bass 2002, 2005; Pimm et al. 2002, 2007).

The natural characteristics of this area make it relatively immune to risk of flooding or frequent fires (Walters et al. 2000). Its location south of the higher-elevation pine rocklands provides it a degree of protection from high water levels that do not occur within any other units. Within the southern portion of the greater Everglades watershed, surface water generally flows from north to south, with most water moving through SRS, and to a lesser extent through Taylor Slough. The pinelands block the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of Unit 1 occur on relatively high elevations and remain relatively dry. Consequently, this area is not easily flooded as a result of managed water releases or upstream events, and the high-water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics.

Similarly, the area is not particularly vulnerable to fires. It is not over drained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and managed prescribed fire. The public road that traverses the area could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides human access greater than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2 (Subpopulation C)

Unit 2 consists of 8,304 acres of marl prairie habitat that lies exclusively within ENP in the vicinity of Taylor Slough, along the eastern edge of ENP. The unit consists of the prairies that flank both sides of the relatively narrow Taylor Slough. The area is bordered by the pine rocklands of Long Pine Key on the west and by isolated pine rocklands and the L-31W canal that runs along the ENP boundary to the east. It is bordered by an area of constriction in Taylor Slough that is closely flanked on both sides by forested habitats at the southern end and by the Rocky Glades, a region of thin marl soils and exposed limestone and sparse vegetation to the north. The area is bisected by the Main Park Road in the southern portion of the unit, but the remainder of the unit consists of contiguous marl prairies.

Although sparrows were not discovered in the area until 1972 (Ogden 1972), the Service considered this unit to be occupied at the time of initial listing on March 11, 1967, under the Endangered Species Preservation Act of 1967 (32 FR 4001). At the time of discovery, sparrows were found to be widely distributed and abundant in this area (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery. Following its discovery, the site was the location of some of the first intensive study of the sparrow's biology and its relationship to its habitat (Werner 1975).

During the mid-1970s, sparrows were abundant at this site (Werner 1975), and surveys in 1981 estimated 432 sparrows in this area (Pimm et al. 2002). Since 1981, the sparrow subpopulation at this site has declined and estimates have ranged from 0 to 144 sparrows between 1995 and the present (Pimm et al. 2002; Pimm and Bass 2005). During intensive nest surveys in 2008, Virzi et al. (2009) documented four females and five males, nine nest attempts and reported nest survival as 22.8 percent. When sparrows were abundant in this area, the habitat was in a relatively dry condition, with average annual hydroperiods between 90 and 180 days (ENP 2005).

Beginning in 1980, a pump station (S-332), which was installed along the eastern boundary of ENP at the approximate location of the historic slough, was operated to increase hydroperiods in the area resulting in extended hydroperiods within the portions of the area downstream from the pump station (ENP 2005). Vegetation changed in this area from suitable marl prairie to unsuitable sawgrass marsh due to altered hydrology as a result of the S-332 pump station operations (ENP 2005), and sparrows ceased to occur in this area. At the same time, the northern portions of Unit 2, north of pump station S-332, continued to be overdrained as a result of pump station and adjacent canal stage operations which effectively lowered the water table in the surrounding agricultural lands immediately bordering ENP (Johnson et al. 1988; ENP 2005). In these overdrained areas, frequent fires impacted the habitat and resulted in reduced sparrow numbers (Pimm et al. 2002). The most recent fire occurred in March 2007 when the Frog Pond fire swept through this area; the habitat is beginning to recover (Sah et al. 2010a; Virzi et al. 2009).

This area provides a contiguous expanse of habitat that is largely separated from other nearby subpopulations in an area that is uniquely influenced by hydrologic characteristics. The Taylor Slough basin is a relatively small system, and much of the headwaters of the Slough are cut off by canals, agricultural land, and development to the east of ENP. Portions of this unit near the slough have deep soil (15.7 inches) (Taylor 1983) and support resilient vegetation that responds rapidly following fire (Taylor 1983; Werner and Woolfenden 1983).

Sparrows were reported to reoccupy burned sites in this region within 1 to 2 years following fire (Werner and Woolfenden 1983). The unit contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrows use. However, the area along the eastern boundary of ENP remains heavily influenced by water management operations (ENP 2005). Portions of the area are also overdrained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of SRS in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in aiding dispersal among the eastern subpopulations, acting as a ''hub'' that facilitates dispersal in the region and re-colonization of local areas that are detrimentally impacted and locally extirpated.

Unit 3 (Subpopulation D)

Unit 3 consists of 10,806 acres of marl prairie vegetation in an area that lies on the eastern side of the lower portion of Taylor Slough. The majority of this area, 92 percent or 9,973 acres, is within the Southern Glades Wildlife and Environmental Area, which is jointly managed by the District and FWC. The remaining 8 percent (883 acres) occurs within the boundary of ENP. The area is bordered on the south by the long hydroperiod *Eleocharis* vegetation and mangroves that flank Florida Bay, on the west by the sawgrass marshes and deepwater vegetation of Taylor Slough, on the east by long-hydroperiod *Eleocharis* vegetation and overdrained areas with shrub encroachment in the vicinity of U.S. Highway 1, and on the north by agricultural lands and development in the vicinity of Homestead and Florida City.

When sparrows were discovered in this area, they were widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, the Service believes that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago.

This is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is consequently unlikely to be affected by the same factors (*e.g.*, large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between SRS and Taylor Slough. This area is separated from other sparrow subpopulations by Taylor Slough, and the area immediately north of this subpopulation consists of agriculture and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape would tend to prevent potential fires from spreading from the area which supports sparrow subpopulations B, C, E, and F into the subpopulation D area.

Similarly, hydrologic conditions in this region are different than those that affect the other subpopulations because water levels are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban and agricultural areas to the north. The 1981 comprehensive population survey estimated 400 sparrows within this region (Pimm et al. 2002). This was higher than any number of sparrows recorded in the area in recent years, and estimates have ranged from 0 to 112 sparrows between 1992 and the present (Pimm et al. 2002; Pimm and Bass 2005).

The area currently contains all PCEs, but the majority of the area is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006). The habitat in this area is divided by several canals that are part of the C–111 basin. This canal system results in relatively altered hydrologic conditions in the region (ENP 2005) and causes extended hydroperiods during wet periods (Pimm et al. 2002).

Unit 4 (Subpopulation E)

Unit 4, subpopulation E, consists of 22,278 acres of marl prairie habitat in an area that lies along the eastern margin of SRS. This unit occurs entirely within ENP. The area is bordered to the south by the pine rocklands of Long Pine Key and by an area dominated by dwarf cypress trees. The sawgrass marshes and deepwater slough vegetation communities of SRS comprise the western and northern boundary of the area, and the Rocky Glades comprise the eastern boundary.

When sparrows were discovered in this area, they were relatively widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. We consequently consider this unit to be occupied at the time of listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). This area is currently occupied by sparrows and contains all of the PCEs.

This area supports one of the large, relatively stable sparrow subpopulations. It is centrally located among the areas supporting other subpopulations, and its central location probably plays an important role in aiding dispersal among subpopulations, particularly movements from the eastern subpopulations (Units 1 – 5) to the only subpopulation west of SRS, subpopulation A. Since 1997, this area has supported the second largest sparrow subpopulation, ranging from 576 to nearly 1,000 individuals in recent years (Pimm et al. 2002; Pimm and Bass 2005).

The centrality of this subpopulation helps to prevent it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of managed water releases is generally dampened by the time their influence reaches this area. However, the proximity of this area to SRS may make the habitats and the sparrows that they support vulnerable to hydrologic effects during wet periods. The western portions of the area may become too deeply inundated to provide good habitat for sparrows under some deep water conditions. Large-scale hydrologic modifications, such as those proposed under the CERP, have the potential to influence habitat conditions in this area (*e.g.*, PCEs), and may require special management attention. Large-scale fires may detrimentally affect this area, and there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation. While the area is relatively distant from ENP boundaries and potential sources of human-caused ignition, fires that are started along the eastern ENP boundary may rapidly spread into the area. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

Unit 5 (Subpopulation F)

Unit 5 subpopulation F consists of 4,883 acres of marl prairie that lies along the eastern boundary of ENP, and is the northernmost of the designated critical HUs. Unit 5 is also the smallest of the five units. It is bounded on the north and west by ENP sawgrass marshes and deep-water slough vegetation communities associated with SRS, and on the east by agricultural and residential development along the eastern boundary of ENP. Its southern boundary is defined and characterized by the sparse vegetation, shallow soils, and exposed limestone depressions and solution holes of the Rocky Glades. When sparrows were discovered in this area, they were relatively widespread (Werner 1975). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of initial listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. The Service consequently considered this unit to be occupied at the time of listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). This area is currently occupied by sparrows, and contains all of the PCEs.

The first comprehensive sparrow population survey conducted in 1981 resulted in an estimated population of 112 sparrows in this area, and most subsequent surveys have resulted in estimates lower than this, including several consecutive years when no sparrows were found (Pimm et al. 2002; Pimm and Bass 2005). However, sparrows were always found in the area in subsequent years following a zero count (Pimm et al. 2002), indicating that sparrows are consistently using the area.

This area would serve to support or recolonize subpopulations C and E (Units 2 and 4) if those areas were to become unsuitable. Loss of available habitat in this area would also result in a reduction in the total spatial distribution of sparrows. Its position in the landscape results in a unique set of threats that differ from those in other subpopulations. Because of its proximity to urban and agricultural areas and its relative topographic location, this area has been consistently overdrained in recent years and remains dry during the year for longer periods than other subpopulations (shortened hydroperiod). The relative dryness of the area may allow the site to remain suitable as habitat for sparrows under very wet conditions, when other subpopulations may become deeply inundated for long durations.

Due in large part to its relatively drier hydrologic condition and its proximity to developed areas, Unite 5 has been subjected to frequent human-caused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine, *melaleuca*, and Brazilian pepper, have become established in local areas (Werner 1975), often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by resource management agencies to address this issue, and control of woody vegetation will continue to be required.

Factors Affecting Critical Habitat within the Action Area

The natural characteristics of Unit 1 (subpopulation B) make it relatively immune to risk of human-induced flooding or frequent fires (Walters et al. 2000). Its location south of the high-elevation pine rocklands provides it a degree of protection from high water levels that do not occur within any other units. Within the southern portion of the greater Everglades watershed, water flows from north to south, with most water moving through SRS, and to a lesser extent through Taylor Slough. The pinelands block the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of the area occur on relatively high elevations and remain comparatively dry. Consequently, this area is not easily flooded as a result of managed water releases or upstream events, and the high-water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics.

Similarly, the area is not particularly vulnerable to fires. It is not overdrained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and intensively managed prescribed fire. The public road that traverses the area could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides greater human access than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2, or subpopulation C, contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrows use. However, the area along the eastern boundary of ENP remains heavily influenced by hydrologic management (ENP 2005). Portions of the area are also overdrained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of SRS in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in supporting dispersal among the eastern subpopulations, acting as a ''hub'' that facilitates dispersal in the region and re-colonization of local areas that are detrimentally impacted.

Construction of the S-332B North and West Detention Areas and the associated pumps and operations schedule has resulted in wetter conditions and improved habitat quality in some areas, and protection of the desired water stage during the sparrow nesting window in subpopulation C critical habitat.

Unit 3, or subpopulation D, is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is unlikely to be affected by the same factors (*e.g.*, large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between SRS and Taylor Slough. This area is separated from other sparrow subpopulations by Taylor Slough, and the area immediately north of this subpopulation consists of agriculture and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape would tend to prevent fires from spreading from the area which supports sparrow subpopulations B, C, E, and F into the subpopulation D area.

Similarly, hydrologic conditions in this region are different than those that affect the other subpopulations because water levels are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban/agricultural areas to the north. The 1981 comprehensive population survey estimated 400 sparrows within this region (Pimm et al. 2002). This was higher than any number of sparrows recorded in the area in recent years, and estimates have ranged from 0 to 112 sparrows between 1992 and the present (Pimm et al. 2002; Pimm and Bass 2005; Virzi et al. 2009).

The area currently contains all PCEs, but the majority of the area is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006). The habitat in this area is divided by several canals that are part of the C–111 Basin. This canal system results in relatively altered hydrologic conditions in the region (ENP 2005) and causes extended hydroperiods during wet periods (Pimm et al. 2002).

CSSS subpopulation D critical habitat was affected when canal infrastructure for the South Dade Conveyance System (SDCS) was completed in the 1980s, which was constructed to meet agricultural water supply needs, flood control, and mitigate saltwater intrusion as part of the overarching the C&SF Project. In addition, in the 1960s, Aerojet-General Corporation built a plant, other infrastructure, and the Aerojet Canal, which is now within the subpopulation D critical habitat boundary, to supply NASA with solid rocket fuel components. It was closed after

NASA chose liquid fuel for the Saturn V program. When the Aerojet product was not selected for the Saturn project, the land and facilities were returned to the State, and are now managed by the District and FWC as a nature preserve.

The centrality of Unit 4 (subpopulation E) helps to prevent it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of any managed water release is generally dampened by the time their influence reaches this area. However, the proximity of this area to SRS may make the habitat and the sparrows that they support vulnerable to hydrologic effects during wet periods. The western portions of the area may become too deeply inundated to provide good habitat for sparrows under some deep water conditions. Large-scale hydrologic modifications, such as those proposed under the CERP, have the potential to influence habitat conditions in this area (*e.g.*, PCEs), and may require special management attention. Large-scale fires may detrimentally affect this area, and there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation. While the area is relatively distant from ENP boundaries and potential sources of human-caused ignition, fires that are started along the eastern ENP boundary may rapidly spread into the area. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

Because of its dryness and its proximity to developed areas, Unit 5 (subpopulation F) has been subjected to frequent human-caused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine, *melaleuca*, and Brazilian pepper, have become established in local areas (Werner 1975), often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by resource agencies to address this issue, and control of woody vegetation will continue to be required.

Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species into CSSS habitat, reducing the habitat suitability. However, the increased risk of eutrophication is difficult to predict and to measure and is not likely to adversely affect the CSSS or its critical habitat.

Status of the Species within the Action Area

Everglade Snail Kite

The action area encompasses the current range of the Everglade snail kite. Therefore, the information in the Status of the Species section addresses the status of the species within the action area, and is incorporated here by reference.

Factors Affecting the Species Environment within the Action Area

The persistence of the snail kite in Florida depends upon maintaining hydrologic conditions that support the specific vegetative communities that compose their habitat along with sufficient apple snail availability across their range each year (Martin et al. 2008). Operation of the C&SF Project and other hydrologic management actions has a significant effect on hydrologic conditions within most of the areas occupied by snail kites. The Corps, District, and St. John's River Water Management District manage water levels in snail kite habitat in accord with many different local and regional water management plans and schedules. Water management plans affect water levels in marshes and lakes upon which snail kites rely, the rates of water level recessions in lakes and marshes, and the timing of high and low water events. These factors, in turn, directly affect snail kite habitat suitability. The compartmentalization of Everglades' wetlands under the C&SF Project, and subsequent hydrologic management of each of the compartments has reduced the connectivity of wetland systems upon which kites rely. Separate and independent management regimes for the different compartments have also impacted snail kites, in some cases by allowing unfavorable conditions in adjacent wetland units at the same time.

Both short-term natural disturbances (*e.g.*, drought) and long-term habitat degradation, including impacts to their prey base, limit the snail kite's reproductive ability. WCA-3A has been identified as the most critical component of snail kite habitat in Florida, in terms of its influence on demography (Mooij et al. 2002; Martin 2007; Martin et al. 2007). A concern is the lack of reproduction within this area in recent years. Current water regulation schedules may shorten the window of time during which kites can breed, and rapid recession rates can result in nest abandonment (Cattau et al. 2008). Hydrologic conditions within WCA-3A have also resulted in reduced apple snail productivity, abundance, and density. Researchers have identified that high water during the breeding season can have significant negative impacts to apple snail egg cluster production (Darby et al. 2005; Darby et al. 2009). In addition, higher-water levels and longer hydroperiods occurring during IOP have been implicated in the conversion of wet prairies (prime kite foraging habitat) to sloughs within WCA-3A (Zweig 2008). Within WCA-3A, there are three primary factors which have the potential to adversely affect snail kites: (1) prolonged high water levels during September through January (or beyond in some years); (2) prolonged low water levels during the early spring and summer; and (3) rapid recession rates. Each is discussed in detail below.

Prolonged High Water Levels

Stages in WCA-3A have exceeded 10.5 feet NGVD in 16 of the past 18 years, while there were only nine occurrences of stages exceeding 10.5 feet during the 28-year period from 1965 to 1993. Stages in 1994, 1995, 1999, 2004, 2005, and 2008 exceeded 11.5 feet NGVD, and are the six highest stages within the POR. It should be noted that from 1965 to the early 1990s, we experienced the last cool phase of the Atlantic Multidecadal Oscillation (AMO), resulting in overall drier conditions during those years. The current warm phase began in the early 1990s, leading to a wetter climate regime since that time.

High water levels and extended hydroperiods have resulted in vegetation shifts within WCA-3A, degrading snail kite habitat. The extended deep water conditions from September into January or beyond, whether resulting from weather conditions, IOP, or a combination of both, appear to have reduced the amount of woody vegetation in the area and contributed to the transition of wet prairies to open water sloughs (Zweig 2008; Zweig and Kitchens 2008). These habitat conversions directly affect snail kites in several ways, most importantly by reducing the amount of suitable nesting and foraging habitat, and reducing prey abundance and availability. Woody vegetation, such as pond apple, willow, and cypress which are used by kites for nesting and perch hunting, can be killed or severely stressed by extreme high water conditions and extended hydroperiods. Such vegetation is slightly elevated above the surrounding marsh and so is affected by prolonged higher-than-normal water levels.

Within WCA-3A and the Greater Everglades, wet prairie exists as a component of the ridge and slough landscape, occurring in the transition zone between higher sawgrass ridges and deeper lily-dominated sloughs. Wet prairies serve as the prime habitat for apple snail egg production and snail kite foraging, which species experts believe is currently the limiting factor to snail kite productivity in WCA-3A (Darby 2008; Kitchens 2008). In addition to deeper water conditions, hydroperiods in WCA-3A have increased, lengthening the time between drying events and further contributing to the conversion of wet prairie. Prolonged hydroperiods reduce habitat structure in the form of emergent vegetation, which is critical for apple snail aerial respiration and egg deposition (Turner 1996; Darby et al. 1999). Occasional drying events are essential to maintain healthy wet prairie and the mosaic of vegetation types that exist in the Everglades system (Sklar et al. 2002; Karunaratne et al. 2006; Darby et al. 2008). It has long been recognized that water levels should recede below ground periodically to allow for regeneration of wet prairie vegetation, although moist soil conditions are needed for seed germination and establishment of new seedlings (Dineen 1974; Goodrick 1974; Zaffke 1983). However, little annual variation in low water depths has occurred within WCA-3A since 1993, virtually eliminating these essential drying events. The effects of this are particularly apparent in southwestern WCA-3A, which has experienced excessive ponding in recent years.

Prey availability has also been affected by the transition of wet prairies to open water sloughs. Snails tend to avoid areas where water depths are greater than 50 cm (Darby et al. 2002). Avoidance of deeper depths may be related to the type and density of vegetation in deeper water areas, food availability, or energy requirements for aerial respiration (van der Walk et al. 1994; Turner 1996; Darby 1998; Darby et al. 2002). Water-lily sloughs support lower snail densities as compared with wet prairies (Karunaratne et al. 2006). Limited food quality and lack of emergent vegetation in the sloughs may account for the lower snail densities. Research indicates that snails depend upon periphyton for food (Rich 1990; Browder et al. 1994; Sharfstein and Steinman 2001), which may be limited within deeper water environments. Karunaratne et al. (2006) observed little or no submerged macrophytes and epiphytic periphyton in the sloughs they studied in WCA-3A. In contrast, species commonly encountered within wet prairie habitat (*e.g.*, *Eleocharis* spp., *Rhynchospora tracyi*, *Sagittaria* spp.) support abundant populations of epiphytic periphyton (Wetzel 1983; Browder et al. 1994; Karunaratne et al. 2006). Apple snails also depend upon emergent vegetation for aerial respiration and oviposition. A reduction in the number of available emergent stems for egg deposition would also contribute to the observed lower snail densities within sloughs.

Prolonged high water extending into January and beyond can also directly impact apple snail reproduction, and by extension snail density and snail kite prey availability. Apple snail studies have documented a dramatic increase in spring egg cluster production as water depths fall below approximately 1.3 to 2.0 feet in WCA-3A and other wetlands (Darby et al. 2005). Darby et al. (2005) found high snail densities (*e.g.*, > 1.0 snail per m^2) in WCA-3A in 2002 and 2003, where densities reflected 2 years (2001 and 2002) of relatively low water levels. In contrast, water depths in 2003 remained above 1.3 to 2.0 feet during the peak reproductive season, and they observed a delay in the peak of egg laying and a decline in annual per capita egg production and egg cluster counts (*e.g.*, approximately 130 egg clusters per 50-meter transect in an area with > 1.0 snail per m^2; Darby et al. 2008). This decrease in 2003 spring egg cluster production resulted in a subsequent 80 percent reduction in snail densities in southern WCA-3A sites in 2004. Relatively low densities (0.02 to 0.40 snails per m^2) continued at sampled sites into 2005 to 2007 and again at a subset of these sites in 2010 (0.06 to 0.08 snails per m^2).

High water during the breeding season can also significantly affect the proportion of juvenile snails - specifically, the deeper the water in the previous year, the greater the proportion of small (< 20 millimeters) snails found in March and April (Darby et al. 2009). This may result from (1) a shift in egg production from summer to fall months, with snails still not of adult size as winter approaches, and (2) suppressed snail growth in deeper water, although the mechanism behind this has not been studied (Darby et al. 2005; Darby et al. 2009). Since kites typically select snails > 20 millimeters for foraging (Sykes et al. 1995), a high percentage of apple snails with shells < 20 millimeters in March and April may not support the energetic needs of nesting kites, resulting in fewer nest initiations and more nest failures (Darby et al. 2009).

Prolonged high water extending into January is also associated with decreased snail kite nest success (Cattau et al. 2008). From as early as late November into the spring, snail kite courtship and pair formation activities, including nest site selection and construction, are occurring. High water conditions during this time can act as an ecological trap in which kites build nests at higher ground surface elevations (GSE) and are then left "high and dry" when water level recedes (Sykes et al. 1995; Cattau et al. 2008). It is believed that snail kites choose nest sites based on water depths directly underneath the nest and in the immediate vicinity. Appropriate water depths in these areas are important to deter predation and provide sustained foraging opportunities for nesting adults and their young. If water levels change rapidly during the nesting season, nesting adult kites and juveniles fledged from these nests may suffer from reduced foraging opportunities, especially when low water levels cause snails to stop moving and become unavailable to foraging kites, resulting in both decreased nest success and lower juvenile survival rates.

Prolonged Low Water Levels

Low water levels have a significant effect on snail kite nest success in WCA-3A (Cattau et al. 2008). If water levels become too low and food resources become too scarce, adults will abandon their nest sites and young (Sykes et al. 1995). A strong relationship also exists between juvenile kite survival rate and annual minimum stage (Martin et al. 2007; Cattau et al. 2008).

Estimated juvenile kite survival rates for years when water levels fell below 10 cm was substantially lower compared to years where estimated water depths stayed above 10 cm (Cattau et al. 2008). Due to their inability to move large distances, juvenile snail kites rely upon the marshes surrounding their nests for foraging. If water levels within these marshes become too low to support foraging (due to decreased apple snail availability), juvenile kite survival will be diminished.

Prolonged low water levels, especially those occurring early in the breeding season, have the potential to adversely impact apple snails. Apple snail egg production is maximized when dry season low water levels are less than 40 cm but greater than 10 cm (Darby et al. 2002). Water depths outside this range can significantly affect apple snail recruitment and survival. If water levels are less than 10 cm, snails cease movement and may become stranded; hence they are not only unavailable to foraging snail kites, they are also unable to successfully reproduce. Depending upon the timing and duration of such low water conditions, apple snail recruitment can be significantly affected by the truncation of annual egg production and stranding of juveniles (Darby et al. 2008). Since apple snails have a 1.0 to 1.5-year life span (Hanning 1979; Ferrer et al. 1990; Darby et al. 2008), they only have one opportunity (*i.e.*, one dry season) for successful reproduction. Egg cluster production may occur from February to November (Odum 1957; Hanning 1979; Darby et al. 1999); however, approximately 77 percent of all apple snail egg cluster production occurs during April through June (Darby et al. 2008). Water levels < 10 cm during peak apple snail egg cluster production substantially reduce annual per capita egg production, and thus recruitment and apple snail densities (Darby et al. 2008). If possible, dry downs during this critical time frame should be avoided. The length of the dry down, and age and size of the snail, are all important factors in determining apple snail survival. Larger apple snails can survive dry downs better than smaller apple snails (Kushlan 1975; Darby et al. 2006, 2008). Darby et al. (2008) found that 70 percent of pre-reproductive adult-sized snails survived a 12-week dry down, while smaller snails (< 15 mm) exhibited significantly lower survival rates (< 50 percent after 8 dry weeks).

Rapid Recession Rates

Under high water conditions early in the nesting season, kites tend to initiate nests in upslope, shallower sites. Water managers may initiate rapid recession rates in the spring to meet the target water regulation schedule. Breeding kites may not be able to raise their young before the water levels reach a critical low water depth, below which snail availability to kites is drastically reduced. In addition, when water levels recede below an active snail kite nest, predation risk increases due to nest exposure to terrestrial predators (Sykes et al. 1995). As a result, nesting success can be further reduced in these areas. Of all the hydrological variables modeled by Cattau et al. (2008), recession rate had the strongest negative effect on nest success. While recession rate describes the rate of change between high and low water levels, the overall difference between these water levels is described by amplitude. For snail kites and apple snails, amplitude between the pre-breeding maximum and the breeding season minimum water levels had a negative effect on juvenile survival in analyses conducted by Cattau et al. (2008).

The Everglades ecosystem evolved to thrive under hydrologic conditions which varied, sometimes significantly, between and within years. The natural variability within the system resulted in a habitat mosaic which ensured long-term persistence of suitable habitat for

Everglades wildlife, including snail kites and apple snails. The impoundment and management of this system has changed the timing, duration, and frequency of high and low water conditions, and has resulted in the apparent trade-offs observed between low and high water in WCA-3A. Under the managed system, drying events following rapid recessions have the potential to cause mortality of apple snails and juvenile snail kites, whereas repeated and extended flooding tends to result in decreased apple snail productivity and long-term degradation of the habitat, which also reduces kite reproduction and hinders the species' recovery. In addition to avoiding frequent extreme and prolonged water levels (high or low), it is essential to incorporate proper (natural) timing of these water levels to better mimic natural hydropatterns.

Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species into snail kite habitat, reducing the habitat suitability for nesting and foraging. Dense growth of these plants also has the potential to reduce the ability of snail kites to forage for apple snails. In addition, the effects of higher nutrient inputs on plant growth can necessitate habitat management activities in areas used by snail kites. These activities can have negative effects on nesting kites if not conducted appropriately.

Status of Critical Habitat within the Action Area

Everglade Snail Kite Critical Habitat

The action area encompasses the current range of the Everglade snail kite. Therefore, the information in the Status of the Species section addresses the status of critical habitat within the action area, and is incorporated here by reference.

Factors Affecting Critical Habitat within the Action Area

The factors affecting designated snail kite critical habitat are generally the same as those described above for the Factors Affecting the Species within the Action Area. Therefore, the information in the Factors Affecting the Species Environment within the Action Area section is incorporated here by reference.

Status of the Species within the Action Area

Wood Stork

Since 1986, the Corps has funded a program to monitor nesting effort and success of wading birds, including wood storks, in the WCAs. The objectives are to track the demographics of the various species and to try to understand the environmental variables related to successful breeding. The program includes aerial surveys to identify locations of wading bird nesting colonies each year as they develop and to estimate the number of nests produced by each wading bird species. Ground surveys by airboat are conducted in colonies that contain wood storks to estimate nesting success (number of young fledged) in a sub-set of marked nests. Nesting effort (number of nests) of wood storks from 2003 to 2012 in the various named colonies in the action area (Figure 3) is summarized below (Table 6).

Table 6. Number of wood stork nests in the CEPP Action Area as reported in the South Florida Wading Bird Reports from 2003 through 2012 (*NM = Not Monitored).

County	Colony Name	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003
Broward	Kinich		120								
Dade	L-28 Crossover									130	40
Dade	Crossover				28						
Dade	Jetport				1,167						375
Dade	Jetport South		350		238						
Dade	Tamiami Trail East1			15	10						
Dade	Tamiami Trail East2			30	20						
Dade	Tamiami Trail West	170	400	350	1,300		75	400		20	350
Dade	Rookery Branch		25		20						
Dade	Paurotis Pond	320	500	325	400	125	150	400		195	130
Dade	Cuthbert Lake	60	90	35	100	20	75	75		75	75
Glades	Brighton Indian Reservation			7	35		12	30			
Lee	Caloosahatchee River East		8	25	120			50			
Lee	Caloosahatchee River West		42	50	500	45	220	420	69	240	45
Martin	Sewel Point/Bird Island			20	120	Active	55	147	117	150	45
Monroe	UnNamed 001				2						
Monroe	Grossman Ridge West		60	75	60						
Monroe	Cabbage Bay	75	70		100						
Monroe	Rodgers River Bay Peninsula	135	80	165							
Monroe	Rodgers Rvr Bay Island			5	5		40	140		120	130
Monroe	Broad River	60	30		50						
Monroe	Lower Taylor Slough				5						
Monroe	Otter Creek (2004 colony)							5			
Monroe	Lostman's Creek	50			130						
P. Beach	PBC SWA	275	386	131	509	154	124	508	200	240	140
P. Beach	Lox NC-4				20						
P. Beach	3B Mud East				7		15		130		
St. Lucie	Cypress Creek	305	285	25	273	Active		100	32	100	
St. Lucie	North Fork St. Lucie River	120			46	NM*	11	142	68	70	35
	Totals	1,570	2,446	1,258	5,265	344	777	2,417	616	1,340	1,365

Wood stork nesting success has been variable and, in several instances, may be attributed to reversals that occurred as a result of heavy rainfall events. Monitoring efforts have shown that:

In 2003, nesting effort in the WCAs was 2.1 times the average of the previous 5 years and 3.9 times the average of the previous 10 years, but large numbers of these nests were abandoned. These failures can be attributed in large part to heavy rainfall, particularly in late March. The nest success rate at Tamiami West was 31 percent lower than in 2002.

In 2004, wood storks initiated nesting somewhat late even by the standards of the previous 20 years, but abandoned nests in response to heavy rainfall in early March. However, there was no evidence of abandonment at the Crossover colony, and the colony appeared to have fledged substantial numbers of young.

In 2005, nests were largely unsuccessful as a result of stable or rising water levels during March due to unseasonable rainfall.

In 2006, wood storks experienced a very good year for nesting within the WCAs and ENP. It was the best year since 2002 at the Tamiami West colony. Approximately 400 nests were located at this colony with a nest success rate of 0.72 and an average of 2.58 chicks fledged per nest. Late summer rainfall in 2005 resulted in high water stages within WCA-3A. In the fall of 2005, rapid drying occurred throughout the season and was essentially uninterrupted during the wood storks nesting season with the exception of two rainfall events in 2006. The abundance of water and rapid recession rates created essentially perfect conditions for high prey availability during much of the breeding season contributing to the high number of successful nests.

In 2007, the numbers of nests and nest success were below average with no pairs attempting to nest in the WCAs. Nest success was well below historical averages with 1.37 chicks per successful nest and 0.57 chicks fledged per nest. This reproductive output is well below the level considered necessary for either demographic replacement or for recovery of the species (Service 2007b). During the winter and spring of 2007, water levels were relatively low. This coupled with a general lack of rainfall and drying conditions is generally associated with good foraging conditions and above average nesting. However, fish sampling efforts indicated that food was not abundant (Cook and Herring 2007). The favorable foraging conditions produced by the low water levels and recession rate, however, could not overcome the reduced standing stocks of fish and aquatic macroinvertebrates necessary for successful reproduction.

In 2008, no wood stork nests were successful anywhere within the Everglades with all nests abandoned by mid-May. This poor performance was not surprising given the weather and water conditions preceding and during the breeding season. The drier than usual wet season of 2007 created suboptimal conditions for the production of fish and aquatic macroinvertebrates, and the unseasonable rainfall in February, March, and April of 2008 led to stable or increasing water stages. These factors combined led to generally poor foraging conditions.

In 2009, wood stork nest numbers were exceptionally high with a 14.5 fold increase over the previous 5-year average and a 4-fold increase above the 10-year average. In fact, wood stork numbers were the highest recorded since 1975. Nest starts experienced a greater than

75 percent chance of fledging at least one young, and successful nests produced over 2.6 young each. Relatively high water levels in 2008 favored ample production of fish and aquatic macroinvertebrates. The abundance of prey in conjunction with a long and continuous period of drying (September 2008 through May 2009) contributed to the high nest success rate in 2009. In addition, the high numbers may be attributed to the number of young birds produced during the bumper 2006 season that have just reached breeding age or from storks from outside the region that were attracted by the favorable conditions.

In 2010 and 2011, wood stork numbers dropped, both range wide and in Florida, from the high of 2009 (12,720 and 9,428, respectively). Nesting pairs dropped in the CEPP action area from 5,265 in 2006 to 1,258; similar to nesting in 2003, higher than in 2005, 2007 or 2008, but less than 2006 and 2009, which recorded 2,446 nesting pairs.

Factors Affecting the Species Environment Within the Action Area

Hydrology

Researchers have shown that wood storks forage most efficiently and effectively in habitats where prey densities are high and the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987). Prey availability to wood storks is dependent on a composite variable consisting of the density (number or biomass/m^2) and vulnerability of prey (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too deep (greater than 30 cm) for storks to forage or the tree canopy at the site is too dense for storks to land. Calm water, about 5 to 40 cm in depth, and free of dense aquatic vegetation is ideal wood stork foraging habitat (Coulter and Bryan 1993). Therefore, the most important factor affecting wood storks in the action area is hydroperiod and hydroperiod is affected by climatological effects and water management strategies. There may be limited disturbances occurring near colonial nest sites from human activity.

Invasive and Exotic Species

Invasive and exotic species may also affect wood storks. Invasive plant species such as *melaleuca*, Australian pine, Brazilian pepper, and other woody species can become established in wood stork habitat and reduce habitat suitability, although wood storks are known to use such habitat it is considered of lower quality than native habitats (Service 2007b). The potential expansion of dense stands of cattail due to high phosphorus water quality may also reduce wood stork foraging habitat. While limited information is available on the effects of invasive exotic animals on wood storks, species like the Burmese python have become established in wood stork habitat and there has been at least one documented case of a python consuming a juvenile wood stork.

Water Quality

The Everglades was historically an oligotrophic system, lacking plant nutrients such as phosphorus, but having high levels of dissolved oxygen. Major portions have become rich in nutrients that promote excessive plant growth and deplete dissolved oxygen primarily due to anthropogenic sources of phosphorus and nitrogen (cultural eutrophication). Degradation of water quality, particularly runoff of phosphorus from agricultural and urban sources, is a concern because it can cause rapid encroachment of cattail (*Typha* sp.) and other undesirable invasive and exotic species reducing the habitat suitability. Dense growth of these plants also has the potential to reduce the ability of wood storks to locate prey. However, the increased risk of eutrophication is difficult to predict given that there is no information available that would allow a measurable prediction of how much, if any, cattail spread may occur as a result of the CEPP.

Status of the Species within the Action Area

Eastern Indigo Snake

Throughout peninsular Florida, this species may be found in all terrestrial habitats which have not experienced high density urban development. In extreme south Florida, these snakes are typically found in pine flatwoods, pine rocklands, tropical hardwood hammocks, and in most other undeveloped areas (Service 1999). Eastern indigo snakes also use some agricultural lands (such as citrus and sugar cane) and various types of wetlands (Service 1999). The current species status is declining based on an assessment of the quantity and quality of available habitat across the range of the eastern indigo snake (Service 2008).

Factors Affecting the Species Environment Within the Action Area

The eastern indigo snake occurs in the project area. The potential CEPP project footprint can be considered eastern indigo snake habitat except for open water not associated with tree islands. Eastern indigo snakes may use vegetated levees and canal banks in south Florida. Eleven indigo snakes were observed, and one was killed at the A-1 FEB site during clearing (mostly sugar cane) and initial construction of the A-1 Reservoir (Service 2013a). The Service (2013) estimated that there might be as many as 182 to 295 indigo snakes in the A-1 FEB action area (15,400 acres). We therefore, expect that indigo snakes also occupy the A-2 FEB site (14,000 acres of mostly sugar cane) at a similar density. Additional upland areas that CEPP will hydrate or degrade include 321 acres of Miami Canal spoil mounds and 226 total acres associated with various smaller components. We do not know if indigo snakes occupy these areas. It is not clear at this time if these areas comprise contiguous habitat of sufficient size to support indigo snakes.

EFFECTS OF THE ACTION

This section analyzes the direct and indirect effects of the proposed action and interrelated and independent actions on CSSS, Everglade snail Kite, wood stork, eastern indigo snake and their critical habitats, if applicable.

Cape Sable Seaside Sparrow

The Service has taken a phased approach to evaluating the effects of the action on CSSS and it is still evolving at this time. The following evaluation is preliminary and will be finalized in the future when more detail regarding specific project actions becomes available. The first phase of the evaluation utilizes the two basic hydrologic metrics which have been used in many projects and with many models over the last decade. These are the nesting season requirement of water below ground surface for a minimum of 60 consecutive days and an average annual hydroperiod of 90 – 210 days. From the available research and scientific literature it is understood that these two requirements must be met in most years to maintain stable subpopulations of CSSS and the suitable habitat on which they depend.

It is not always a simple matter, however, to extract this information from regional hydrologic models and model code must be written in order to produce usable information. Given the time constraints encountered during CEPP, the District's modeling team did as well as could be expected; however, some of the PMs did not perform adequately. In some cases the same indicator regions, which combine model data in certain geographic areas, were not used for each PM. These anomalies have small effects to specific parts of the analysis but may be additive in the overall result, and so should be noted. Basic information (*e.g.*, number of years target met) regarding these two metrics is summarized below and can also be reviewed in the Corps' BA (Corps 2013b).

The second phase of the analysis uses post-processed model output generated by ENP (discussed in more detail below) and focuses more on the spatial extent and geographic location of project-altered hydroperiods within CSSS habitat. These results are presented in table and graphical format below and show the location and extent of project changes as compared to the ECB.

The final phase utilizes Geographic Information System (GIS) tools to overlay the change in hydroperiod condition over the long term occupancy data, as assessed by the range-wide helicopter surveys of singing males, to determine the extent of suitable habitat that will be altered by the project. This information is summarized below, in table and graphical format, by acreage altered in each of several occupancy categories ranging from high to low occupancy.

Construction Effects

The Service does not anticipate any physical disturbance from project equipment or personnel because construction sites and staging areas will be outside known CSSS suitable habitat for the CEPP. Noise associated with construction activities and vehicle and equipment activity, such as traveling to and from the project site, staging areas, and disposal areas outside the project site could disturb sparrows if it occurs adjacent to occupied habitat during the breeding season. However, disturbance to breeding sparrows is not anticipated due to the distance from project activities to historical nest sites.

Operational Effects

Regional Simulation Model Evaluation Methodology

CEPP project alternatives composed of Management Measures (*e.g.*, infrastructure, canal filling, water quality treatment areas, operations, etc.) were assessed using the system-wide regional hydrologic model - Regional Simulation Model (RSM). The RSM was the primary tool used to evaluate the final array of alternatives which were compared to the Existing Condition Base

(EC2012) and Future Without Project (FWO) baselines to determine the final project alternative for CEPP. The EC2012 was developed to represent the system-wide infrastructure and operations that were in place at the time CEPP plan formulation was initiated, approximately January 2012, and is the basis for evaluations conducted by the Service. The reader should refer to Section 2 of the CEPP PIR main report and Appendix C.1 for additional documentation of the EC2012 and Alt 4R2 conditions. RSM provided daily estimates of hydrology across the 41-year POR (1965-2005). The model simulates the region's complex hydrology using south Florida's climate records and technical details on regional canals, water control structures, local topography, and storage reservoirs.

The Regional Simulation Model results were used to compare the performance of Alt 4R2 in relation to EC2012 through calculation of PMs and ETs in order to analyze potential project effects on CSSSs. Microsoft Excel 2010 and ArcMap10 GIS software was used to analyze RSM results and create tables, graphs, and maps to graphically compare action alternatives. The RSM has been applied to several Everglades restoration projects, including the Northern Everglades and Estuaries Protection Program, Biscayne Bay Coastal Wetlands, C-111SC, and WCA-3 Decompartmentalization. For a more detailed description of the RSM refer to the CEPP PIR prepared by the Corps.

There are many uncertainties involved in the use of hydrologic models and although significant effort has been invested into the development and calibration of these models, recognition of model uncertainty is needed when interpreting the ecological significance of model results (Corps 2013a). There is uncertainty in the predictions derived from these models that stems from input variability and measurement errors, parameter uncertainty, model structure uncertainty, and algorithmic (numerical) uncertainty. These uncertainties lead to doubt as to whether the specific performance indicators and measures accurately captures the overall performance. The likelihood of capturing all the processes occurring in a system as complex as the Everglades within simulation models is low. There will always be some uncertainty present in predicting environmental benefits associated with any CERP project because of the size and complexity of the Everglades ecosystem, as well as the difficulty in fully understanding its physical and biological processes. However, the outputs of the sub-regional hydrologic models and PMs used to quantify ecosystem benefits for the CEPP utilize the best data available to predict hydrologic and ecological changes as a result of the project.

Hydrological Effects

Northeast Shark River Slough

The CEPP TSP assumes the L-29 Canal maximum operational stage limit will be increased to 9.7 feet NGVD and the G-3273 constraint will be removed. Total net structural inflows into Northeast Shark River Slough (NESRS; via the L-29 Canal; computed as the sum of S-333, S355A, S-355B, L-29SA, L-29PA, L-29PB, L29 Levee Gap, and S-356 minus S-334) are significantly increased with Alt 4R2, compared to the CEPP EC2012. For Alt 4R2, peak stages in the L-29 Canal are 9.59-9.60 feet NGVD west of the L-29 divide structure and 9.50-9.51 feet NGVD east of the L-29 divide structure. Compared to the EC2012, stages are significantly increased by 0.5-0.9 feet under all hydrologic conditions at NESRS-2 for Alt 4R2. Similar trends are also observed farther south at the NESRS-1 monitoring gauge. These stage increases could have effects on CSSS subpopulations C, E, and F and possibly the southern portion of subpopulation A.

Western Shark River Slough

Western Shark River Slough (WSRS) located west of the L-67 Extension Levee and bounded on the north by Tamiami Trail, is primarily influenced by rainfall and water management operations at the S-12 structures (A, B, C and D). Under ERTP, the utilization of the S-12 structures and the seasonal sequential closure periods beginning from the west at S-12A (November 1 – July 14) and S-12B (January 1 – July 14) is meant to move water from WCA-3A into SRS while providing conditions for CSSS Subpopulation-A (CSSS-A) nesting and breeding. Modification to the ERTP seasonal closure periods for the S-12A and S-12B was not considered during CEPP preliminary screening and alternative formulation, based on the Corps consideration of the Service's Biological Opinion for ERTP.

Compared to EC2012, Alt 4R2 stages within northwest ENP (NP-201) are generally significantly decreased by 0.1-0.3 feet under both wet and dry hydrologic conditions; stages are slightly increased or unchanged from EC2012 for normal hydrologic conditions between approximately 35 percent and 55 percent on the stage duration curve. To the south and west, the NP-205 monitoring gauge (used as an indicator for CSSS-A hydrology) indicates a potentially significant stage decrease of 0.1-0.2 feet under all hydrologic conditions for Alt 4R2, compared to the EC2012. Stages further south within Central Shark River Slough (CSRS) (P-33) are generally significantly increased by 0.2-0.4 feet under all hydrologic conditions for Alt 4R2. Stages within CSRS demonstrate a combined hydrologic response to the hydrologic changes previously indicated for both NESRS and WSRS; the resultant combined average annual transect flows within CSRS are significantly increased.

Taylor Slough

Compared to the EC2012, ENP stages along Taylor Slough (NP-TSB) are slightly decreased by approximately 0.1 feet during the wettest 20 percent of hydrologic conditions and slightly increased by 0.1-0.2 feet during normal to dry hydrologic conditions with Alt 4R2. These stage changes could be indicative of potential effects on CSSS subpopulation C. Alternative 4R2 includes the Blue Shanty flowway and the L-29 divide structure to direct surface water flows further west within NESRS which may result in a possible effect of increased stages in the southern portion of CSSS subpopulation A.

Cape Sable Seaside Sparrow Evaluation Criteria

The sparrow is selective in its life history requirements preferring short hydroperiod marl prairie habitat that generally exists on the periphery, or within higher relief areas of more pronounced habitat features such as sloughs, marshes, and sawgrass flats. This very existence "on the edge" can create a condition where restoring more natural flow regimes (depth, timing, and duration) may affect the short hydroperiods necessary for sparrow habitat. This has necessitated a discussion of how to balance the wide range of wildlife and ecological needs during the transition into full Everglades's restoration. The rationale and methodology for performance criteria (PMs and ETs) used to evaluate effects on the sparrow are also discussed in further detail in the PIR (Corps 2013a). Metrics were applied to RSM model output comparing the existing condition (EC2012) to the TSP (Alt 4R2) and are subject to the important assumption that the model is accurately characterizing project conditions as they will actually occur on the ground. The complications involved in this assumption were previously discussed; nonetheless, model outputs can be used to evaluate the trends anticipated in comparing alternatives. The performance criteria analyzed for CSSSs and their designated critical habitat in subpopulations A through F are described below. Figure 8 shows the location of the subpopulations, their critical habitat boundaries if designated and the indicator regions provided by the Service to group appropriate model cells.

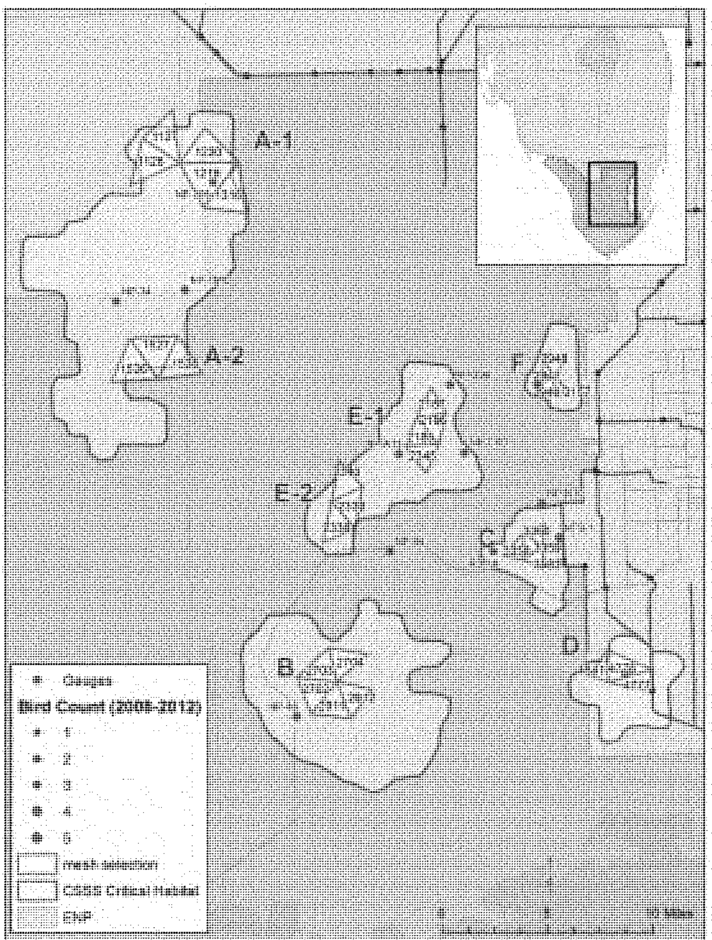

Figure 8. Locations of CSSS subpopulations (A-F), indicator regions and water level gauges

Cape Sable Seaside Sparrow Nesting Criteria

Performance Measure A (PM-A) (NP-205, CSSS-A): Number of years there is a minimum of 60 consecutive days at NP-205 below 6.0 feet NGVD29 (Avg. ground elevation), beginning no later than March 15 and continuing through July 15. The results of the analysis conducted for this PM are shown in Figure 9 and discussed below in the CSSS Nesting Criteria Results section.

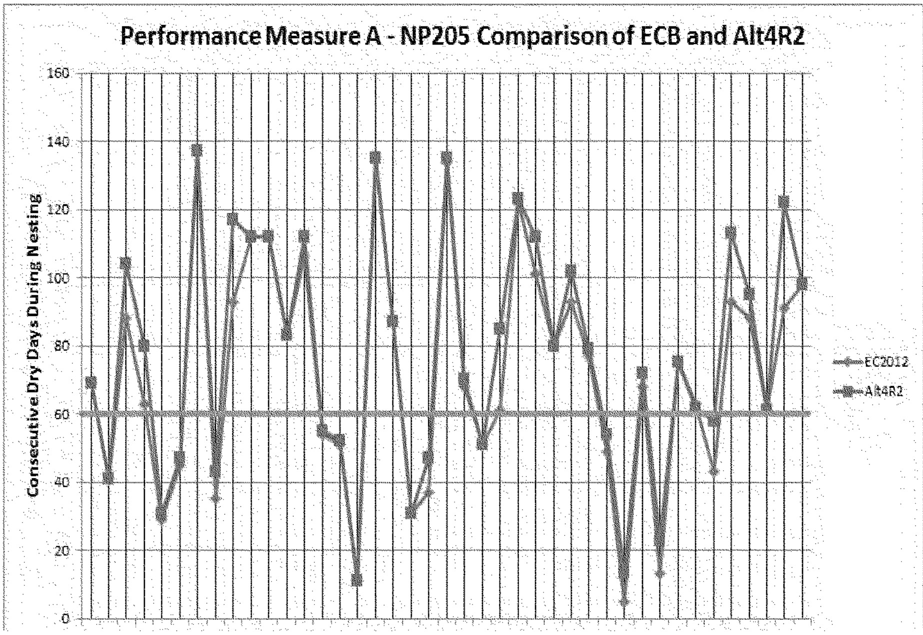

Figure 9. Performance Measure A results. Number of continuous days NP-205 (located in subpopulation A1) was dry for each year in the 1965 through 2005 POR comparing EC2012 to Alt 4R2. The 60 day criterion is shown as a green line.

Ecological Target 1 (ET-1) (NP-205, CSSS-A): Strive to reach a water level of <7.0 feet NGVD at NP-205 by December 31 annually. This target was derived as a progress indicator to ensure that nesting season water levels would reach 6.0 feet NGVD by mid-March. The results of the analysis conducted for this PM indicate no change with the project and discussed below in the CSSS Nesting Criteria Results section. The target was met 38 years of the POR in the EC2012 scenario and 39 years in the Alt 4R2 scenario.

Ecological Target 1A (ET-1A): Annual maximum total number of consecutive dry days between March 1 and July 15 at individual gauge locations representative of CSSS subpopulations. Target is 60 or greater consecutive dry days. The results of the analysis conducted for this PM are included in the Corps' BA for CEPP shown in Table 7 and discussed below in the CSSS Nesting Criteria Results section.

Table 7. Annual maximum total number of consecutive dry days between March 1 and July 15 at CSSS indicator regions. Target is 60 or greater consecutive dry days (green) with data also shown for 40 (yellow) and 80 (olive) day targets. Comparison of EC2012 and Alt 4R2 for each subpopulation of CSSS are for the 41-year POR. The percentage for each 'maximum dry days' calculation is also shown as a percentage of the 41 day POR (percent POR Days). Finally the average maximum consecutive dry days over the POR calculation is tabulated (POR Average Maximum Consecutive Days; grey shading).

CSSS Subpopulation Indicator Region	Criteria	EC2012	% POR Days		Alt4R2	% POR Days
A1	POR Ave. Max. Cons. Days	72			78	
	60 Day	27	66		27	66
	40 Day	34	83		36	88
	80 Day	18	44		20	49
A2	POR Ave. Max. Cons. Days	82			74	
	60 Day	33	80		27	66
	40 Day	36	88		34	83
	80 Day	24	59		20	49
B	POR Ave. Max. Cons. Days	115			113	
	60 Day	40	98		40	98
	40 Day	41	100		41	100
	80 Day	37	90		37	90
C	POR Ave. Max. Cons. Days	107			103	
	60 Day	39	95		39	95
	40 Day	40	98		39	95
	80 Day	35	85		34	83
D	POR Ave. Max. Cons. Days	61			66	
	60 Day	21	51		22	54
	40 Day	27	66		29	71
	80 Day	12	29		15	37
E1	POR Ave. Max. Cons. Days	95			87	
	60 Day	37	90		33	80
	40 Day	38	93		36	88
	80 Day	29	71		25	61
E2	POR Ave. Max. Cons. Days	82			74	
	60 Day	31	76		27	66
	40 Day	36	88		31	76
	80 Day	21	51		18	44
F	POR Ave. Max. Cons. Days	96			93	
	60 Day	33	80		33	80
	40 Day	36	88		37	90
	80 Day	30	73		28	68

Cape Sable Seaside Sparrow Habitat Criteria

Ecological Target 2 (ET-2) (CSSS): Strive to maintain a hydroperiod between 90 and 210 days (three to seven months) per year throughout sparrow habitat to maintain marl prairie vegetation. The results of the analysis conducted for this PM are shown in Table 8 and discussed below in the CSSS Habitat Criteria Results section.

Table 8. Number of years out of the POR and percentage of the total 41-year POR years, that the hydroperiod was between 90 and 210 days each year at indicator regions throughout sparrow habitat in order to maintain marl prairie vegetation (ET-2).

CSSS Sub-Population	EC2012 # Years	%POR Years		Alt4R2 # Years	%POR Years
A-1	4	10		10	24
A-2	9	22		8	20
B	25	61		24	59
C	18	44		15	37
D	11	27		10	24
E-1	24	59		18	44
E-2	12	29		10	24
F	17	41		14	34

In addition to displaying the results as number of years the target is met, it is also useful to show the hydroperiods in critical subpopulations by year in the POR. Table 9 below shows Alt 4R2 hydroperiod in CSSS-A1 by year as compared to the EC2012 on the left side. On the right side of the table the years of the POR have been put in order by the hydropoeriod length in days. Blue highlights represent hydroperiods that are considered too wet for suitable sparrow habitat while green indicates the 90-210 day desired condition. CSSS-A2, E1 and E2 are represented in sequential tables below.

Table 9. Average annual hydroperiod as modeled for Alt 4R2 and EC2012 for the POR. Red shading indicates periods less than 90 days, green is 90-210 days, aqua is 210-240 and blue is greater than 240 day hydroperiod.

Sub Population A-1

Water Year	ECB 2012	Alt 4R2
1966	313	325
1967	279	267
1968	306	295
1969	326	320
1970	318	315
1971	156	139
1972	306	287
1973	257	236
1974	210	183
1975	229	203
1976	272	242
1977	225	205
1978	296	262
1979	291	273
1980	321	315
1981	217	202
1982	275	213
1983	341	336
1984	312	302
1985	190	170
1986	305	301
1987	304	291
1988	300	286
1989	183	167
1990	203	172
1991	224	199
1992	300	290
1993	306	307
1994	321	313
1995	351	346
1996	307	306
1997	336	314
1998	285	285
1999	301	302
2000	296	292
2001	221	184
2002	287	281
2003	297	294
2004	255	238
2005	240	210
Annual Ave.	277	262

Year	ECB 2012	Year	Alt 4R2
1971	156	1971	139
1989	183	1989	167
1985	190	1985	170
1990	203	1990	172
1974	210	1974	183
1981	217	2001	184
2001	221	1991	199
1991	224	1981	202
1977	225	1975	203
1975	229	1977	205
2005	240	2005	210
2004	255	1982	213
1973	257	1973	236
1976	272	2004	238
1982	275	1976	242
1967	279	1978	262
1998	285	1967	267
2002	287	1979	273
1979	291	2002	281
2000	296	1998	285
1978	296	1988	286
2003	297	1972	287
1988	300	1992	290
1992	300	1987	291
1999	301	2000	292
1987	304	2003	294
1986	305	1968	295
1968	306	1986	301
1972	306	1999	302
1993	306	1984	302
1996	307	1996	306
1984	312	1993	307
1966	313	1994	313
1970	318	1997	314
1994	321	1980	315
1980	321	1970	315
1969	326	1969	320
1997	336	1966	325
1983	341	1983	336
1995	351	1995	346
Annual Ave.	277		262

Table 10. Average annual hydroperiod as modeled for Alt 4R2 and EC2012 for the POR in CSSS-A2. Red shading indicates periods less than 90 days, green is 90-210 days, aqua is 210-240 and blue is greater than 240 day hydroperiod.

Sub Population A-2							
Water Year	ECB 2012	Alt 4R2		Year	ECB 2012	Year	Alt 4R2
1966	296	305		1981	100	1971	146
1967	265	262		1978	138	1989	150
1968	290	306		1971	148	1985	157
1969	312	331		1991	156	1990	162
1970	365	365		1985	157	1981	170
1971	148	146		1990	161	1977	174
1972	213	256		1989	164	1974	183
1973	245	260		1974	175	1991	188
1974	175	183		1977	181	2001	227
1975	235	240		1972	213	1976	230
1976	243	230		2001	219	1978	231
1977	181	174		2004	228	2005	234
1978	138	231		1987	231	1982	236
1979	291	306		1975	235	1975	240
1980	266	354		2005	239	2004	240
1981	100	170		1976	243	1987	241
1982	249	236		1973	245	1972	256
1983	365	365		1982	249	1973	260
1984	279	301		2003	263	1967	262
1985	157	157		1967	265	1997	266
1986	275	317		1980	266	2002	278
1987	231	241		1992	270	2003	284
1988	280	286		1997	270	1988	286
1989	164	150		2000	275	2000	288
1990	161	162		1986	275	1999	290
1991	156	188		1994	275	1984	301
1992	270	308		1999	276	1966	305
1993	356	363		2002	276	1994	306
1994	275	306		1984	279	1968	306
1995	365	365		1988	280	1979	306
1996	293	321		1968	290	1992	308
1997	270	266		1979	291	1986	317
1998	358	358		1996	293	1996	321
1999	276	290		1966	296	1969	331
2000	275	288		1969	312	1980	354
2001	219	227		1993	356	1998	358
2002	276	278		1998	358	1993	363
2003	263	284		1970	365	1970	365
2004	228	240		1983	365	1983	365
2005	239	234		1995	365	1995	365
Annual Ave.	251	266		Annual Ave.	251		266

Table 11. Average annual hydroperiod as modeled for Alt 4R2 and EC2012 for the POR in CSSS-E1. Red shading indicates periods less than 90 days, green is 90-210 days, aqua is 210-240 and blue is greater than 240 day hydroperiod.

Sub Population E-1						
Year	ECB 2012	Alt 4R2	Year	ECB 2012	Year	Alt 4R2
1965	253	266	1971	33	1981	62
1967	174	205	1981	49	1971	67
1968	234	263	1990	73	1990	83
1969	256	282	1987	79	1989	103
1970	341	360	1989	96	1987	104
1971	33	67	2005	107	1975	128
1972	162	178	1985	107	1985	145
1973	162	188	2001	116	2005	140
1974	148	153	2004	114	1974	153
1975	123	128	1975	123	2004	153
1976	164	180	1980	124	1991	155
1977	137	179	2003	132	2003	164
1978	162	191	1977	137	2001	166
1979	167	264	1974	148	1972	178
1980	124	245	1991	151	1977	179
1981	49	62	1972	162	1976	180
1982	196	205	1973	162	1973	188
1983	358	365	1978	162	1978	191
1984	187	251	1986	163	1982	205
1985	107	145	1976	164	1967	205
1986	163	241	1979	167	1992	208
1987	79	104	1994	169	2000	230
1988	224	249	1967	174	2002	227
1989	96	103	1984	187	1997	237
1990	73	83	1992	189	1994	239
1991	151	155	2000	190	1986	241
1992	189	208	1982	196	1980	245
1993	260	330	1997	209	1988	249
1994	169	239	2002	216	1984	251
1995	365	365	1988	224	1968	263
1996	249	275	1968	234	1979	264
1997	209	237	1999	248	1965	266
1998	294	305	1996	249	1999	274
1999	248	274	1965	253	1996	275
2000	190	230	1969	256	1969	282
2001	116	166	1993	260	1998	305
2002	216	227	1998	294	1993	330
2003	132	164	1970	341	1970	360
2004	114	153	1983	358	1983	365
2005	107	140	1995	365	1995	365
Annual Ave.	179	211	Annual Ave.	179		211

Table 12. Average annual hydroperiod as modeled for Alt 4R2 and EC2012 for the POR in CSSS-E2. Red shading indicates periods less than 90 days, green is 90-210 days, aqua is 210-240 and blue is greater than 240 day hydroperiod.

Sub Population E-2						
Year	**ECB 2012**	**Alt 4R2**	**Year**	**ECB 2012**	**Year**	**Alt 4R2**
1966	291	301	1971	98	1971	109
1967	250	251	1989	126	1989	129
1968	273	303	1990	131	1990	132
1969	327	342	1981	155	1985	171
1970	365	365	1985	160	1981	176
1971	98	109	1987	177	1987	199
1972	271	305	1974	184	2001	199
1973	281	292	2001	185	1974	201
1974	184	201	2004	190	1991	202
1975	193	211	1975	193	2005	208
1976	213	220	1991	196	1975	211
1977	212	223	2005	202	1976	220
1978	290	300	1977	212	1977	223
1979	307	318	1976	213	2004	225
1980	270	357	1982	227	1982	228
1981	155	176	1967	250	1967	251
1982	227	228	1992	252	2003	256
1983	365	365	1986	254	1988	275
1984	280	326	1997	256	2002	276
1985	160	171	2002	258	1997	281
1986	254	296	2003	262	1999	286
1987	177	199	1988	267	1973	292
1988	267	275	1980	270	1992	292
1989	126	129	1999	270	1986	296
1990	131	132	1972	271	2000	296
1991	196	202	2000	272	1978	300
1992	252	292	1968	273	1966	301
1993	320	356	1984	280	1968	303
1994	314	337	1973	281	1972	305
1995	365	365	1978	290	1996	317
1996	290	317	1996	290	1979	318
1997	256	281	1966	291	1984	326
1998	333	339	1979	307	1994	337
1999	270	286	1994	314	1998	339
2000	272	296	1993	320	1969	342
2001	185	199	1969	327	1993	356
2002	258	276	1998	333	1980	357
2003	262	256	1970	365	1970	365
2004	190	225	1983	365	1983	365
2005	202	208	1995	365	1995	365
Annual Ave.	248	256	Annual Ave.	248		266

The following criteria were analyzed further to discern annual differences and meteorological variability associated with rainfall patterns, (*i.e.*, wet, dry, and average years) as well as the spatial extent (location in reference to critical habitat and CSSS frequency of occupation) of effects.

1. Habitat maintenance criteria for preferred nesting grass species included an analysis of acreage experiencing a 0, 1 to 89, 90 to 210, and 211 to 365-day discontinuous hydroperiod (total number of days water level is above ground level) during the calendar year.

2. Graphical analysis of habitat maintenance criteria to display project effects throughout the entire CSSS range.

We identified years within the POR that have representative hydrologic conditions in order to make the analysis manageable. This exercise can use various metrics and has been completed in different ways in previous Everglade's projects. For use in this project, and to better match the species effects being evaluated, the Service used average annual hydroperiod within all of the CSSS areas along with other metrics such as precipitation. Months within water year definitions may vary between analyses but have little effect on the results. The methodology used to identify representative wet, dry and average years was conducted in the following manner:

1. Using rainfall data from the Royal Palm Ranger Station (indicative of CSSS-E), and Tamiami Trail 40 Mile Bend station (indicative of CSSS-A), monthly rainfall data for the POR was tabulated for all years and averaged. Years with a high amount of missing data were omitted. Rainfall amounts were totaled for a water year beginning on October 1 and ending on September 30. Years were classified as to whether they were in the warm (wet) or cool (dry) phase of the AMO. The annual average rainfall total for 1965-2005 for each station/subpopulation was calculated with the standard deviation. If a water year was greater than one-half standard deviation (SD) of the period average, it was classified as a wet year. If the water year was greater than one-half SD below the period average is was classified as a dry year. Years between the SD were considered average years. Table 13 shows the results of these analyses.

Table 13. Results of hydroperiod years analysis (1965 – 2005) based on rainfall at Royal Palm Ranger Station and Tamiami Trail 40 Mile Bend precipitation stations and AMO.

Water Years		
Average Years	Wet Years	Dry Years
1970	1966	1971
1972	1968	1975
1976	1969	1985
1982	1983	1986
1991	1995	1989
1992	2005	1990
1998	--	--
2001	--	--

2. Using rainfall data from the Royal Palm Ranger Station, Tamiami Trail 40 Mile Bend Flamingo Ranger Station, and Everglades precipitation stations, monthly rainfall data for the POR was tabulated for all years and averaged. Years with a high amount of missing data were omitted. Rainfall totals were calendar year (January 1 – December 31). Each individual year average precipitation for all stations was the calculated as a percentage of the POR average. Years in the range of 0 -33 percent of the POR were classified as dry, years in the range of 33.1 to 66 percent of the POR were classified as average, and years in the range of 66.1 to 100 percent of the POR were classified as dry. Years for further analysis were selected from these groupings by cross-referencing with the years from analysis 1 detailed above and also selected to be representative of the range of years within each dry, average, and wet scenario. Figure 10 illustrates the results of this analysis.

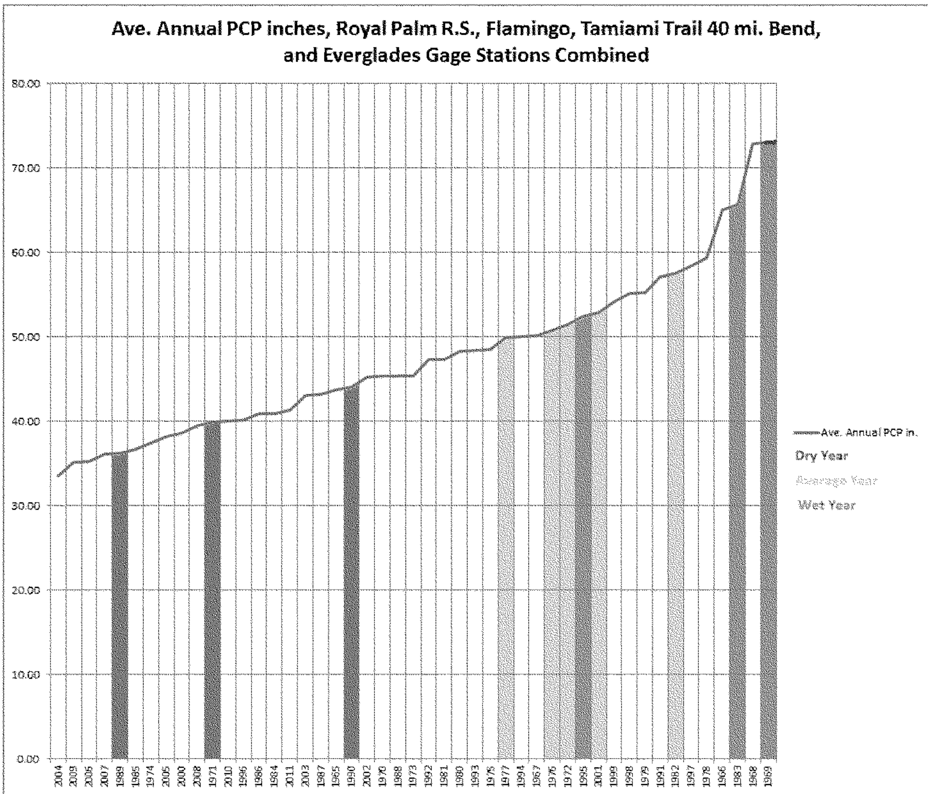

Figure 10. Results of annual precipitation analysis at Royal Palm Ranger Station, Tamiami Trail 40 Mile Bend, Flamingo Ranger Station, and Everglades precipitation stations, for selection of conceptual dry, average, and wet years to be utilized in Service's spatial analysis of CEPP project effects.

3. Annual (water year November 1 through October 31) discontinuous hydroperiod (number of total days per year water level is above ground surface) based on RSM output for EC2012 for each subpopulation (or modeled indicator region A1, A2, E1, E2) was tabulated (Table 14). Each year's hydroperiod was averaged over all subpopulations A-F, and also over subpopulations B-F to exclude the operationally wet condition in subpopulation A from the analysis. Years were grouped by the overall hydrologic target range within which they fell based on CSSS habitat maintenance hydroperiod ranges; (1) <90 days (dry); (2) 90 – 210 days (average); (3) >210 – 240 days (borderline); and (4) > 240 days (wet). Table 14 shows the results of these analyses including all years analyzed and those selected for the Service's hydroperiod analysis.

4. Based on the results of the analyses performed in 1 through 3 above, years were selected that were in agreement in all analyses with the conditions that defined dry, average, and wet annual scenarios. In general, dry and wet scenario years were distinctive in how strongly they fell into their respective classifications and 3 years were readily identified for further analysis. Due to the variability in the average scenario, 5 years were selected to strengthen the analysis due to the importance of average years in reference to CSSS habitat requirements. Dry years selected were 1971, 1989, and 1990, wet years selected were 1969, 1983, and 1995, and average years selected were 1972, 1976, 1977, 1982, and 2001 (Table 14).

Table 14. CEPP RSM modeled EC2012, November 1 to October 31 water year, discontinuous hydroperiod days by year analyzed in 1965 – 2005 POR and CSSS subpopulation. Years are grouped by average, dry, and wet years scenarios and also by alternate years considered (white shading) and those years selected for further analysis of habitat criteria metric (red, green, and blue).

	Dry									
	Alternate Years Considered						Years Analyzed			
CSSS Subpop.	1975	1985	1986	2003	2004	2005	* 1971	* 1989	* 1990	Ave. 71,89, 90
A1	229	191	307	297	250	237	156	185	206	182
A2	233	163	252	263	207	225	143	166	162	157
B	143	93	93	88	107	62	23	54	52	43
C	40	40	66	38	42	47	0	27	2	10
D	166	160	301	251	178	166	136	140	145	140
E1	122	109	138	139	111	117	30	97	73	67
E2	190	161	237	267	174	199	96	128	131	118
F	33	47	151	128	50	96	0	45	13	19
Ave.	145	121	193	184	140	144	73	105	98	92
Ave. B-F	116	102	164	152	110	115	48	82	69	66

	Average															
	Alternate Years Considered										Years Analyzed					
CSSS Subpop.	1970	1978	1981	1984	1991	1992	1993	1994	1998	2000	* 1972	* 1976	* 1977	* 1982	* 2001	Ave. 72,76, 77,82, 01
A1	323	296	217	315	225	296	312	319	288	296	309	265	222	266	219	256
A2	365	141	97	239	156	250	343	243	351	270	213	225	180	230	217	213
B	196	219	128	123	147	143	99	66	248	152	176	164	87	178	137	148
C	215	42	42	124	134	160	59	101	149	97	85	113	58	104	88	90
D	310	334	192	221	218	265	304	353	303	269	276	195	206	235	195	221
E1	349	163	49	169	151	183	211	163	296	185	162	162	132	195	116	153
E2	365	290	156	259	198	235	300	284	333	267	270	207	212	219	184	218
F	322	24	45	160	136	169	242	249	218	127	116	119	58	167	79	108
Ave.	306	189	116	201	171	213	234	222	273	208	201	181	144	199	154	176
Ave. B-F	293	179	102	176	164	193	203	203	258	183	181	160	126	183	133	157

	Wet										
	Alternate Years Considered							Years Analyzed			
CSSS Subpop.	1966	1968	1970	1988	1997	2000	2005	* 1969	* 1983	* 1995	Ave. 69,83, 95
A1	317	304	323	303	325	296	237	329	339	350	339
A2	290	272	365	277	234	270	225	307	365	365	346
B	197	211	196	181	172	152	62	220	275	300	265
C	192	200	215	174	169	97	47	189	268	321	259
D	334	250	310	269	239	269	166	341	342	359	347
E1	242	230	349	201	203	185	117	241	352	365	319
E2	286	267	365	261	241	267	199	324	365	365	351
F	195	201	322	175	167	127	96	192	327	365	295
Ave.	257	242	306	230	219	208	144	268	329	349	315
Ave. B-F	241	227	293	210	199	183	115	251	322	346	306

The habitat maintenance criteria analysis conducted by the Service was performed on the years selected as discussed above. Hydrologic data for the analysis was based on output from the RSM which was interpolated to a 500 meter grid and reprojected to UTM, NAD83 by ENP (Pearlstine et al. 2013). Interestingly, ENP produced a Marl Prairie Habitat Suitability Index using the same data set and analyzed with four different metrics in combination. Their results are very similar to what is discussed below (Pearlstine et al. 2013, Corps 2013b). Daily water level predictions for EC2012 and Alt 4R2 were input as layers into the previously discussed GIS analysis to produce spatial representations of the extent of hydroperiod range occurrence within the CEPP project area for all years analyzed. In addition it was possible to produce change maps (comparing EC2012 and Alt 4R2) illustrating the extent and location of acreages gained or lost for the desired hydroperiod range (90 to 210 day) for CSSS habitat maintenance. Figures 11 through 32, located after the Literature Cited section of this document, contain the results of these analyses. From these GIS layers, it was possible to calculate acreage changes (comparing EC2012 and Alt 4R2) separated by hydroperiod range within CSSS subpopulation critical habitat boundaries. Table 15 contains the results of this analysis for habitat conditions within CSSS critical habitat boundaries in B, C, D, E, and F, and formerly proposed (but not designated) critical habitat in A. A final analysis was then conducted from these data based on CSSS subpopulations to determine where acreage changes were occurring in reference to CSSS habitat use over the POR within which they have been monitored (1981 through 2013). The CSSS occurrence is illustrated in Figures 34 through 44, located after the Literature Cited section of this document, and the results of the habitat change analysis for habitat utilized are contained in Tables 24 through 26.

Cape Sable Seaside Sparrow Nesting Criteria Results

The CSSS nesting season can last from February to August (Service 1983), but the majority of nesting occurs in the drier spring season. Nests are constructed 17 to 21 centimeters off the ground (Lockwood et al. 2001) and preferentially in mixed marl prairie habitat. Pimm et al. (2002) estimates the nest cycle of sparrows to range from 34 to 44 days, when totaling the number of days required for all the nesting stages (egg laying, incubation, nestling, and fledgling). If water levels rise above the mean height of the nests during this period the sparrow will cease breeding (Lockwood et al. 1997; Lockwood et al. 2001; Basier et al. 2008; Cade and Dong 2008). CSSS breeding pairs will renest during the breeding season if the duration of drier conditions permit. As discussed previously, due to a multitude of factors including high rates of nest failure, juvenile mortality, short life span, and habitat threats currently affecting the CSSS, a minimum of two potential complete nesting cycles is considered essential to maintain current population levels and possibly rebuild depleted subpopulation levels when habitat conditions have improved.

A measure of the potential for sparrow nesting success is the number of consecutive days between March 1 and July 15 that water levels are below ground surface. This range of dates incorporates most of the period when sparrows have been observed nesting (Lockwood et al. 1997; Lockwood et al. 2001) and is an indirect measure of the number of days potentially available for sparrow courtship and nesting (Van Lent et al. 1999; Lockwood et al. 1997; Lockwood et al. 2001). Modeling of sparrow reproductive potential (Pimm and Bass 2001, Walters et al. 2000) supports the recommendation for evaluation of nesting condition availability, which states that 40 consecutive days for 8 out of 10 years (80 percent) is considered favorable for sparrow population persistence; 40 days for 7 out of 10 years (70 percent) is considered borderline for persistence; 80 consecutive days for 8 out of 10 years (80 percent) is considered very favorable for increasing population numbers; and 80 days for 7 out of 10 years (70 percent) is favorable.

For purposes of this evaluation, nesting criteria PM-A analyzed the number of continuous days NP-205 was dry and used a 60-day criteria as being successful. A frequency of this condition was not calculated. Figure 9 illustrates the results of this analysis showing individual years of record as a function of the 60-day (red line) criteria. The results show that in both EC2012 and Alt 4R2, 27 years meet the 60-day criteria indicating no noticeable effect of the project on this metric. However, those 27 years only represent meeting the metric in the 41-year POR in 66 percent of the years. When the record is further analyzed to compare with the above-mentioned 40 and 80-day frequency recommendations, the 40-day criteria is met in 83 percent of years in EC2012 and 88 percent in Alt 4R2; both are considered favorable. A similar analysis for the 80-day criteria results in meeting the target in 44 percent of years for EC2012 and 49 percent for Alt 4R2, considerably below the "borderline" classification in both scenarios.

Ecological Target 1 (ET-1) at NP-205, was created as metric for CSSS-A was a metric created to reach a water level of <7.0 feet NGVD29 at NP-205 by December 31 annually, for nesting season water levels to reach 6.0 feet NGVD29 by mid-March (about 10 weeks later). This metric was met in 38 years (93 percent of POR) in EC2012 and would be met in 39 years (95 percent of POR) for Alt 4R2. It appears that this metric is not sensitive enough to discern differences between alternatives and it appears that meeting a water level of 7.0-feet at NP-205 on December 31st, is not at issue. Future analyses should look more closely at the timing of dry down in March which is a critical period for the beginning of CSSS nesting.

Table 7 contains the results of the ET-1A analyses. The annual maximum total number of consecutive dry days between March 1 and July 15 at gauges and individual cells throughout the CSSS subpopulations were tabulated. The target is 60 or greater consecutive dry days (green) with data also shown for 40 (yellow) and 80 (olive) day targets. Comparison is made between EC 2012 and Alt 4R2 for each CSSS subpopulation for the 41-year POR. The percentage of each maximum dry-days calculation is also shown as a percentage of the 41 day period of record (percent POR Days). Finally the average maximum consecutive dry days over the POR calculation is tabulated (POR Avg. Max. Cons. Days) (grey shading). Results are discussed for each CSSS subpopulation.

<u>CSSS-A1</u>

No change is indicated in the number of years meeting the 60-day target comparing EC2012 (27 years) to Alt 4R2 (27 years), (Table 7). However, those 27 years only represent meeting the metric in the 41-year POR in 66 percent of the years. When the record is further analyzed to compare with the afore mentioned 40 and 80-day frequency recommendations, the 40-day criterion is met in 83 percent of years in EC2012 and 88 percent in Alt 4R2; both considered "favorable" for maintaining the current condition for sparrows in CSSS-A. A similar analysis for the 80-day criterion results in meeting the criteria in 44 percent of years in EC2012 and 49 percent in Alt 4R2; considerably below "borderline" in both scenarios. Based on the metric, this level of existing and projected occurrence of nesting period duration will not be sufficient to sustain or increase the CSSS subpopulation in the area of indicator region A1 (the northern portion of the subpopulation).

CSSS-A2

A decrease is indicated in the number of years meeting the 60-day target comparing EC2012 (33 years) to Alt 4R2 (27 years; Table 7). Once again, those 27 years only represent meeting the metric in the 41-year POR in 66 percent of the years. When the record is further analyzed to compare with the above 40 and 80-day frequency recommendations, the 40-day criterion is met in 88 percent of years in EC2012 and 83 percent in Alt 4R2; both considered favorable. A similar analysis for the 80-day criterion results in meeting the criteria in 59 percent of years in EC2012 and 49 percent in Alt 4R2; considerably below borderline in both scenarios. This level of existing and projected occurrence of nesting period duration will not be sufficient to sustain the CSSS subpopulation in the area of indicator region A2 (the southern portion of the subpopulation).

CSSS-B

No change is indicated in the number of years meeting the 60-day target comparing EC2012 (40 years) to Alt 4R2 (40 years; Table 7). Those 40 years represent meeting the metric in the 41-year POR in 98 percent of the years. When the record is further analyzed to compare with the above 40 and 80-day frequency recommendations, the 40-day criterion is met in 100 percent of years in EC2012 and 100 percent in Alt 4R2; both far exceeding favorable conditions. A similar analysis for the 80-day criterion results in meeting the criteria in 90 percent of years in EC2012 and 90 percent in Alt 4R2; considerably above very favorable in both scenarios. This level of existing and projected occurrence of nesting period duration should continue to provide nesting conditions that are very favorable to the continued existence of the CSSS-B subpopulation (currently the largest and most self-sustaining subpopulation).

CSSS-C

No change is indicated by the RSM analysis in the indicator cells used, in the number of years meeting the 60-day target comparing EC2012 (39 years) to Alt 4R2 (39 years; Table 7). Those 39 years represent meeting the metric in the 41-year POR in 95 percent of the years. When the record is further analyzed to compare with the above 40 and 80-day frequency recommendations, the 40-day criterion is met in 98 percent of years in EC2012 and 95 percent in Alt 4R2; both far exceeding favorable conditions. A similar analysis for the 80-day criterion results in meeting the criteria in 85 percent of years in EC2012 and 83 percent in Alt 4R2 very favorable in both scenarios. These results indicate that nesting conditions should remain favorable for CSSS-C. However, this subpopulation has been subjected to a high frequency of fire occurrence that has suppressed its capacity to sustain historical population levels and expand. In addition, the

Service has concerns about the accuracy of the RSM model predictions in this area, possibly attributable to errors in the base elevations utilized. These errors are evident when comparing historical data at real-time gauges within the subpopulation to existing conditions (EC2012) projected by the RSM, and will be further discussed in future biological opinions by the Service as consultation proceeds with implementation of CEPP.

CSSS-D

An increase is indicated in the number of years meeting the 60-day target comparing EC2012 (21 years) to Alt 4R2 (22 years), (Table 7). However, those 21 and 22 years only represent meeting the metric in the 41-year POR in 51 and 54 percent of the years, respectively. When the record is further analyzed to compare with the above 40 and 80-day frequency recommendations, the 40-day criterion is met in 66 percent of years in EC2012 and 71 percent in Alt 4R2; both considered barely favorable. A similar analysis for the 80-day criterion results in meeting the criterion in 29 percent of years in EC2012 and 37 percent in Alt 4R2; considerably below borderline in both scenarios. This level of existing and projected occurrence of nesting period duration will not be sufficient to sustain the CSSS subpopulation in the area modeled by RSM in subpopulation D (one of the smallest and most imperiled CSSS subpopulations).

CSSS-E1

A decrease is indicated in the number of years meeting the 60-day target comparing EC2012 (37 years) to Alt 4R2 (33 years) in the area modeled by RSM in for indicator region E1 (Table 7). EC2012 meets the target 37 years or 90 percent of the POR while Alt 4R2 meets it 33 years or 80 percent of the POR. When the record is further analyzed to compare with the 40 and 80-day frequency recommendations, the 40-day criterion is met in 93 percent of years in EC2012 and 88 percent in Alt 4R2; both considered favorable. A similar analysis for the 80-day criterion results in meeting the criteria in 71 percent of years in EC2012 and 61 percent in 4R2; barely favorable in EC2012, and below borderline in Alt 4R2. These changes between existing and projected levels of nesting period duration are indicative of anticipated changes that the CEPP project will have in rerouting flows to the eastern portion of SRS. Based on these projected changes, some detrimental effect on CSSS nesting is indicated and needs to be closely monitored in this critical subpopulation (currently the second largest CSSS subpopulation). The area represented by indicator region E1 also contains the majority of the breeding birds in the subpopulation.

CSSS -E2

A decrease is indicated in the number of years meeting the 60-day target comparing EC2012 (31 years) to Alt 4R2 (27 years) in the area modeled by RSM for indicator region E2 (Table 7). The 31 years in which EC2012 meets the target in the 41-year POR represents 76 percent of the years while the 27 years by Alt 4R2 represents 66 percent of the years. When the record is further analyzed to compare with the above 40 and 80-day frequency recommendations, the 40-day criterion is met in 88 percent of years in EC2012 (favorable) and 76 percent in Alt 4R2 (borderline). A similar analysis for the 80-day criterion results in meeting the criteria in 51 percent of years in EC2012 and 44 percent in Alt 4R2, both well below borderline for nesting conditions. These indicated changes from the level of existing to projected occurrence of nesting period duration are indicative of anticipated changes that the CEPP project will have in rerouting flows to the eastern portion of SRS. Based on these projected changes, some detrimental effect to CSSS nesting is indicated and needs to be closely monitored in this critical subpopulation (currently the second largest CSSS subpopulation) and especially in this southern portion of CSSS-E indicated by indicator region E2 due to the already existing borderline nesting conditions.

CSSS-F

No change is indicated in the number of years meeting the 60-day target comparing EC2012 (33 years; 80 percent) to Alt 4R2 (33 years; 80 percent; Table 7). When the record is further analyzed to compare with the above 40 and 80-day frequency recommendations, the 40-day criterion is met in 88 percent of years in EC2012 and 90 percent in Alt 4R2; both considered favorable. A similar analysis for the 80-day criteria shows the target is met in 73 percent of years in EC2012 and 68 percent in Alt 4R2; a decrease and barely favorable in both scenarios. The 80-day criterion decrease may be indicative of anticipated changes that the CEPP project will have in rerouting flows to the eastern portion of SRS where CSSS-F is located. This subpopulation has also been subjected to a high frequency of fire occurrence and woody plant invasion, which has suppressed its capacity to sustain historical population levels or expand. This level of existing and projected occurrence of nesting period duration needs to be closely monitored and other negative habitat effects reversed in order to optimize the potential to sustain the CSSS subpopulation E (one of the smallest and most imperiled subpopulations).

Finally, the average maximum consecutive dry days over the POR calculation is tabulated (POR Average Maximum Consecutive Days; grey shading) in Table 7. Results of this generalized metric are mostly indicative of changes discussed for each subpopulation above with the project showing decreased number of consecutive dry CSSS breeding days during the period from March 1 through July 15 in regions A2, C, E1, E2, and F, gains in A1, and D, and essentially no change in B.

Cape Sable Seaside Sparrow Habitat Criteria Results

CSSS nesting habitat studies indicate a preference for nest sites that provide specific vegetative characteristics (Basier et al. 2008). Nests are built where at least 25 to 50 percent of the vegetative litter is moderately high. The presence of specific grasses such as *Muhlenbergia filipes*, *Schizachyrium rhizomatum*, and *Schoenus nigricans* also appear to be cues for nest placement. These grass species show an optimal preference for sites that characteristically have an annual discontinuous hydroperiod (water above ground level) in the range of 90 to 210 days. Habitats with average hydroperiods longer than this range are generally dominated by species such as sawgrass.

The (ET-2) metric that was applied for this analysis was the number of years out of the POR that the hydroperiod was between 90 and 210 days each year. EC2012 and Alt 4R2 were compared at indicator regions located within each subpopulation or segment of the subpopulation. An additional metric was calculated that illustrates the percentage of years met out of the total 41-year POR. Table 8 shows the results of this analysis based on the RSM model output. As a starting point for discussion and a means of comparison, the model results for subpopulation B are provided first, due to the robustness of habitat conditions within this subpopulation. The ET-2 metric based on RSM output for subpopulation B shows that the target 90-210 day hydroperiod range is met in 25 years in EC2012 and 24 years in Alt 4R2 representing 61 percent and 59 percent of the POR respectively and indicating no or minimal adverse effect of CEPP.

Similarly to CSSS-B, CSSS-E has shown consistent population numbers and habitat conditions and will likely be the most impacted of the subpopulations. In CSSS-E1, the ET-2 metric shows that the target 90-210 day hydroperiod range is met in 24 years in EC2012 and declines to 18 years in Alt 4R2 representing 59 percent and 44 percent of the POR respectively. This indicates a reduction of 6 years or 15 percent with the project. CSSS-E is currently the second largest subpopulation. The southern portion of CSSS-E as indicated by indicator region E-2 shows that the target 90-210 day hydroperiod range is met in 12 years in EC2012 and 10 years in Alt 4R2 representing 29 percent and 24 percent of the POR, respectively, and indicating a reduction of 2 years or 5 percent with the project. These results are consistent with anticipated changes that the CEPP project will have in rerouting flows to the eastern portion of SRS where CSSS-E is located.

The ET-2 metric for CSSS-C shows that the target 90-210 day hydroperiod range is met in 18 years in EC2012 and 15 years in Alt 4R2 representing 44 percent and 37 percent of the POR, respectively, and indicating a reduction of 3 years or 7 percent with the project. Similar data is indicated for the smaller subpopulations with F showing that the target is met in 17 years in EC2012 and 14 years in Alt 4R2 representing 41 percent and 34 percent of the POR, respectively, (a reduction of 3 years or 7 percent with the project), and for CSSS-D, the target being met in 11 years in EC2012 and 10 years in Alt 4R2 representing 27 percent and 24 percent of the POR, respectively, (a reduction of 1 year or 3 percent with the project). Finally, the ET-2 metric for indicator region A-2 shows that the target 90-210 day hydroperiod range is met in 9 years in EC2012 and 8 years in Alt 4R2 representing 22 percent and 20 percent of the POR, respectively, and indicating a reduction of 1 year or 2 percent with the project. The ET-2 metric for indicator region A-1 shows that the target 90-210 day hydroperiod range is met in 4 years in EC2012 and 10 years in Alt 4R2 representing 10 percent and 24 percent of the POR, respectively, and indicating a potential increase of 6 years or 14 percent with the project.

The following conclusions can be drawn from the previous discussion of the ET-2 metric and the RSM predicted effects of the CEPP project on the CSSS. The number of years the 90-210 day hydroperiod range is met in CSSS-B is projected to be unaffected by CEPP. Only CSSS-E and specifically, the northern portion of this subpopulation as indicated by indicator region E-1, has a similar pattern to that in CSSS-B in that the number of years the 90-210 day hydroperiod range is currently being met in the POR, is indicative of healthy habitat conditions. However, the CEPP will reduce that by 6 years or 15 percent (Corps 2013b). Tables 11 and 12 show how the project will change hydroperiods from the existing condition for each year of the POR in indicator regions E1 and E2. In E-1 specifically, the years 1994, 1997 and 2000 are the greatest concern because this will result in almost a decade of consecutive years of long hydroperiods similarly to what happened in A-1 (Table 9) which resulted in changes to suitable sparrow habitat and decreased reproductive success. Operational flexibility should be used in situations like these to avoid consecutive years with long hydroperiods.

Most other subpopulation indicator regions including A-2 (Table 10), C, D, E-2 (Table 12), and F indicate suboptimal habitat conditions, as compared to those that exist in B and E-1, and will be further reduced by the CEPP. Only indicator region A-1 shows a benefit of CEPP compared to existing conditions (6 years or 14 percent of POR). This perceived benefit is again conceptually consistent with anticipated changes that the CEPP project will have in rerouting flows away from the western portion of SRS where CSSS-A is located. However, based on a comparison of healthier (CSSS-B and CSSS-E1) subpopulations, the number of years that are modeled by RSM that the 90-210 day hydroperiod range will be met in the POR, even with improved conditions indicates that habitat conditions in that area will continue to be suboptimal and will not contribute to the recovery of the sparrow in CSSS-A.

The previous analyses and discussion of project effects on sparrow habitat illustrates the complexity involved in assessing impacts to individual subpopulations and evaluating the overall effects of the project on a landscape scale. The Service reiterates that the previous analyses were conducted based on model output and are subject to concerns expressed regarding this output. Calculations of acreages affected in individual sparrow subpopulations using various metrics provide insight into the magnitude of perceived effects but do not reveal the spatial distribution of those effects within the subpopulations and within the project study area as a whole. The previous analyses illustrated that project effects are principally related to the 90 to 210-day discontinuous hydroperiod in all subpopulations. This metric is consistent with the Primary Constituent Element (2) Herbaceous Vegetation, published for the sparrow in the critical habitat designation (50 FR, 62736), which will be discussed in the critical habitat effects analysis. The Service conducted additional analyses using GIS software to illustrate the spatial relationships of this metric.

Data resulting from RSM analysis and ET-2 was potentially lacking in that it was based on indicator cells defined by the RSM model grid within each subpopulation that represented only a small portion of the habitat (albeit the cells were placed in areas known to be frequented by breeding CSSS based on helicopter survey data). In an attempt to further refine the analysis of CEPP effects on CSSS habitat conditions, the Service conducted additional analyses to discern annual differences and meteorological variability associated with rainfall patterns, (*i.e.*, wet, dry, and average years) as well as the spatial extent (location in reference to critical habitat and CSSS frequency of occupation) of effects. Habitat maintenance criteria for preferred nesting grass species included analysis of acreage experiencing a 0, 1 to 89, 90 to 210, and 211 to 365 day discontinuous hydroperiod (total number of days water level is above ground level) during the calendar year. Additional graphical analysis of the habitat maintenance criteria was included to display project effects over the entire CSSS area. Methodology was discussed in the previous CSSS Evaluation Criteria section.

Analysis of Habitat Criteria in CSSS Subpopulation and Critical Habitat Boundaries

In order to discern annual differences and meteorological variability in the analysis, conceptual average, dry and wet years were selected after rigorous examination to determine each year's fit within defined parameters. Our discussion of effects is organized by each scenario (average, dry, or wet year). The years selected from the RSM modeled POR to represent average years were 1972, 1976, 1977, 1982, and 2001. By definition, an average year would be expected to occur more frequently and therefore, have more influence of shaping habitat conditions, and therefore, our analysis of CEPP project effects will be weighted more heavily towards the effects during those years. The years selected from the RSM modeled POR to represent dry years were 1971, 1989, and 1990, and the wet years 1969, 1983, and 1995.

One of the more evident results from the RSM output data was the habitat maintenance criteria for preferred nesting grass species that included analysis of acreage experiencing a 90 to 210-day discontinuous hydroperiod during the calendar year (total number of days water level is above ground level). The analysis performed for subpopulation B indicated that the proposed project would have no obvious effect on this metric. The analysis also showed for subpopulation B that this hydroperiod range occurred on an average of about 23,000 acres (59 percent of total acreage) in both the existing condition and with-project scenarios during the average years. The same metric showed that for the existing condition and with project scenarios in the dry years, approximately 8,800 acres (22 percent) and in the wet years, 8,000 acres (22 percent), met the hydroperiod range for discontinuous hydroperiod with little change between the existing condition and with-project scenarios. Based on the continued health of subpopulation B, this provides additional support for the assumption that hydroperiod during the average year is particularly important in terms of its influence on sustaining suitable sparrow habitat conditions.

<u>Average Years</u>

Figures 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, and 31, graphically depict a comparison between EC2012 and Alt 4R2 of discontinuous hydroperiod range (0, 1-89, 90 to 210, and >210 days) within the CEPP study area for each average year selected. Figures 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, and 32, following each of these yearly comparisons graphically depict the change in the 90 to 210-day target hydroperiod with the project compared to the existing condition (either gained or lost) with calculations of acreage gained or lost for the entire CEPP study area. All of these figures illustrate the CSSS critical habitat boundaries for B, C, D, E, and F and proposed but not designated critical habitat in CSSS-A. To avoid confusion based on these figures, Table 15 cross-references the dual labeling criteria for the subpopulations with the numerical labeling (1 -7) coming originally from the proposed critical habitat listing, and the alphabetic labeling (A – F) coming from the historical record. For future discussion, all subpopulations/critical habitat will be designated as A1, A2 (collectively referred to as A), B, C, D, E and F. Further caution needs to be taken to avoid confusing the A1 and A2 indicator regions (the northern and southern main subpopulation A) that were used in previously discussed metrics. The A1 refers to Unit 1 while A2 Unit 2 refers to the Ochopee area from the Proposed Critical Habitat revision and these will be referenced as such for this analysis.

A visual examination of Figures 11, 13, 15, 17, and 19, for the average years analyzed reveals two dominant effects of the project that are consistent with one of the major goals of CEPP to move water from the western portion of SRS to the eastern side. The first most obvious effect occurs in subpopulation A1 (and especially the more northerly and easterly portion) visually depicts more habitat occurring in the 90 to 210-day target range (green) in an average-year scenario both within and outside the subpopulation boundary when comparing the existing condition to with project condition. This observation is supported by the results tabulated in Table 15 that shows an average of 4,952 acres gain (over 8 percent of A1 habitat) for this metric within A1 and could be indicative of potential overall improvement of habitat quality and extent in the future with the project. Considerable habitat is also shown to be created outside of the A1 subpopulation boundary but this occurs in habitat that is either unsuitable for CSSS use and/or sparrows have never been documented in those areas. The more southerly and easterly portions of subpopulation A1 do not seem to be equally benefited by the project. The project does not appear visually to have any effect on subpopulation A2 and Table 15 only shows an average gain of 15 acres for this metric. The second most obvious effect of the project from visual examination of Figures 11, 13, 15, 17, and 19, is shown in subpopulation E, where habitat in the target range is consistently lost along the entire northwestern side of its critical habitat boundary. This observation is supported by the results tabulated in Table 15 that shows an average of 942 acres lost with the project for this metric within the subpopulation E critical habitat. This loss of habitat with the project is of concern because subpopulation E currently supports the second largest CSSS subpopulation and is vitally important to the overall viability of the entire CSSS population.

Further visual examination of Figures 11, 13, 15, 17, and 19, for the average years analyzed, reveals that the with-project condition shows no discernable negative effect on subpopulation B critical habitat with Table 15 enumerating an average gain of target acreage of 283 acres. Subpopulation C likewise reveals that the with-project condition shows no discernable negative effect on subpopulation C critical habitat with Table 15 enumerating an average gain of target acreage of 751 acres. This project effect needs to be further scrutinized due to concerns about model accuracy in this area.

A visually detectable gain is evident with the project in Figures 11, 13, 15, 17, and 19, within subpopulation F critical habitat in the target hydrologic range with acreage currently occurring in the 1 to 89-day range being replaced by the target 90 to 210-day range. Table 15 calculates an average shift of 798 acres to the target range, an average of 16 percent of the total subpopulation F critical habitat. Finally, visual examination of Figures 11, 13, 15, 17, and 19, for the average years analyzed reveals that the with-project condition shows a slightly discernable negative effect in several years on subpopulation D critical habitat with Table 15 enumerating an average loss of target acreage of 465 acres (approximately 4 percent) of the total subpopulation D critical habitat. The Service's Biological Opinion for the C-111SC Project determined that approximately 1,600 acres were removed from the target range favorable for CSSS habitat use by the C-111SC Project, and for which habitat improvement measures were stipulated in the Biological Opinion's Terms and Conditions. Further analysis of this habitat loss indicated by the CEPP project needs to be conducted to determine whether this acreage loss in subpopulation D is in addition to or contained within the 1,600 acres that were impacted by the C-111SC Project.

Over all CSSS subpopulations combined, Table 15 enumerates a net total average gain (in the average year scenario) with the project of target acreage of 5,391 acres (approximately 3.5 percent of the total subpopulations critical habitat B - F and subpopulation A habitat). However the vast majority of this (92 percent) is attributable to the sizeable gain indicated in subpopulation A.

Dry Years

The dry years analysis of CEPP project effects on the 90 to 210-day target metric utilized an average of 1971, 1989, and 1990 as an indicator of project effects. A visual examination of Figures 21, 23, and 25, for the dry years analyzed and tabulation of acreage changes (Table 15) reveals very little change within subpopulation A1 (-7 acres), A2 (+62 acres), B (+122 acres), C (0 acres), and F (0 acres). However subpopulation D (+789 acres) and subpopulation E (+1,124 acres) do show some benefit in a dry year scenario representing approximately 7 percent and 5 percent of available critical habitat within these subpopulation critical habitat boundaries, respectively. Over all CSSS subpopulations combined, Table 15 enumerates a net total average gain in a dry year scenario with the project, of target acreage of 2,090 acres (approximately 1.3 percent of the total subpopulations critical habitat B - F and subpopulation A habitat). However, the vast majority of this (92 percent) is attributable to the moderate gains indicated in subpopulations D and E. As discussed previously, project effects in a dry year scenario although not to be discounted, are not expected to contribute as strongly as a driving force in shaping CSSS habitat conditions as an average-year scenario.

Wet Years

The wet years analysis of CEPP project effects on the 90 to 210-day target metric utilized an average of 1969, 1983, and 1995 as an indicator of project effects in this scenario. The only subpopulation that exhibits an increase (average of 705 acres) in acreage meeting the 90 to 210-day target metric with the project is subpopulation A1 (Figures 27, 29, and 31, and Table 15). However, this represents only about 1.2 percent of the total acreage contained within the subpopulation A1 boundary. Subpopulation A2 shows no change with the project. All other subpopulations show decreases in acreage meeting the target metric (Figures 27, 29, and 31, and Table 15); B (-734 acres, 1.9 percent of habitat), C (-1004 acres, 12.5 percent of habitat), D (-666 acres, 6.2 percent of habitat), E (-963 acres, 4.3 percent of habitat), and F (-1,001 acres, 20 percent of habitat). Table 15 enumerates a net total average loss in a wet year scenario with the project, of target acreage of 3,664 acres (approximately 2.4 percent of the total subpopulations critical habitat B - F and subpopulation A habitat). However, in the wet year scenario, these effects are spread out over all the subpopulations except subpopulation A. As discussed previously, project effects in a wet year scenario although not to be discounted, are not expected to contribute as strongly as a driving force in shaping CSSS habitat conditions as an average-year scenario.

Analysis of Habitat Criteria in CSSS Occupied Habitat

The final component of the Service's analysis of CSSS habitat maintenance criteria was performed to discern differences in the effect of project operations related to the documented degree of usage by the sparrow during the period it has been monitored by helicopter counts. Figure 33 illustrates the results of those bird counts summarized for all survey years. Figures 34 through 44 then illustrate these bird counts (consolidated into larger groupings) superimposed onto the hydroperiod occurrence maps previously generated for selected years in the average, dry, and wet scenarios. Tables (24-26) tabulate the acreage changes (averaged for all years in the average, dry, and wet years scenarios), comparing the EC2012 existing condition to the Alt 4R2 project condition for the hydroperiod ranges analyzed by CSSS usage. Zone totals (grey shading) sum all occupied habitat in each subpopulation regardless of the density of usage. The adjoining table then expresses these figures as a percentage of all total occupied habitat in each bird count range. We will again discuss our observations based on this data by scenario.

<u>Average Years</u>

Based on previous discussion, the Service contends that the average years are most important in terms of effects on CSSS and their habitat. Further, since the 90 to 210 discontinuous hydroperiod metric is the desired range that encourages growth of sparrow preferred grasses, our discussion will be centered on this (green shaded) range. Table 24 details a total net benefit of 4,038 acres throughout all habitat in subpopulation A1 independent of sparrow density. The vast majority of this acreage (3,692 acres) benefited, is in areas sparsely used (1 to 5 birds) by the sparrow. In contrast, very little habitat that is more densely used (6 to 10 and 11 to 20 birds) is positively affected by the project. Most of this habitat gained appears to be converted from wetter (211 to 365 day hydroperiod) acreage, and some is even converted to the drier 1 to 89 day category. Another explanation for the data indicated in this subpopulation however, could be that the severe hydrologic effects that decimated this subpopulation beginning in 1992 (and have continued to present day) may have limited bird usage that otherwise may have occurred more densely in some of this habitat. Nonetheless, consistent with other metrics previously discussed, a small percentage of positive effect is indicated by the project on habitat that has been occupied in the A1 subpopulation in an average year. The same conclusion cannot be made for subpopulation A2 (Table 24) where a very small loss (-9 acres) of habitat in occupied areas with the project is indicated. Subpopulation B, the largest subpopulation shows a very small positive effect of the project (+257 acres of total occupied habitat) representing 0.8 percent of all occupied habitat in an average year. Conversely based on this metric, subpopulation E (the second largest subpopulation) and subpopulation D show net losses (-563 and -367 acres respectively) in occupied habitat again largely concentrated in the more sparsely populated areas. Finally, the smaller subpopulations C and F, (Table 24) based on the metric indicate gains in acreage (574 acres and 475 acres respectively) again skewed in the more sparsely occupied areas, and appearing to be converted from habitat in the drier ranges (0 to 89 days).

Dry Years

The majority of effects of the project in dry years based on the 90 to 210 day discontinuous hydroperiod metric in occupied habitat (Table 25), are positive and concentrated in subpopulations A1, D, and E. Subpopulation A1 shows a net gain in the metric (+185 acres) in sparsely inhabitated (1 to 5 birds) areas. In addition, 1,263 acres are gained in the 1 to 89 day hydroperiod, both the aforementioned being converted from wetter (211 to 365 day) sparsely occupied habitat. 96 acres (90 to 210 days) and 76 acres (211 to 365 days) are converted with the project in more densely occupied habitat (11 to 20 birds) to habitat with a 1 to 89 day hydroperiod. Both subpopulations D and E show net gains (+586 days and +859 days) in the target range with the project in occupied habitat in the target 90 to 210 day hydroperiod both being converted from drier habitat ranges. It is interesting to note that acreages benefited in subpopulation E are spread across a range of densities of occupied habitat from 1 to >40 birds (Table 25). Subpopulation F shows no occupied acreage in the target 90 to 210 day hydroperiod range during a dry year scenario, but does indicate that 1,127 acres are converted from dry to the 1 to 89 day hydroperiod range.

Wet Years

All effects of the project in wet years based on the 90 to 210 day discontinuous hydroperiod metric in occupied habitat (Table 26), are negative and concentrated in subpopulations B, C, and D in a wet year scenario. Subpopulations B (-587 acres) and subpopulation C (-575 acres) show the largest losses of occupied habitat in the target 90 to 210 day metric, both acreages being converted to the wetter 211 to 365 day hydroperiod range with a smaller amount of drier 1 to 89 day hydroperiod occupied acreage also being converted. Likewise, subpopulation D shows a loss of 168 occupied acres to the wetter hydroperiod range in a wet year scenario. In general, when comparing EC2012 to Alt 4R2 in the wet years scenario (Figures 42 to 44), it is immediately evident that the majority of occupied habitat is already too wet based on our analysis criteria and therefore is not reflected in any change in hydroperiod range due to the project.

Interrelated and Interdependent Actions

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. We anticipate that all predecessor projects to CEPP (*e.g.*, LORS, C-44 Reservoir, A-1 FEB, etc.) are interrelated actions that will be analyzed when more detail is available to finalize consultation.

Cape Sable Seaside Sparrow Critical Habitat

This Programmatic Biological Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat as in 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat. In evaluating project impacts to designated critical habitat for the CSSS, potential adverse impacts to PCEs were examined using RSM for a comparison of EC2012 and Alt 4R2 scenarios. The RSM predicts conditions over a 41-year POR so to facilitate the analysis we've chosen, through careful analysis detailed previously in this document, five individual average years (1972, 1976, 1977, 1982 and 2001), three wet years (1969, 1983 and 1995) and three dry years (1971, 1989 and 1990) to be representative of the range of hydrologic conditions that may be observed in the Everglades. The evaluations compare EC2012 against the project for each of the referenced years in the POR within critical habitat for the sparrow. The PCEs for the CSSS were described in the 50 FR 62736, and discussed previously in this Programmatic Biological Opinion. Although critical habitat was not designated for CSSS Subpopulation A, it was proposed for critical habitat designation; therefore, we will address effects to Subpopulation A in this section to facilitate the reader's understanding of effects.

<u>PCE 1: Calcitic Marl Soils</u>

Marl soils are characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades and support the vegetation community on which sparrows depend. They also result from specific hydrologic conditions that are characteristic of the marl prairie. Presently, soils in the marl prairie landscape within sparrow habitat vary in physical and chemical characteristics due to the variation in topography, hydrology, and vegetation (Sah et al. 2007). There are no methods upon which to evaluate CEPP operations on soils, we therefore rely on our hydrologic analyses of marl prairies as a surrogate for the soils analysis.

<u>PCE 2: Herbaceous Vegetation</u>

Greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species: Muhly grass, Florida little bluestem, blacktopped sedge, and cordgrass. These plant species act as cover and substrate for foraging, nesting, and normal behavior for sparrows during a variety of environmental conditions. Many other herbaceous plant species also occur within sparrow habitat (Ross et al. 2006), and some of these play important roles in the life history of the sparrow (Sah et al. 2007).

Previous discussion provided the Service's justification for the use of the 90 to 210-day discontinuous hydroperiod metric to measure optimal conditions for maintenance of sparrow habitat and for the above plant species detailed in this PCE. Tables 16 through 21 document the results of RSM hydrologic model simulations for average, dry, and wet years selected for the existing condition (EC2012) and with project Alt 4R2 conditions for subpopulations B, C, D, E, and F which coincide with their associated critical habitat, and for the subpopulation A habitat.

Based on this metric all 39,022 acres of subpopulation B critical habitat would be predominately unaffected by the CEPP project as currently outlined and modeled in an average and dry year. During wet years, 734 acres (-1.9 percent of total habitat acreage) would be affected, predominately along the periphery of the critical habitat boundary relatively unused by sparrows Figures (42, 43, and 44).

Our analysis indicates that subpopulation A1 habitat as outlined will experience an increase of 4,952 acres (+8.3 percent of total habitat acreage) meeting the optimal 90 to 210 day hydroperiod window in an average year, would be unaffected in a dry year, and would experience an increase of 705 acres (1.2 percent) meeting the same hydroperiod window in a wet year. Overall, this analysis indicates that potential beneficial changes in vegetative composition could occur as a result of the proposed project within a limited portion of the subpopulation A1 habitat boundary some of which is currently being utilized by sparrows (Figures 34 through 44). Based on this metric, subpopulation A2 habitat as outlined would be predominately unaffected by the CEPP project as currently outlined and modeled in an average, dry, and wet year scenario.

Our analysis indicates that subpopulation E critical habitat would experience a decrease of 942 acres (4.2 percent) meeting the optimal 90 to 210-day hydroperiod window in an average year, and would experience an increase of 1,124 acres (5 percent) in a dry year, and would experience a decrease of 963 acres (-4.3 percent) meeting the same hydroperiod window in a wet year. Overall, this analysis indicates that potential negative changes in vegetative composition could occur as a result of the proposed project within a portion of the subpopulation E critical habitat and especially along the northeastern border of the critical habitat boundary some of which is documented to be utilized by the CSSS (Figures 34 through 44).

Subpopulations C and F critical habitat may increase by 751 acres (9.3 percent of total critical habitat acreage) and 798 acres (16.1 percent of total critical habitat acreage), respectively, meeting the optimal 90 to 210-day hydroperiod window in an average year; but would be unaffected in a dry year, and would experience decreases of 1,004 acres (12.4 percent) and 2,001 acres (20.2 percent), respectively, meeting the same hydroperiod window in a wet year as a result of the project. Overall, this analysis indicates that potential beneficial changes in vegetative composition could occur as a result of the proposed project within a limited portion of the subpopulation C and F habitat boundaries These subpopulations, which are widely viewed as being maintained in an unnaturally too-dry state could also experience a benefit of a reduction of wildfire frequency. Further analysis is needed to verify this RSM modeled effect of the project on subpopulation C to clarify uncertainty concerns expressed previously. Finally, subpopulation D critical habitat would experience a decrease of 465 acres (4.3 percent) meeting the optimal 90 to 210-day hydroperiod window in an average year, would experience an increase 789 acres (7.4 percent) in a dry year, and would experience a decrease of 666 acres (-6.2 percent) meeting the same hydroperiod window in a wet year. Overall, this analysis indicates that potential negative changes in vegetative composition could occur as a result of the proposed project within a portion of the subpopulation D critical habitat, some of which is documented to be utilized by the CSSS (Figures 34 through 44).

In summary, the analysis indicated that, based on model output, subpopulations D and E critical habitat is likely to experience a reduction in the quality for sparrows of the vegetative communities due to changes in hydrology caused by the proposed project. Hydrologic conditions that occur in an average year are the most influential in effect on the resultant vegetation community. The effects of the project as indicated by this metric in an average year based on RSM simulations on critical habitat for subpopulation B and A2 will be indistinguishable, slightly beneficial for subpopulations A1, C, and F, and detrimental to subpopulations D and E.

PCE 3: Contiguous Open Habitat

Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees. The constituents of this PCE are largely predicated on a combination of hydroperiod and periodic fire events. Fires prevent hardwood vegetation from invading these communities and prevent the accretion of dead plant material, both of which decrease the suitability of this habitat type for CSSSs. Implementation of the proposed project could extend hydroperiods, especially along the eastern flank of SRS causing a minimal effect on the occurrence of natural fires in the area. Establishment of woody vegetation in marl prairie habitat is often complicated by a variety of factors including hydroperiod that can favor woody vegetation preferring longer or shorter periods of inundation, land elevation changes such as levees, and nutrient loading. The proposed project components and operation could result in hydrology changes in some portions of critical habitat that could have an effect on woody vegetation decline, appearance, or persistence in limited areas of some subpopulations (especially C, D, and F). Many woody plant species once established demonstrate substantial resilience to moderate hydrology changes. The complexities associated with the interaction of different woody plant species hydrologic requirements, nutrient occurrence, and fire make an interpretation of CEPP project model output in reference to effects on PCE 3 subjective at best. Appreciable changes in the PCE within each critical habitat area are not anticipated without additional measures being taken (*i.e.*, fire management, woody vegetation removal, etc.) to reestablish more natural conditions.

PCE 4: Hydrologic Regime–Nesting Criteria

The fourth PCE of CSSS Critical Habitat states that a hydrologic regime should be maintained such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years (72 FR 62749). This metric can be analyzed using hydrologic model output from the RSM and becomes critical given that the project provides most of its additional flows to the Everglades during the dry season. It is reasonable to expect that a higher water table during the dry season could reduce the amount of in-ground storage thus causing dry season rainfall to rise above the ground surface more frequently and for longer durations. Water depths >7.9 inches (20 cm) during this period will result in elevated nest failure rates (72 FR 62749). If these water depths occur for short periods during nesting season, sparrows may be able to re-nest within the same season, however, it has been documented that male sparrows sing less when there is surface water and this may delay courtship until water recedes.

To evaluate this metric, RSM hydrologic model output was used to measure the amount of time water was at or above 7.9 inches (20 cm) during the sparrow nesting season at 19 individual gauge or model cell locations throughout the period or record (40 years). Results can be seen in Tables 22 and 23, and generally indicate that the frequency of time when water depths are above 7.9 inches, with the project in place, will not be significantly increased in most areas even though the duration of existing events will be lengthened. Year and location of all exceedences can be seen in Tables 22 and 23, for both EC 2012 and Alt 4R2 and year and location of new events can be seen in 1968, 1970 and 1993 in CSSS-F and 1980, 1983, and1993 for CSSS-A2. This metric includes a frequency limit where the condition should not be met more than 2 out of every 10 years. Tables 22 and 23, indicate years in red where the depth exceeded 7.9 inches at least twice during a rolling 10-year period. Yellow is indicative of a year where depth exceeds 7.9 inches but more than 10 years separated the occurrences. The project, similarly to the existing condition, could cause minor impacts in CSSS-A1, CSSS-A2, and CSSS-F.

Species Response to the Proposed Action

At this time, we expect CEPP to provide minor benefits to CSSS-A while negatively affecting CSSS-E but we cannot predict the entire species response to the action due to the level of uncertainty regarding project timeline, future interdependent projects, unknown operations, limited funding, and changes to the status of the species by the time the CEPP is ready to be constructed. Similarly, we cannot predict the effects to critical habitat for this species.

Everglade Snail Kite

Factors to be Considered

Water resource development projects may have a number of direct and indirect effects on the Everglade snail kite and snail kite habitat. Direct effects are primarily habitat based and include: (1) the potential loss of habitat for snail kites and their prey; (2) disturbance of snail kites due to construction, operation and maintenance activities; and (3) restoration and preservation of snail kite habitat. Indirect effects may include: (1) an increased risk of snail kite disturbance or mortality from increased watercraft operation; and (2) increased risk of chemical contaminant bioaccumulation.

This project site contains snail kite habitat and is located within the geographic range of the Everglade snail kite. The timing of construction for this project, relative to sensitive periods of the snail kite's lifecycle, is unknown. Snail kites may be found on and adjacent to the proposed construction footprint year-round. We do not know when construction will start, but it could last 19 years, and be operated for up to 50 years. The operational plan is not yet finalized to the extent that would allow us to determine the extent of these changes for the CEPP.

Analyses for Effects of the Action

The proposed action will capture more surface water from the Lake Okeechobee and C-44 watersheds, store it in Lake Okeechobee, and redirect approximately 210,000 ac-ft per year of water to the Greater Everglades. The effects of the action are listed below.

Beneficial Effects

Beneficial effects are those effects of the proposed action that are completely positive, without any adverse effects to the listed species or its critical habitat. One of the purposes of the CEPP is to put additional water into northern WCA-3A where it is generally too dry for snail kites and apple snails. However, to do this, water levels in southern WCA-3A are expected to become deeper. The Corps (2013b) states "significant improvements over the existing conditions occur during the May 1 to June 1 timeframe within northern WCA-3A as well as within WCA-3B, while moderate increases were viewed within southwestern WCA-3A." The Corps' analysis (2013b) also indicated that the CEPP would provide better conditions for apple snail populations as compared to existing conditions, particularly in WCA-3A, WCA-3B, and ENP.

Another potential benefit could be the creation of snail kite nesting and foraging habitat in FEB-2. However, it is not clear whether this component could be an attractive nuisance for snail kites (due to fluctuating water levels or chemical contaminants).

Direct Effects

Direct effects are those effects that are caused by the proposed action, at the time of construction, are primarily habitat based, are reasonably certain to occur and include: (1) the potential loss of snail kite habitat and habitat that supports snail kite prey and (2) harassment by operation and maintenance activities.

Potential Loss of Habitat for Snail Kites and their Prey

Due to the level of uncertainty with the CEPP, it is not clear what water level changes will occur in Lake Okeechobee or the Greater Everglades. The current LORS is expected to be modified prior to implementation of the CEPP, but the latest modeling shows the CEPP will hold the lake higher, in general, to make more water available to the FEBs. Evaluation of snail kite critical habitat within Lake Okeechobee was not performed by the Corps. After the completion of the Herbert Hoover Dike reconstruction, outside water supply interests may put pressure on managing agencies to make the lake even deeper. Generally higher lake stages could reduce the quality of the habitat for snails and snail kites in Lake Okeechobee over existing conditions.

Modelling uncertainty coupled with operational plans yet incomplete make it difficult to accurately predict how water levels will change in the WCAs and ENP. Adding more water to the WCAs, should make them deeper, but until new water starts flowing, it is unclear how habitat for snails and kites will respond to the new hydrologic regime. There is at least some potential for habitat becoming too deep for snail kites to use, especially in wet years.

Harassment by Operation and Maintenance Activities

If snails and snail kites use the FEBs, periodic water level fluctuations (operations) or contaminants may negatively affect kites. Snail kite nests are susceptible to nest collapse if water levels drop too low, or nests may be flooded if levels rise too high. Disturbance of nesting or foraging snail kites may also occur during maintenance activities.

Interrelated and Interdependent Actions

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. We anticipate that all predecessor projects are interrelated actions and will be analyzed when more detail is available to finalize consultation.

Indirect Effects

Indirect effects are those effects that result from the proposed action, are later in time, and are reasonably certain to occur. The indirect effects this project will have on the Everglade snail kite may include: (1) an increased risk of snail kite disturbance or mortality from increased watercraft operation and (2) increased risk of chemical contaminant bioaccumulation.

Disturbance or Mortality from Increased Watercraft Operation

If the CEPP increases hydroperiods to the point where previously unsuitable areas become suitable for watercraft operation, and if those areas are occupied by foraging or nesting kites, then disturbance or mortality of kites by watercraft may occur. Mortality may occur through direct strikes of watercraft with adult, juvenile or nestling kites, or through wakes that may cause nest collapse. Repeated disturbance of nesting adults may also cause nest abandonment.

Bioaccumulation of Chemical Contaminants

Mercury contamination is widespread in the Greater Everglades but it is not clear if the FEBs will become a source of methyl-mercury bioaccumulation for snail kites. Other yet unidentified contaminants may also appear.

Effects to Critical Habitat

The Corps (2013b) indicated that implementation of the CEPP would have no effect on designated Everglade snail kite critical habitat within Lake Okeechobee, WCA-1, or WCA-2. However, because the CEPP will generally hold Lake Okeechobee water levels higher to meet the goals of the CEPP, we cannot accept the Corps conclusion regarding critical habitat in the lake until more project details and the new lake regulation schedule for Lake Okeechobee are developed.

The Corps (2013b) also stated, "The goal of CEPP is to increase hydroperiods within WCA-3 and ENP, which coincides with habitat requirements of apple snail and Everglade snail kite within WCA-3 and NESRS." While this may seem to indicate a benefit to critical habitat, the current level of information is not sufficient to confirm or reject the Corps' conclusion.

Species Response to the Proposed Action

At this time, we expect some benefits from the CEPP to snail kites in northern WCA-3A, but we cannot predict the entire species response to the action (in Lake Okeechobee or Greater Everglades) due to the unconfined level of uncertainty regarding project timeline, future interdependent projects, unknown operations, limited funding, and changes to the status of the species by the time the CEPP is ready to be constructed. Similarly, we cannot predict the effects to critical habitat for this species.

Wood Stork

Factors to be Considered

Water resource development projects may have a number of direct and indirect effects on the wood stork and wood stork habitat. Direct effects are primarily habitat based and include: (1) the potential loss of habitat for storks and their prey and (2) restoration and preservation of stork habitat. We found no indirect effects to the wood stork from the CEPP.

This project site contains stork habitat and is located within the geographic range of the wood stork. The timing of construction for this project, relative to sensitive periods of the stork's lifecycle, is unknown. Storks may be found on and adjacent to the proposed construction footprint year-round. We do not know when construction will start, but it could last 19 years, and be operated for up to 50 years. The operational plan is not yet finalized to the extent that would allow us to determine the extent of these changes for the CEPP.

Analyses for Effects of the Action

The proposed action will capture more surface water from the Lake Okeechobee and C-44 watersheds, store it in Lake Okeechobee, and redirect approximately 210,000 ac-ft per year of water to the Greater Everglades. The effects of the action are listed below.

Beneficial Effects

Beneficial effects are those effects of the proposed action that are completely positive, without any adverse effects to the listed species or its critical habitat. One of the purposes of the CEPP is to put additional water into northern WCA-3A where it is generally too dry for storks and their prey. However, to do this, water levels in southern WCA-3A and northern ENP are expected to become deeper. Using probability modelling by Pearlstine et al. (2013), the Corps (2013b) predicted wood stork foraging conditions would improve in WCA-3A (Northeast, Northwest, and Miami Canal), WCA-3B, and ENP (South and Southeast); however, foraging conditions were predicted to decreased in WCA-3A (Central and South) and ENP (North).

Direct Effects

Direct effects are those effects that are caused by the proposed action, at the time of construction, are primarily habitat based, are reasonably certain to occur and include the potential loss of wood stork habitat and habitat that supports stork prey.

Potential Loss of Habitat for Wood Storks and their Prey

Due the unconfined level of uncertainty with the CEPP, it is not clear what water level changes will occur in Lake Okeechobee or the Greater Everglades. The current LORS is expected to be modified prior to implementation of the CEPP, but latest modeling shows the CEPP will hold the lake higher generally to make more water available to the FEBs. After the completion of the Herbert Hoover Dike reconstruction, outside water supply interests may put pressure on managing agencies to make the lake even deeper. The lake would probably need to be held substantially higher than existing conditions before foraging storks would be negatively affected. Modelling uncertainty coupled with operational plans yet incomplete make it difficult to accurately predict how water levels will change in the WCAs and ENP. Adding more water to the WCAs, should make them deeper, but until new water starts flowing, it is unclear how habitat for storks will respond to the new hydrologic regime. There is at least some potential for habitat becoming too deep for wood storks to use, especially in wet years.

Interrelated and Interdependent Actions

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. We anticipate that all predecessor projects are interrelated actions and will be analyzed when more detail is available to finalize consultation.

Species Response to the Proposed Action

At this time, we expect some benefits from the CEPP to storks in northern WCA-3A, but we cannot predict the entire species response to the action due to the unconfined level of uncertainty regarding project timeline, future interdependent projects, unknown operations, limited funding, and changes to the status of the species by the time the CEPP is ready to be constructed.

Eastern Indigo Snake

Factors to be Considered

Water resource development projects may have a number of direct and indirect effects on the eastern indigo snake and its habitat. This project site contains indigo snake habitat. The proposed action will construct a 14,000-acre FEB, backfill portions of the Miami Canal (321 acres lost), and remove vegetation at six other smaller location comprising 226 total acres. All these sites have suitable cover and may support indigos snakes and their prey. Because of the action, the habitat will be permanently lost and snakes may be injured or killed and probably will be displaced. Construction of FEB-2 is scheduled for the end of the 19-year construction schedule and the Miami Canal backfilling is at the beginning; however, we do not know when construction will start on either component.

Analyses for Effects of the Action

The proposed action will capture more surface water from the Lake Okeechobee and C-44 watersheds, store it in Lake Okeechobee, and redirect approximately 210,000 ac-ft per year of water through FEBs and STAs to the Greater Everglades. The effects of the action are listed below.

Direct Effects

Direct effects are those effects that are caused by the proposed action, at the time of construction, are primarily habitat based, are reasonably certain to occur and include: (1) the loss of indigo snake habitat and habitat that supports its prey and (2) disturbance, injury, or mortality of indigo snakes due to construction, operation and maintenance activities.

<u>Loss of Habitat for Eastern Indigo Snakes and their Prey</u>: The footprint of the A-2 FEB is in agricultural production with sugar cane as the primary crop, although rice has also been observed in some fields. A few areas have become overgrown with exotic Brazilian pepper, willow, dog fennel, and grasses including invasive exotic Napier grass. Man-made drainage features such as ditches and narrow canals traverse the A-2 FEB and are continually being modified and created in response to agricultural needs. Sugar cane fields, fallow lands, and canal banks may be inhabited by indigo snakes (Layne and Steiner 1996). Because this species is a habitat generalist, we anticipate that indigo snakes will be present in most land cover types as long as prey items and cover are adequate. Additional factors which may influence habitat suitability for the species in pastures and cane fields are patch size, interspersion of other important habitats, proximity to large natural areas, and effects of workers on wildlife. For this project, we are assuming that the entire portion of the A2-FEB and Miami Canal embankments are potential habitat for the indigo snake. The Service considers that 14,000 acres of moderate to high quality indigo snake habitat will be converted to FEB. About 231 acres of spoil mounds will be used to partially backfill the Miami Canal.

<u>Injury and mortality</u>: It is difficult to determine the number of indigo snakes (adults, juveniles, hatchlings, and nests) that would be directly injured or killed by the project. Due to the nature of the proposed construction (*i.e.*, vegetation removal, debris piling and burning, canal filling or dredging, embankment construction, scraping, grading, and initial hydration), the Service estimates that some of the indigo snakes present at the time of the action could be adversely affected by the project. The flooding of the FEB—whether the initial flooding or re-flooding after drought—has the potential to drown indigo snakes nests/eggs, and inundate their burrows and other refugia.

Disturbance during construction: The increased human presence on the site during construction along with the operation of construction equipment and vehicles may disturb indigo snakes to the point they leave the project area. This may result in missed foraging and mating opportunities and these individuals may be more vulnerable to predation and intraspecific aggression.

Interrelated and Interdependent Actions

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. We anticipate that all predecessor projects are interrelated actions and will be analyzed when more detail is available to finalize consultation.

Indirect Effects

Indirect effects are those that are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. The indirect impacts evaluated by the Service include injury and mortality associated with: (1) post-construction traffic by vehicles accessing the area for project monitoring, operations, maintenance, or possible recreational access; (2) post-construction maintenance of the roads, embankments, pump stations, and FEB; (including vegetation management methods such as mowing, herbicide application, and physical removal); (3) reduced foraging opportunities associated with fluctuations in the prey populations due to FEB drying or flooding; and (4) bioaccumulation of chemical contaminants. The indirect effects that the proposed action may have on indigo snakes within the action area are discussed below.

Injury and Mortality

Once construction is completed, additional vehicular traffic will access and operate in the area as a result of project monitoring, operations, and maintenance. Some of the FEB embankments may also be accessible to the public for recreational purposes. The Service anticipates that a small number of indigo snakes may occupy the project area during operation and maintenance for the life of the project. Given the elevation of the project site embankments and the number of prey items that could become established in and around the FEB, these snakes (especially snakes that bask on the embankment roads during cooler weather) may be injured or killed from the operation of vehicles and equipment, although the precise number of snakes affected is difficult to measure. Specifically, the mowing of embankments has the potential to injure or kill indigo snakes, and destroy or degrade potential habitat. In general, the District uses guidelines that specify that wildlife is not to be harmed during mowing; however, mowing does not usually occur until vegetation reaches 8 to 10 inches in height. At this height, it may be difficult for equipment operators to observe and avoid snakes or other wildlife.

Loss of Prey

We expect that a prey base for the indigo snake could become established within the wet portion of the FEB and along the embankments following the establishment of an appropriate vegetative cover. Depending on the operation of the project and available water, the FEB may occasionally dry out in low-precipitation years and result in a loss of prey items. Pesticide application may occur as part of project maintenance or accommodation of recreational activities. Prey (*e.g.*, insects, fish, amphibians, and some reptiles) may be vulnerable to pesticide application and may be killed, and therefore, not available to indigo snakes as a result of these activities.

Bioaccumulation of Chemical Contaminants

Mercury contamination is widespread in the Greater Everglades but it is not clear if the FEBs will become a source of methyl-mercury bioaccumulation for indigo snakes. Other yet unidentified contaminants may also appear.

Species Response to the Proposed Action

Construction, operation, and maintenance of the project can result in actions that may kill or injure individual indigo snakes and destroy nests, and destroy or degrade occupied and potential habitat and foraging areas. Clearing, burning, earthmoving, construction, operation, and maintenance activities may also adversely affect indigo snakes by causing them to leave the area, and possibly miss foraging and mating opportunities. Individual indigo snakes fleeing the area may be more vulnerable to predation and intraspecific aggression. The Service anticipates that the number of indigo snakes at FEB-2 and Miami Canal banks will be less after construction than that of the baseline condition. This is due to the habitat conversion from uplands to wetlands.

The Service anticipates that up to 14,000 acres of potential indigo snake habitat within FEB-2 would be impacted by the proposed action. The number of individuals present at the time of the action is not known. The Service estimates as many as 100 to 200 indigo snakes may be present within the construction area of the project. Furthermore, we anticipate that indigo snake nests may be present prior to or during construction. These population estimates are based partly on population density estimates in native and altered habitats at ABS (Layne and Steiner 1996) and in the sugar cane fields at the EAA A-1 Reservoir Project site. After construction, we anticipate the number of indigo snakes and nests affected will decrease due to loss or conversion of habitat and ongoing disturbance.

We believe some indigo snakes may move to the FEB embankments and canal banks following construction if vegetative cover and prey items are present. Indigo snakes may also access the FEB during periods of low water or dry-down. Access to prey items in the FEB will likely be controlled by the ability of the snake to negotiate water depth and the extent of available foraging habitat in ecotones between dry and wet areas. We cannot estimate the number or age of indigo snakes that may move into the FEB. Individual indigo snakes may also be affected by ongoing and future maintenance and management activities.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this Programmatic Biological Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they will require a separate consultation pursuant to section 7 of the Act.

One cumulative effect that may result from an improved Greater Everglades ecosystem (as a result of the CEPP) could be an increase in public recreational use (hunting, fishing, boating, sight-seeing, etc.) not requiring Federal permits. These activities, if they represent an increase in human presence over baseline conditions, may increase disturbance of CSSS, snail kites, wood storks, and indigo snakes potentially leading to injury or mortality. Currently, we have no way to quantify this effect.

Cape Sable Seaside Sparrow

Within the action area, essentially all of the lands supporting CSSSs and their designated critical habitat are State, or federally-owned and managed lands. Activities that may occur in the action area, but outside of State or federally-owned lands, have the potential to affect sparrow habitat primarily through changes in hydrology or water quality. However, water management to meet flood protection requirements, water supply, and restoration are permitted by the Corps and therefore have a Federal nexus upon which section 7 consultation pursuant to the Act may be necessary. In addition, these water management efforts must meet State and Federal water quality requirements. The Service is unaware of any changes in water management that may affect sparrows or their critical habitat therefore, within the action area that would not undergo section 7 review under the Act.

The 30,000-acre Southern Glades Wildlife Management Area is managed cooperatively between the District and FWC and is located in Miami-Dade County adjacent to the C-111 Canal between ENP and U.S. Highway 1. The area was acquired to protect wildlife habitat, including the CSSS, and as part of Everglades restoration. Activities that can and have occurred on these lands include hydrologic/habitat restoration, exotic plant and animal control, prescribed burns, public use, environmental education, and mitigation. In accordance with the Florida Statutes Chapter 373.1395, lands acquired by the District shall be managed to "ensure a balance between public access, general public recreational purposes, and restoration and protection of their natural state and condition." Generally, these actions would be consistent with the maintenance and restoration of sparrow habitat.

Therefore, the majority of potential effects to CSSSs and their habitat, including designated critical habitat, are anticipated to be related to future Federal actions that will require a separate consultation under the Act. Therefore, the Service does not anticipate any appreciable cumulative effects to CSSSs or their designated critical habitat.

Eastern Indigo Snake

Another cumulative effect would be the conversion of surrounding lands that currently support indigo snakes to more intensive agricultural (*e.g.*, row crops or sod) or residential uses that would support less indigo snakes, but only if no wetlands were impacted (*i.e.*, no Federal permit was required). The primary threat today to the indigo snake is habitat loss and fragmentation due to development (Lawler 1977; Moler 1985a). Besides loss of habitat, residential developments also increase risk of harm to indigo snakes in the interface areas between urban and native habitats because it increases the likelihood of snakes being killed by property owners and domestic pets. Increased traffic associated with development may also lead to increased indigo snake mortality. It is difficult to predict the spatial extent or timing of indigo snake habitat loss due to land use conversion within the action area (but outside of the project site). Given the large action area with the travel corridors that cross the state and the inclusion of Lake Okeechobee and the KCOL, it is likely that residential development will continue in this area. Some of this conversion may be in the form of tree removal (loss of cover) or more complete residential development (trailer parks, moderate density residential, or ranchettes). Some of these conversions may not impact wetlands or require Federal permits. As a result, we anticipate the action area will support fewer indigo snakes in the future.

PRELIMINARY CONCLUSION

The following conclusions are **preliminary** and will be finalized in the future when more details regarding specific project actions and their implementation timeline becomes more certain. Incidental take for the CSSS, Everglade snail kite, and wood stork is not enumerated; however, take may occur as a result of the CEPP. At this time, there is too much uncertainty when the specific actions that will affect these species will occur and what the species' baselines will be at those times. Furthermore, project details will likely change before implementation. The Service understands the Corps' reluctance to continue with such a large project without finalizing formal consultation; however, we reiterate our continued support and commitment to the completion of CEPP. We have attempted to provide a path forward, using the best available information to provide the Corps with as much assurance as possible that CEPP and future restoration actions will meet ESA regulatory requirements and be readily implementable as planned.

Cape Sable Seaside Sparrow

After reviewing the current status of the CSSS, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, it is the Service's biological opinion that the CEPP, as currently proposed and characterized by the RSM modeling provided by the Corps, is not likely to jeopardize the continued existence of the CSSS. Additionally, the action is not likely to adversely modify critical habitat for the CSSS.

There will, however, at times be significant impact to some areas of sparrow habitat due to changing hydrology. This is to be expected with any large restoration project, but the transition must be managed carefully to avoid catastrophic impacts to this imperiled species. RSM modeling shows that 40,736 acres (averaged for 1972, 1976, 1977, 1982, and 2001) of the roughly 59,844 acres in CSSS-A (Table 16) are currently experiencing hydroperiods longer than the 90 - 210 day hydroperiod needed to maintain habitat. While CEPP makes some modest improvement to 4,500 acres, hydroperiods are still too long in most of the area and sparrows will likely not increase in number in these areas. Likewise, dry nesting seasons long enough to provide opportunity to fledge 2 or more broods (80 days) only occurs 5 out of 10 years (Table 7) and will likely not be improved with the project. CEPP was anticipated to move more water east into the historic flow way thus reducing western flows and lowering the WCA-3A pool, and may yet do so though the modeling doesn't indicate that it will occur. Recent helicopter surveys have observed slightly more singing males distributed across a wider area of CSSS-A which may indicate an improvement in habitat conditions leading to successful nesting. This has not been confirmed and careful monitoring will be needed to see if CEPP actually improves conditions or if modifications to current operations will be needed. The status quo in CSSS-A will not enable the recovery of the species and although CEPP takes meaningful steps in moving water eastward, more needs to be done.

Hydrologic modeling shows that CSSS-E will likely receive the most impact and while this was not unexpected, the breadth of possible impacts coupled with the relatively minor enhancements to habitat in other areas, gives the Service cause for concern. RSM modeling results indicate that the project will create hydroperiods longer than the 90-210 range in 7 additional years than the base condition (12 years). Average increase in hydroperiod for the seven additional years is 49 days. The average annual increase in hydroperiod across the POR is 31 days (range 0 – 121 days). This increase in hydroperiod affects an average of 2,109 acres (over the selected average years analyzed) of the 22,261 total acres within CSSS-E critical habitat. More importantly, the acreage affected is concentrated in areas where singing males have been observed in many of the years that the surveys have been conducted. Of the total impacted area, 715 acres occur where 11 to greater than 40 birds have been surveyed since the surveys began. These hydrologic changes have the potential to affect areas within CSSS-E that have high densities of successfully nesting sparrows. Similarly, nesting periods long enough to sustain two or more nesting attempts (>80 days) are reduced 4 years from 71 percent of the POR to 60 percent.

As expected, the project shows benefits to the eastern most subpopulation's F and C, though results for C should be interpreted with caution. There is reason to question the modeling results in this area, as has been the case in previous projects dating back to the South Florida Water Management Model. Additionally, the project results in impacts to CSSS-D which is part of a previous CERP project entitled C-111SC. It is unclear at this time if these impacts are additive in nature to the impacts assessed in the C-111SC project or if they are new.

Taken as a whole, the effects to CSSS from CEPP, if it were to be implemented next year, would likely result in detrimental impact to sparrows and their habitat. Fortunately, there is time to implement management actions whereby the environmental baseline can better be assessed and CSSS populations and their habitat can be strengthened to better weather the transition to full restoration.

In order to address the management actions needed to improve the environmental baseline, the Department of the Interior (DOI) has agreed to develop and implement a multi-agency Memorandum of Understanding (MOU). It is anticipated that the following agencies will be invited to participate in this MOU: ENP, USGS, Service, Corps and South Florida Water Management District. This MOU will include actions intended to assess the current CSSS population and improve CSSS habitat during the transition to CEPP. Actions carried out through this MOU will be in compliance with the mission and mandates of the individual agency funding or carrying out said action. No participating agency will be required to carry out actions outside of its authorities. The MOU may include the following actions:

1. Develop a Spatially-explicit Population Estimator to be used in conjunction with annual CSSS surveys. The status of the CSSS has been based on annual population estimates from a statistically-derived multiplier of 16 birds per documented male. This multiplier is no longer considered appropriate due to low subpopulation sizes and gender bias, and is believed to result in an overestimation of the population size and its stability. It is critical that we have an accurate estimation of the sparrow population before beginning projects that may affect this species. This project should be completed as soon as possible in conjunction with the Service, U.S. Geographical Survey (USGS), and ENP so that it may be utilized with ongoing annual surveys as soon as possible to more accurately assess the baseline population of CSSS.

2. Implement a program for the removal of woody vegetation currently rendering some areas of sparrow habitat unsuitable. The agencies will remove woody vegetation in currently occupied or potential CSSS habitat. The planned strategy will be coordinated with the ENP and District prescribed fire strategy, where applicable, to utilize fire in combination with other methods as a woody vegetation control tool. Retreatment will be conducted the following year to augment effectiveness (and may be extended to out-years). Restoration actions that should be employed may include mechanical and/or chemical treatment of areas where woody vegetation encroachment has limited CSSS use of occupied and potential CSSS habitat areas. This program would be an ongoing project.

3. Complete an updated CSSS population viability analysis. Population modeling will help to identify the threats influencing CSSS the most, what life stage is driving population growth, and what management scenarios would have the most impact. This project would include a review and compilation of existing data, and a workshop to develop data analysis and modeling approaches, beyond the development of the model.

4. In coordination with the ENP and the District, a strategy of planned annual acreage and rotation interval burns will be implemented in both occupied and potential CSSS habitat areas. Annual monitoring of habitat conditions in treated areas will be conducted. The Corps should work closely with the ENP and District fire programs, and the Service to ensure that water levels post burn are managed to encourage regrowth of preferred CSSS graminoid species.

5. Conduct a feasibility study for the future translocation of CSSS to Subpopulation A. Once considered a core subpopulation, subpopulation A declined significantly between 1992 and 1996 and has never recovered. Today 90 to 97 percent of the remaining sparrows are concentrated within two subpopulations (B and E). Only subpopulations B and E are considered above the emergency action trigger thresholds identified in the Emergency Management Action Plan for the endangered Cape Sable Seaside Sparrow. The other remaining subpopulations are close to extirpation, with recent surveys detecting few or no sparrows. This restricted distribution makes the sparrow particularly vulnerable to stochastic events, a threat that could be greatly reduced if Subpopulation A persists and is bolstered. In Subpopulation A, small population size, low recruitment, and limited long-distance dispersal have yielded low annual productivity. This subpopulation also shows an alarmingly skewed male-biased sex ratio, which has contributed greatly to low annual productivity. This gender bias is likely to reduce the potential for population growth and increase extinction risk. In fact, this phenomenon was reported in a closely-related subspecies, the Dusky Seaside Sparrow (*A. m. nigrescens*), before it went extinct. This project would include the preliminary steps required to translocate female sparrows from a larger, more stable subpopulation into subpopulation A to ensure persistence of this critically important sparrow subpopulation. Activities are indicated below:
    a. Evaluate Juvenile Survival and Dispersal Patterns. Juvenile CSSS would be captured and color-banded in an effort to study juvenile survival and dispersal patterns, and gain much needed information on this age class. Genetic samples (*e.g.*, blood or feathers) could also be collected to determine the gender of captured juveniles to determine if morphometrics can be used successfully to identify gender in the field.
    b. Create a Habitat Suitability Index. Using remote sensing of vegetation and subsequent ground-truthing of plant species, this task will then create a CSSS Habitat Suitability Index whereby the quality of other potential or occupied CSSS habitat can be measured. This will support habitat maintenance activities (fire management, woody vegetation removal, etc.) as well as potential reintroduction or translocation of CSSS efforts.
    c. Evaluate Genetic Variation in CSSS. An expanded microsatellite library will be developed and analyzed for CSSS. A larger library of microsatellite markers would provide the enhanced precision necessary to detect inbreeding depression, local population genetic structure and the degree of mixing between subpopulations, and to identify individuals for translocation that would maximize genetic diversity while maintaining local variation. This library would be invaluable for future monitoring of population genetic structure and diversity.

Everglade Snail Kite

After reviewing the current status of the Everglade snail kite, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, it is the Service's biological opinion that the CEPP, as currently proposed and characterized by the RSM modeling provided by the Corps, is not likely to jeopardize the continued existence of the Everglade snail kite. Additionally, the action is not likely to adversely modify critical habitat for the Everglade snail kite.

The Corps' BA provided an analysis of kites that used the apple snail as a surrogate. The Service does not believe that this is an adequate analysis, although, it was the best that could be achieved given the CEPP schedule. The Service is working closely with field researchers to prepare a more robust analysis which looks at water depths across the study area and assesses effects to snail kites and their critical habitat. The Service anticipates that the project may result in incidental take of the species. Once more certainty regarding project details and implementation dates is learned, the Service will enumerate incidental take and complete consultation on Everglade snail kites, as appropriate.

Wood Stork

After reviewing the current status of the wood stork, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, it is the Service's biological opinion that the CEPP, as currently proposed and characterized by the RSM modeling provided by the Corps, is not likely to jeopardize the continued existence of the wood stork. The Service anticipates that the project may result in incidental take of the species. Once more certainty regarding project details and implementation dates is learned, the Service will enumerate incidental take and complete consultation on wood storks, as appropriate.

Eastern Indigo Snake

After reviewing the current status of the eastern indigo snake, the environmental baseline for the action area, the effects of the proposed action and cumulative effects, it is the Service's biological opinion that the CEPP Project, as currently proposed, is not likely to jeopardize the continued existence of the eastern indigo snake.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act 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 Act provided that such taking is in compliance with the TCs of this Incidental Take Statement.

The measures described below are nondiscretionary, and must be undertaken by the Corps so they become binding conditions of any grant or permit issued to the applicant, 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 TCs or (2) fails to require the applicant to adhere to the TCs 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. To monitor the impact of incidental take, the Corps shall report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

AMOUNT OR EXTENT OF TAKE FOR THE CSSS, EVERGLADE SNAIL KITE, AND WOOD STORK

The Service has reviewed the biological information for the CSSS, Everglade snail kite, and wood stork presented by the Corps and District, and other available information relevant to this action. Due to the high level of uncertainty associated with the CEPP at this time, in particular unavailable operational details, we are not in a position to anticipate the amount or extent of incidental take that will occur for the three avian species and are therefore not enumerating take at this time for these three species in this Programmatic Biological Opinion. Therefore, RPMs and their implementing TCs will not be identified at this time. When more details regarding project design, implementation schedule, interdependent projects, and operational details are provided, we will coordinate with the Corps to determine the proper path for completion of consultation.

The Service anticipates that operational flexibility will be necessary and appropriate to reduce take and to minimize impacts of the proposed project on the CSSS, Everglade Snail Kite, and wood stork. The Service will work with the action agency to implement measures, including *Standard Protection Measures,* where applicable, to minimize adverse effects to the listed avian species during construction and operations during construction. The Service anticipates that implementing Terms and Conditions to minimize the impacts of incidental take for the three avian species may include hydrologic, vegetative, and species monitoring in areas where CEPP implementation is expected to effect change. Reasonable and Prudent Measures and their implementing Terms and Conditions will be developed consistent with CEPP authority in consultation with the Corps as more project and species information becomes available.
To comply with section 7 of the Act, the Corps commits to reinitiate consultation with the Service prior to advancing the project to construction. At that time, the Corps will provide additional information, as appropriate, which will allow the Service to complete our analysis of the project's effects on the above listed avian species and complete consultation on the project. As details become available, and the project is closer to implementation, the Corps and the Service will reevaluate whether incidental take is reasonably likely to occur and amend this Biological Opinion as necessary.

Because the CEPP action area overlaps several other restoration projects and implements the same types of actions, duplicative measures will be avoided in developing Terms and Conditions to implement Reasonable and Prudent Measures for CEPP.

AMOUNT OR EXTENT OF TAKE FOR THE EASTERN INDIGO SNAKE

The Service has reviewed the biological information for the eastern indigo snake, presented by the Corps and District, and other available information relevant to this action. Incidental take of eastern indigo snake is likely during construction and operation, particularly construction of the FEB-2 and the Miami Canal backfill. The amount of take includes 14,000 acres of the FEB currently in sugar cane and row crops that will become inundated and mostly unusable to indigo snakes. Up to 268 snakes could be harassed through being displaced as a result of the CEPP and up to two indigo snakes may be injured or killed (harmed).

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that the potential for incidental take, as assessed with current information, is not likely to result in jeopardy to the CSSS, Everglade snail kite, or wood stork, or destruction or adverse modification of critical habitat for the CSSS and Everglade snail kite during implementation of the CEPP. Furthermore, the Service determined that the incidental take anticipated for the eastern indigo snake, as assessed with current information, is not likely to result in jeopardy of that species during the implementation of CEPP.

REASONABLE AND PRUDENT MEASURES

When providing an incidental take statement, the Service is required to give reasonable and prudent measures it considers necessary and appropriate to minimize the take, along with TCs that must be complied with, to implement the reasonable and prudent measures. As this document does not enumerate take for the three avian species, as discussed above, the Service is not identifying RPMs or TCs for those species. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service finds the following RPM is necessary and appropriate to reduce take and to minimize the direct and indirect effects of the proposed project on the eastern indigo snake.

Eastern Indigo Snake

1. As part of the project description, the action agency has agreed to the implementation of the *Standard Protection Measures for the Eastern Indigo Snake* (Service 2013d). We have considered these measures in this Programmatic Biological Opinion, but believe the following reasonable and prudent measures are also necessary and appropriate to further minimize the incidental take of eastern indigo snakes:
    a. Disturbance and injury to indigo snakes should be minimized during construction activities;
    b. Disturbance and habitat loss should be minimized during FEB hydration and project operation and maintenance;
    c. The Corps and District will coordinate and report to the Service on construction activities, FEB filling and rehydration, long-term operation and maintenance, management, and recreational activities; and
    d. Live, dead, or injured indigo snakes will be handled appropriately including the proper notification of the FWC and Service.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must comply with the following TCs, which implement the RPM described above and outline reporting and monitoring requirements for the eastern indigo snake. These TCs are non-discretionary.

Eastern Indigo Snake

1. The Corps shall minimize road and construction-related disturbance, injury, and mortality:
   a. The Corps shall require the applicant to provide at least one qualified observer during ground clearing activities. The observer's qualifications will be provided to and approved by the Service's CEPP biologist (U.S. Fish and Wildlife Service, SFESO; 1339 20th Street; Vero Beach, Florida 32960, 772-562-3909), 2 weeks prior to initiation of construction or clearing activities. The observer's primary function would be to visually evaluate the area to be cleared immediately prior to, and following vegetation removal, stockpiling, and burning and to record any indigo snake activity. This would also include any other relevant wildlife observations for indigo snake prey or predators. Only the qualified observer or individuals who have been either authorized by a section 10(a)(1)(A) permit issued by the Service, or by the State of Florida through the FWC for such activities, are permitted to come in contact with an indigo snake.
   b. Indigo snakes encountered during construction may be physically moved out of harm's way pending prior notification and approval by the Service (to areas to be determined). Under no circumstances shall more than one indigo snake be held in the same container and the time the snake is held should be minimized to the extent practical. Staff qualifications will be provided to and approved by the Service prior to the start of this activity.
   c. A speed limit of no greater than 25 mph shall be posted for all vehicular traffic on non-public roads. Pre-construction education materials shall specify speed restrictions.
2. The Corps shall minimize disturbance, habitat loss, mortality due to drowning, and loss of prey during operation and maintenance of the project:
   a. Initial hydration of the FEB shall be no more than 6 inches per day until the water depth is 6 inches above the average elevation of the FEB floor. Once that depth is reached, the fill rate is not restricted.
   b. The Corps shall require the District to monitor indigo snake response during the initial filling of the FEB to determine the effect of hydration on indigo snakes. If approved by the Service, individual indigo snakes may be captured by authorized personnel and released outside the FEB. If necessary, indigo snakes shall be held in captivity only long enough to be moved the minimum distance into suitable habitat out of harm's way; at no time shall more than one snake be kept in the same container.
3. The Corps shall comply with monitoring and reporting requirements:
   a. The Service shall be notified immediately upon the finding of a live, injured, or dead indigo snake.

b. Hydration of the FEB shall be monitored to assure consistency with the TCs listed above and should be reported within the daily stage email or via web link. Results of observations associated with initial hydration including water levels, observations of indigo snakes or their prey, additional information identified in the monitoring plan, and recommendations to reduce effects to indigo snakes during rehydration shall be provided to the Service's CEPP Project biologist (U.S. Fish and Wildlife Service, South Florida Ecological Services Office; 1339 20th Street; Vero Beach, Florida 32960, 772-562-3909) within 30 days following the activity.

c. The Corps shall provide the Service's CEPP biologist (U.S. Fish and Wildlife Service, South Florida Ecological Services Office; 1339 20th Street; Vero Beach, Florida 32960, 772-562-3909), a 1-week advance notice on the schedule for ground clearing of vegetation and other construction phases so that we may participate in on-site observational activities.

4. Disposition of dead or injured animals (salvage):

a. Upon locating a dead, injured, or sick federally listed species, initial notification must be made to referenced project biologist and the nearest Service Law Enforcement Office (U.S. Fish and Wildlife Service; 1339 20th Street; Vero Beach, Florida 32960; 772-562-3909). Secondary notification should be made to the FWC, South Region; 8535 Northlake Boulevard, West Palm Beach, Florida; 33412-3303; 561-625-5122; 1-888-404-3922. Injured indigo snakes may be transported to the Busch Wildlife Sanctuary (or other Service pre-approved facility); 2500 Jupiter Park Drive, Jupiter, Florida, 33458; 561-575-3399 for immediate medical care. If not specifically instructed by Service law enforcement to submit dead specimens, all dead specimens and snake sheds shall be offered to the Florida Museum of Natural History; Gainesville, Florida 32601. The museum should be contacted with regard to details for preservation and transport.

b. Care shall be taken in handling sick or injured specimens to ensure effective treatment and care or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. Dead indigo snakes should be placed on ice and frozen as soon as possible. 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.

c. Annually, a report of all indigo snakes killed or injured by operation or maintenance of the CEPP must be submitted to the Service's CEPP biologist (U.S. Fish and Wildlife Service, South Florida Ecological Services Office; 1339 20th Street; Vero Beach, Florida 32960; 772-562-3909). This report shall contain the location (latitude and longitude), dates, times, prevailing environmental conditions, and the circumstances surrounding all sightings of indigo snakes and the disposition of all indigo snakes found. A site map with observation locations shall also be included in this report. If no snakes are encountered, a report shall be submitted indicating that fact.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act 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.

1. The Corps should, in cooperation with the Service, District, and ENP, develop and implement a CSSS Comprehensive Conservation Plan to ensure the necessary actions are outlined and implemented to recover and conserve the CSSS while maintaining other project purposes.

2. Early modeling for CEPP indicated a potential for a reduction in freshwater discharge to Biscayne Bay. Flow reductions, if they occur, would increase salinity in this region which may negatively impact juvenile crocodile habitat. Monitoring of freshwater flows to Biscayne Bay is currently included in the CEPP Adaptive Management (AM) and so should be continued for the life of the project. However, the CEPP AM Plan does not currently include the frequency by which freshwater flows should be assessed nor thresholds that identify significant freshwater flow reductions. The Service recommends that these components of Biscayne Bay flow assessments be included in the Final CEPP ADP.

REINITIATION NOTICE

As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency 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; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; (3) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In this consultation incidental take is only enumerated for eastern indigo snakes. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

It will be essential that the Corps and Service continue to coordinate closely through the detail design and implementation of the various phases of CEPP. There will likely be instances where reinitiation of consultation may be required in addition to those mentioned above. The Service also anticipates additional consultation will be needed on individual project components and their implementation schedules as more detail becomes available.

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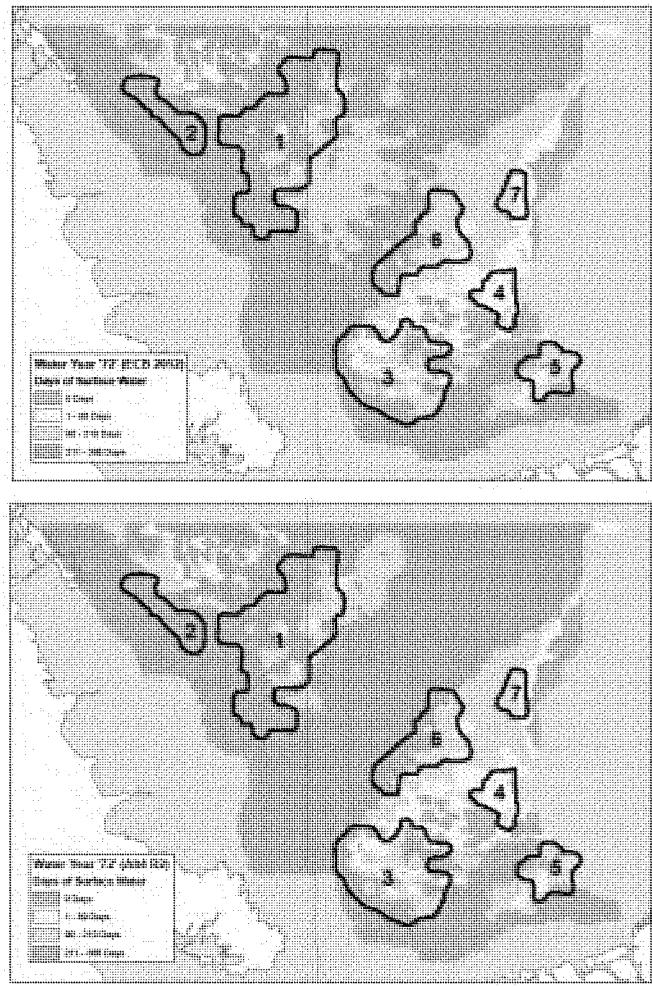


Figure 11. Location of CSSS critical habitat: Units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (Units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1972 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1972 (average), (lower figure).

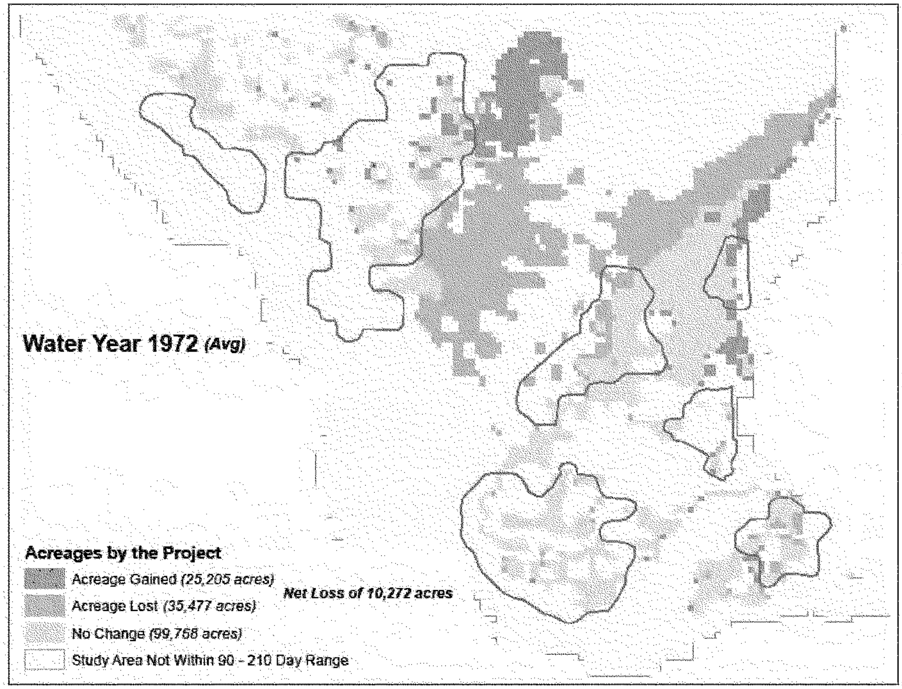


Figure 12. Location of CSSS critical HUs 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (Units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1972 (average). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

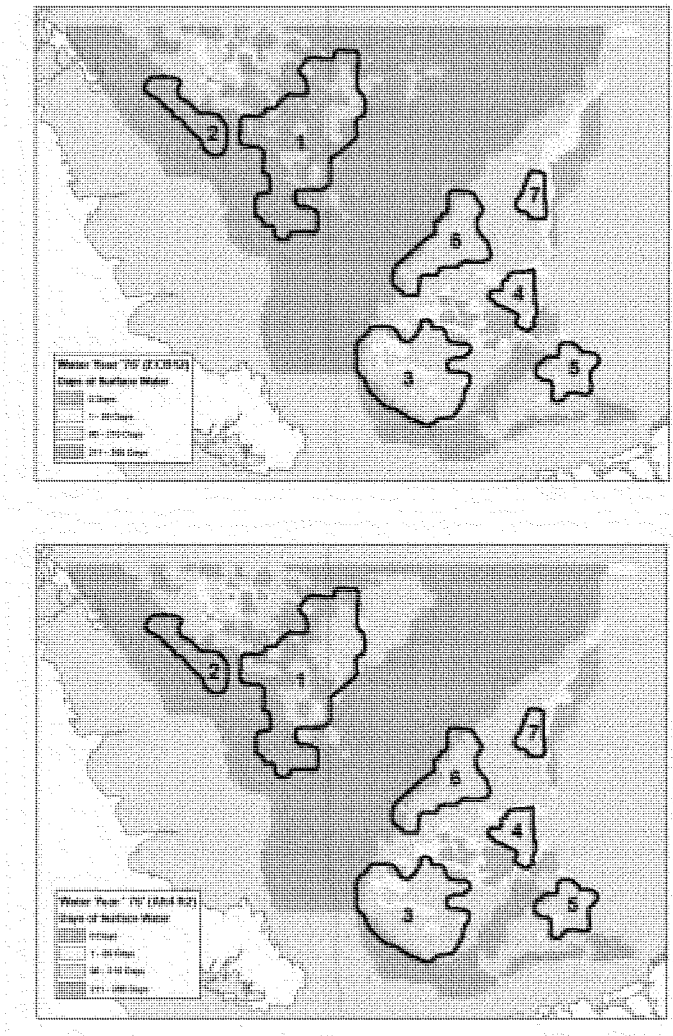


Figure 13. Location of CSSS critical HUs 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (Units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1976 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1976 (average), (lower figure).

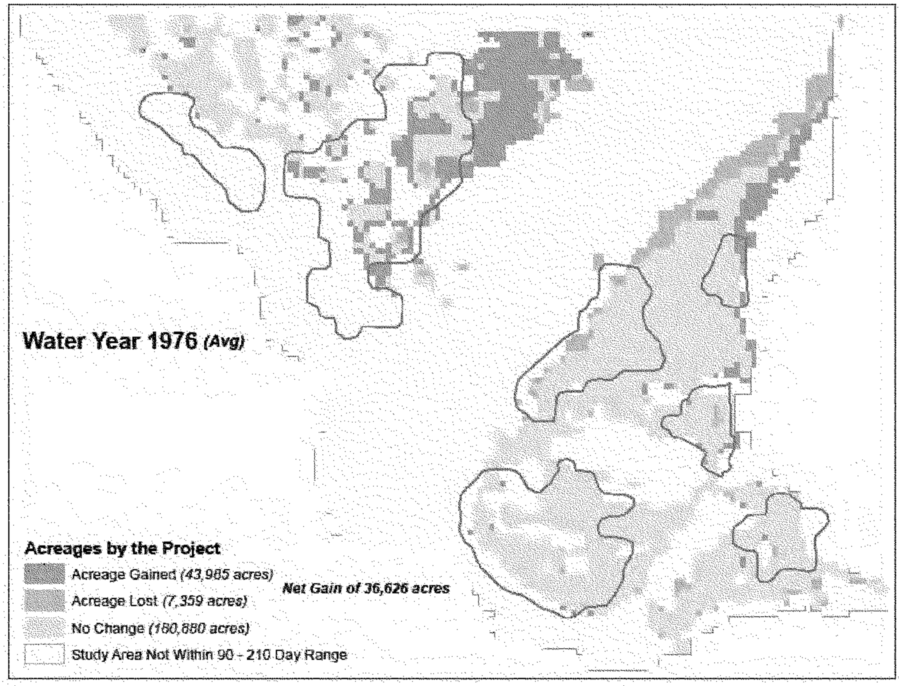


Figure 14. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1976 (average). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

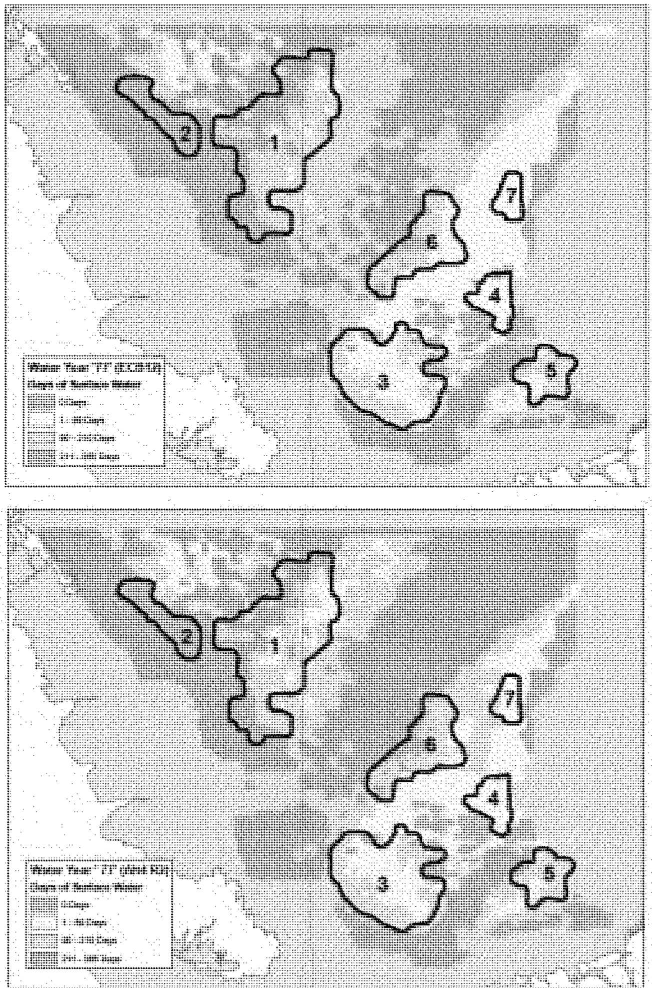


Figure 15. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1977 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1977 (average), (lower figure).

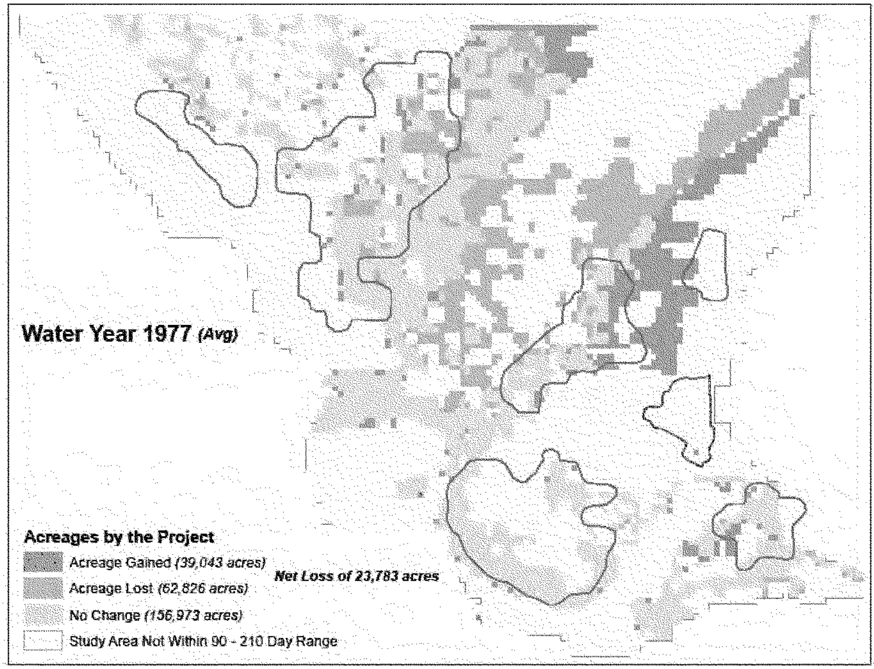


Figure 16. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1977 (average). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

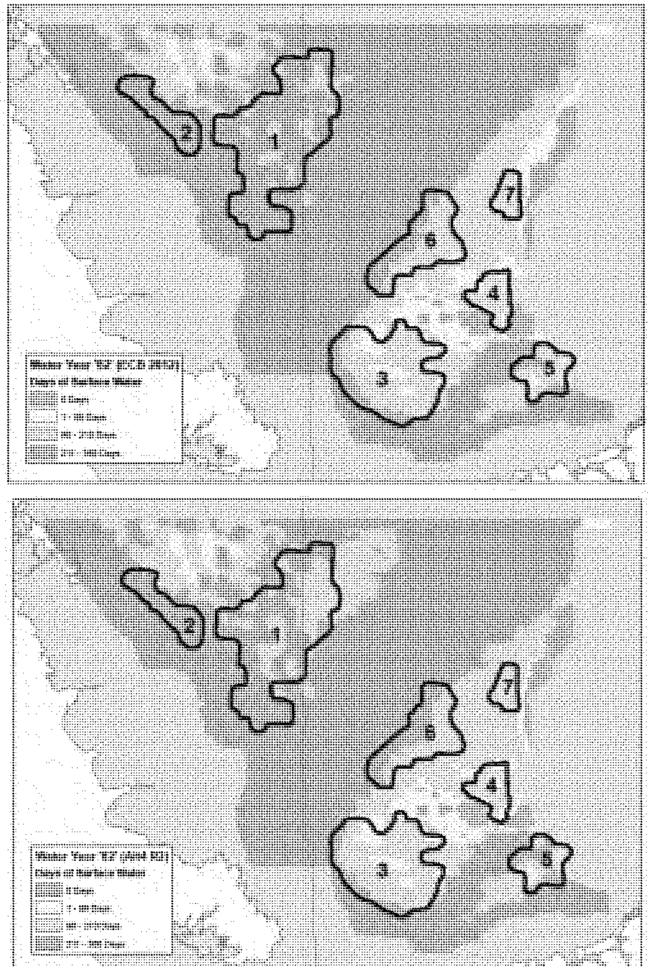


Figure 17. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1982 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1982 (average), (lower figure).

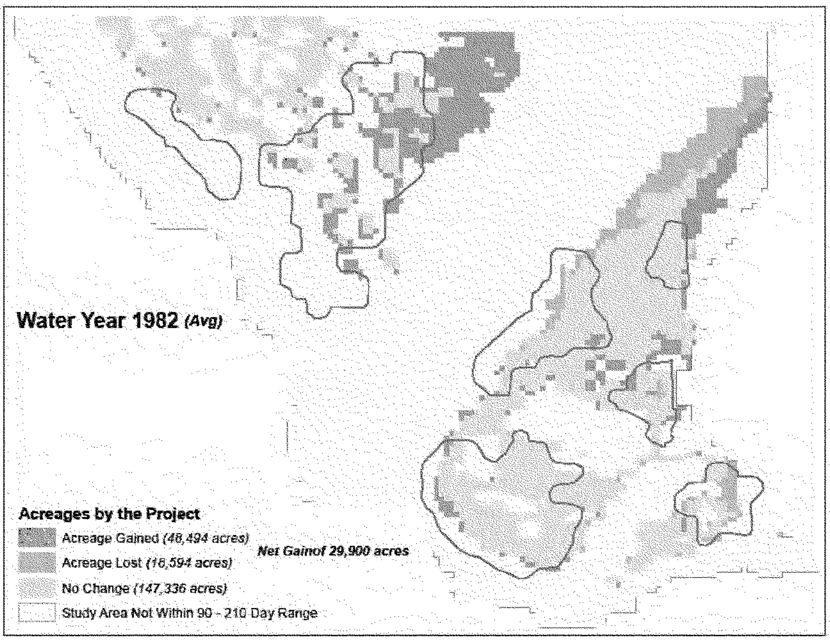


Figure 18. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1982 (average). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

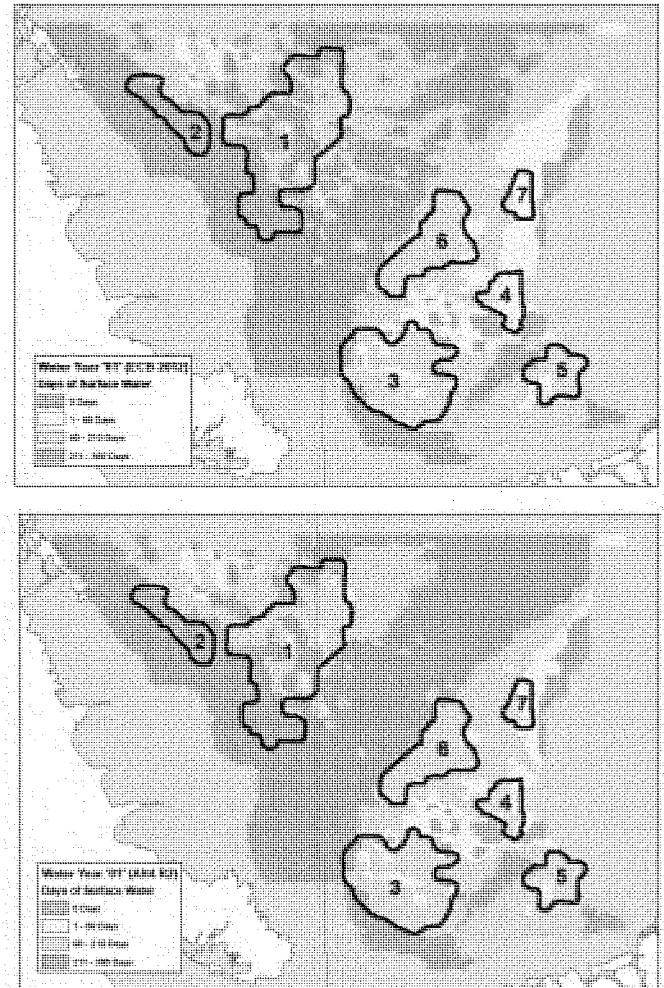


Figure 19. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 2001 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 2001 (average), (lower figure).

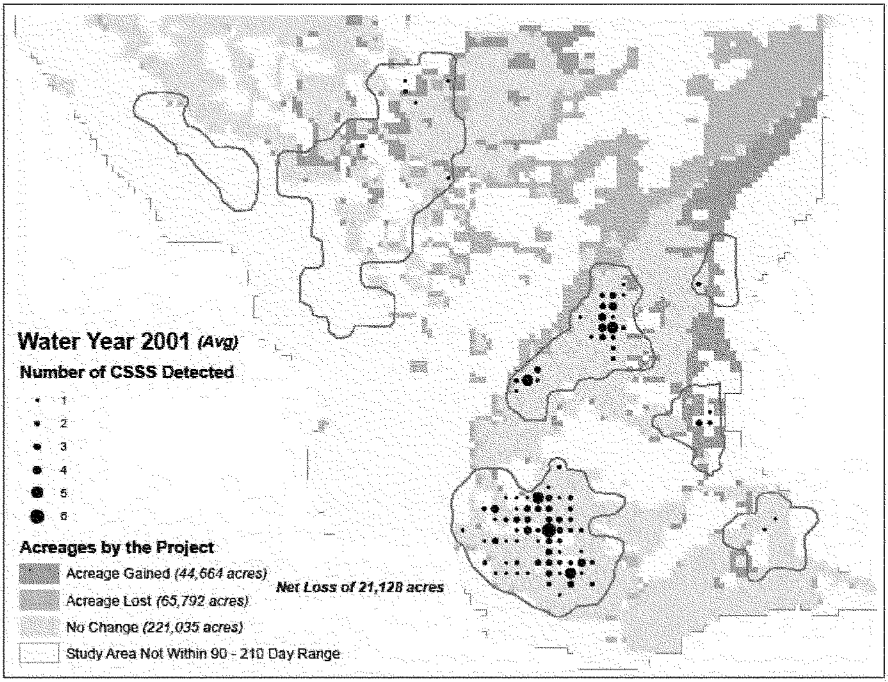


Figure 20. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 2001 (average). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

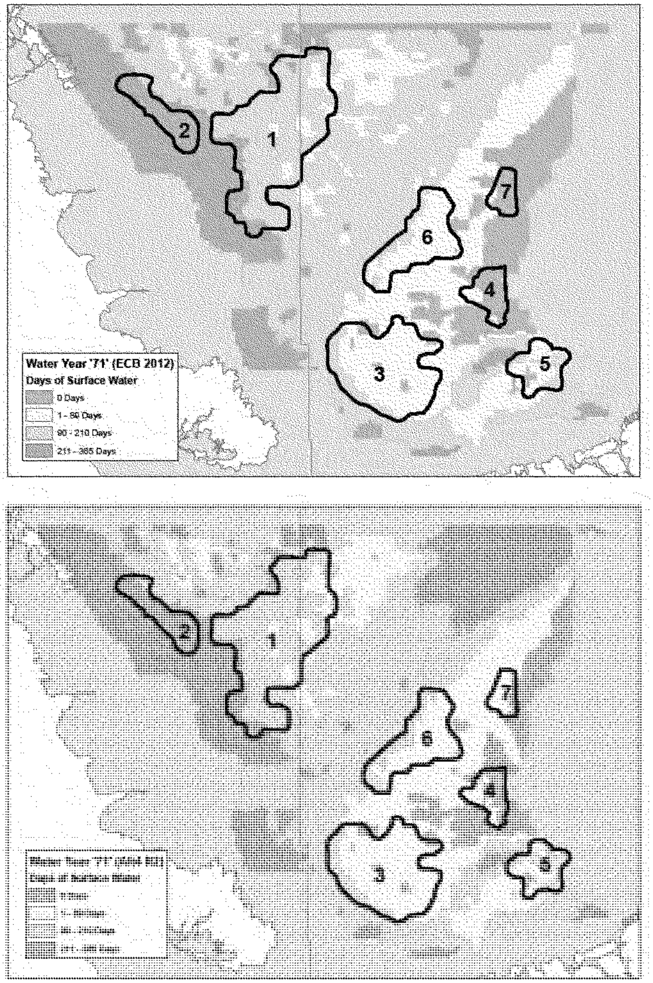


Figure 21. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1971 (dry), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1971 (dry), (lower figure).

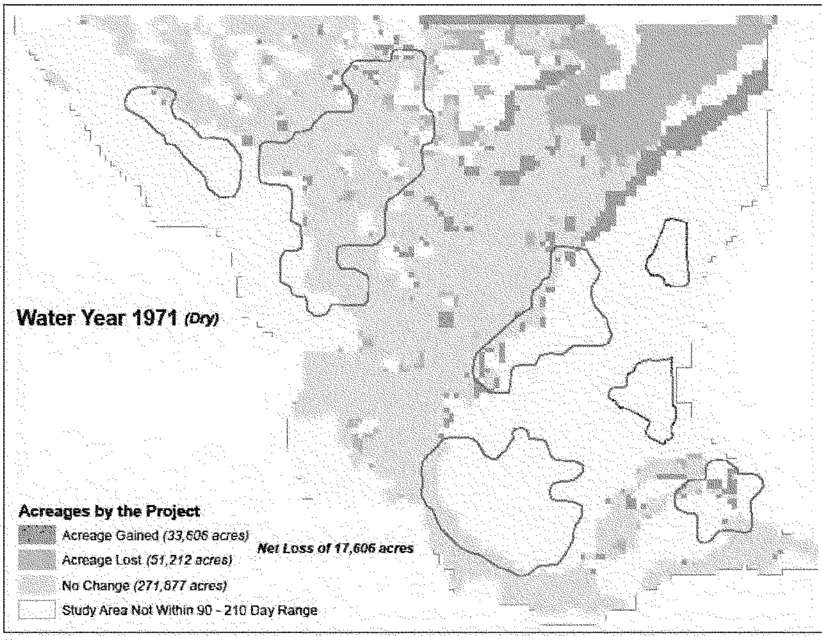


Figure 22. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1971 (dry). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

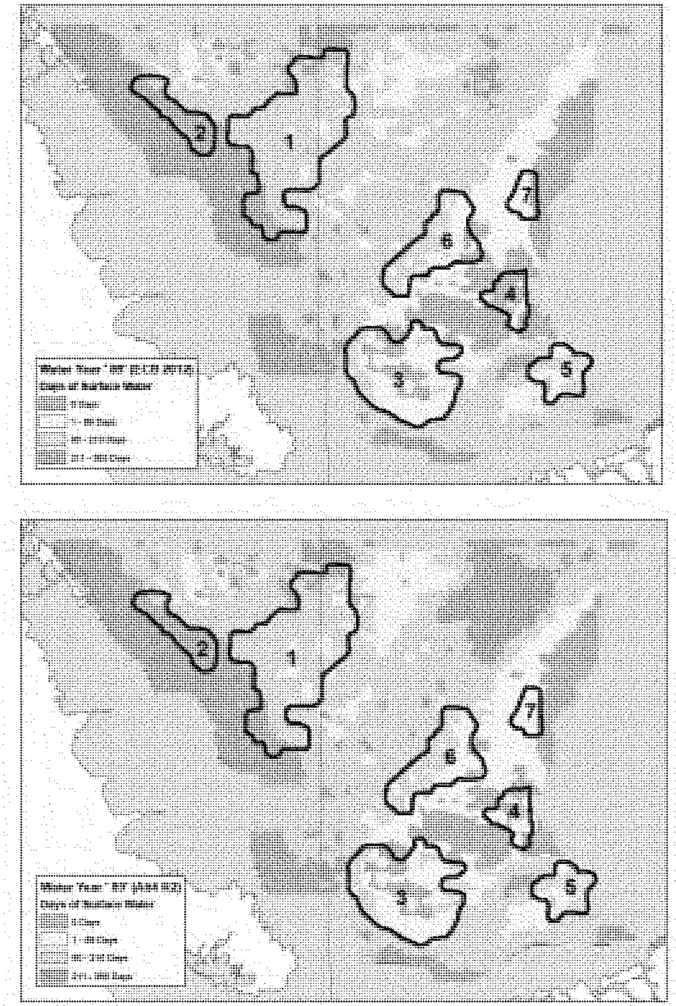


Figure 23. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1989 (dry), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1989 (dry), (lower figure).

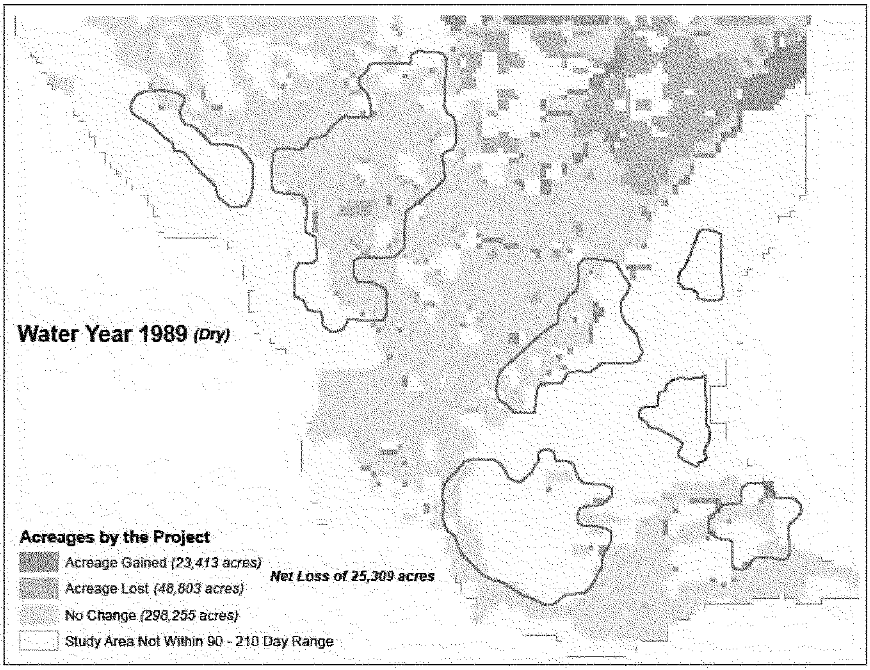


Figure 24. Location of CSSS critical habitat: Units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1989 (dry). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

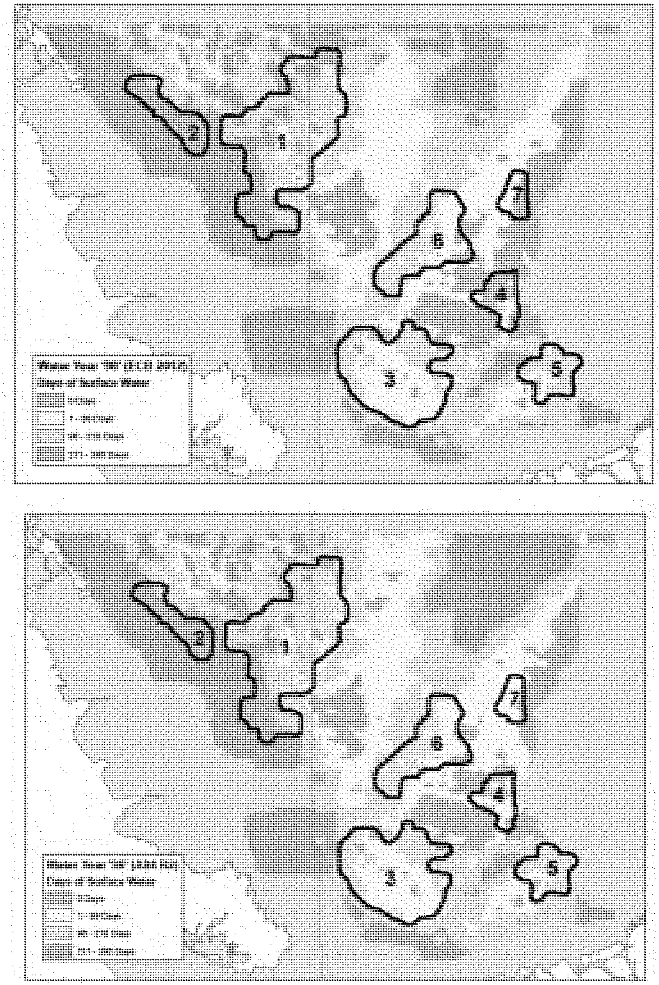


Figure 25. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1990 (dry), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1990 (dry), (lower figure).

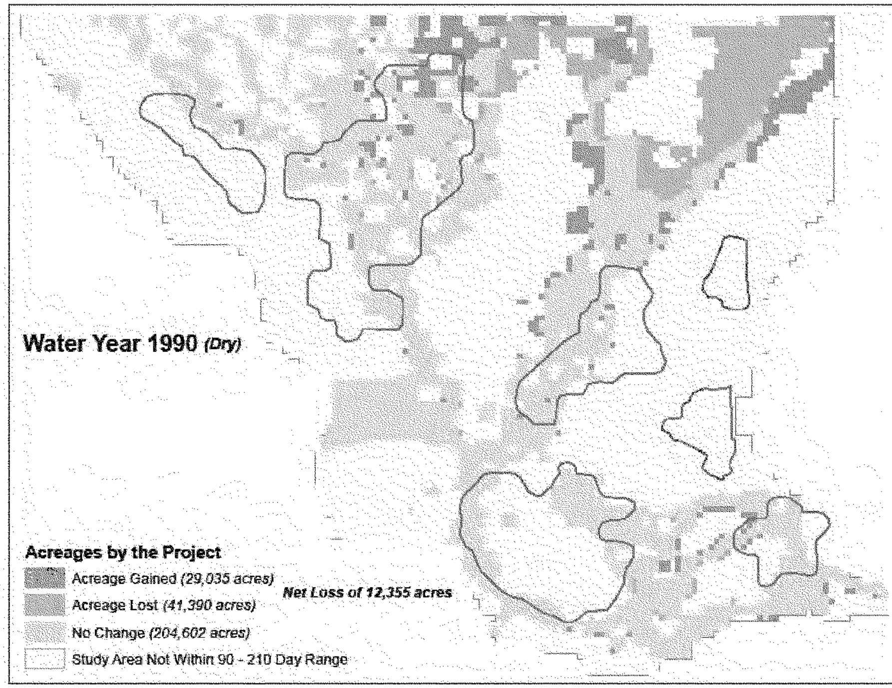


Figure 26. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1990 (dry). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

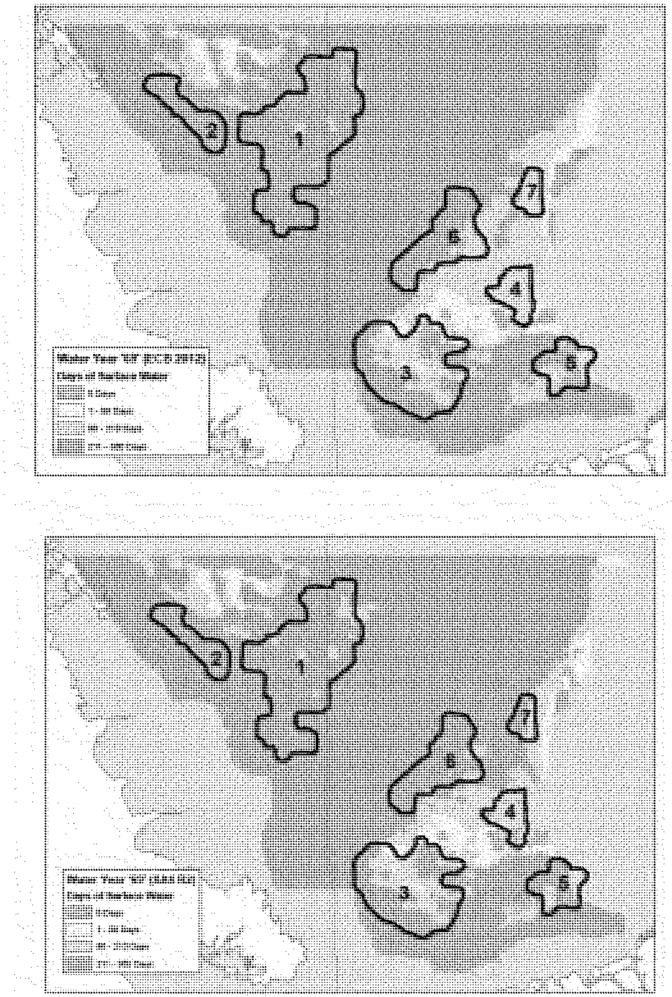


Figure 27. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1969 (wet), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1969 (wet), (lower figure).

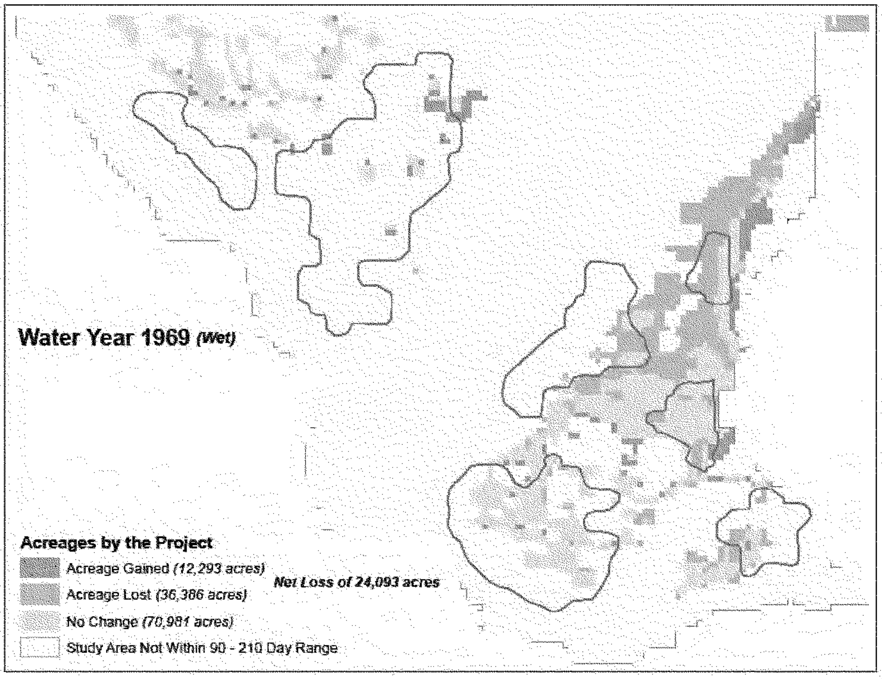


Figure 28. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1969 (wet). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

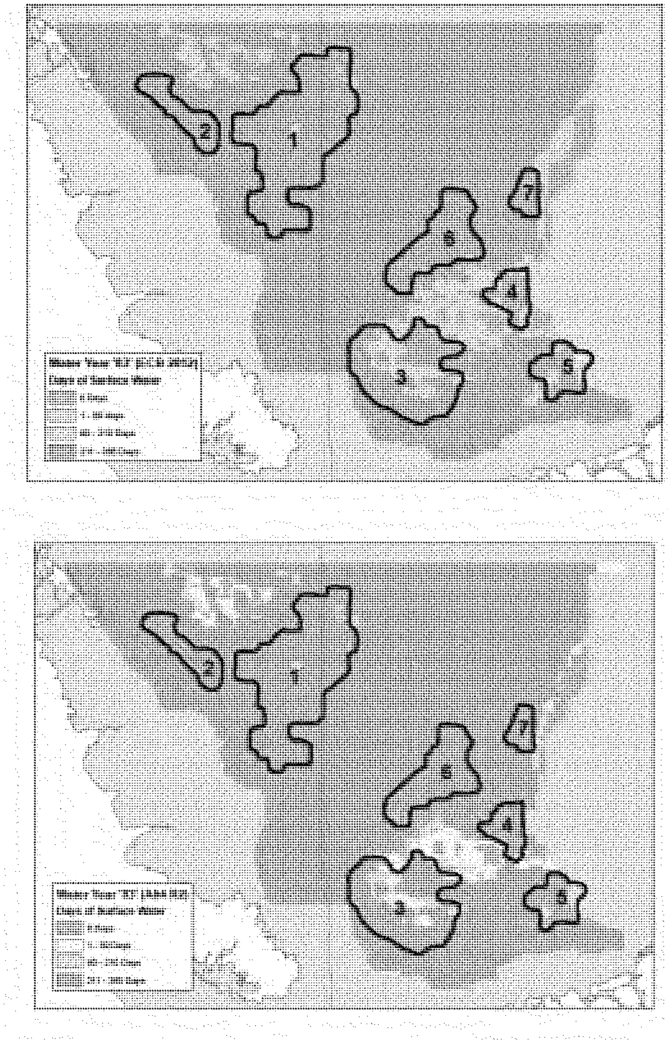


Figure 29. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1983 (wet), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1983 (wet), (lower figure).

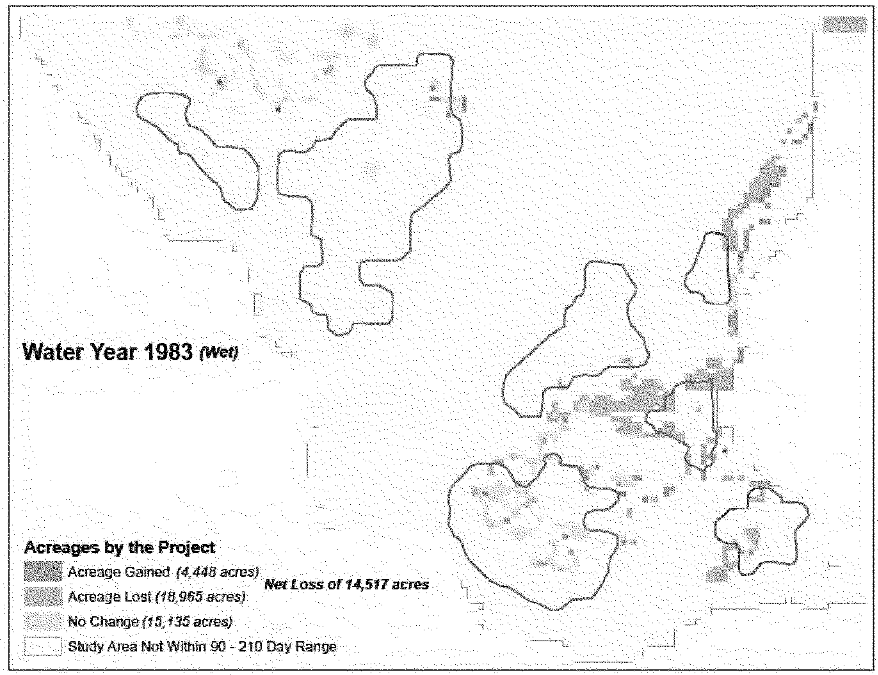


Figure 30. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1983 (wet). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

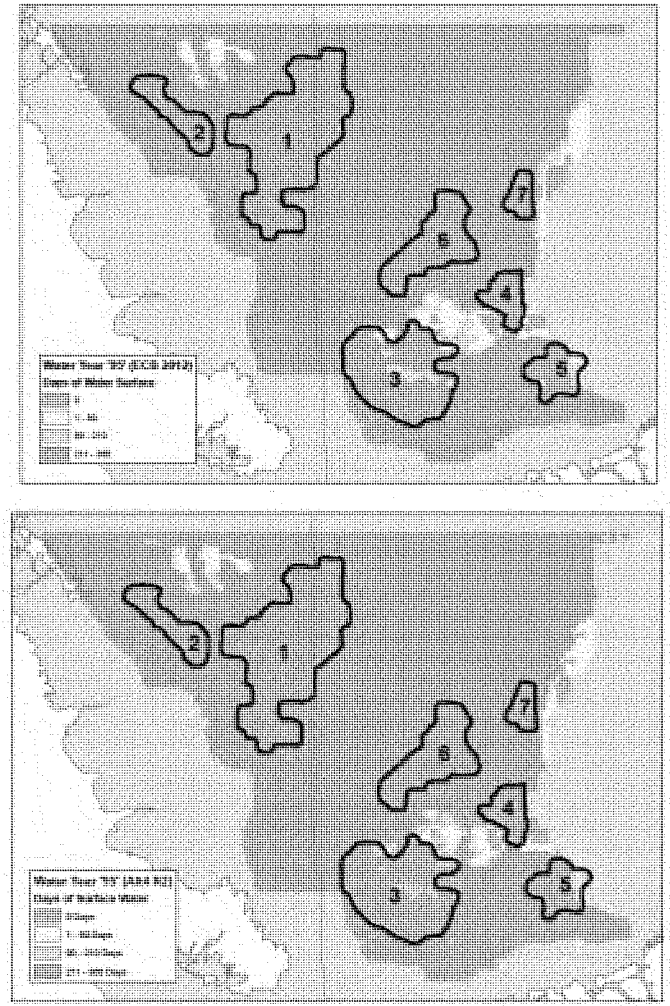


Figure 31. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1995 (wet), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1995 (wet), (lower figure).

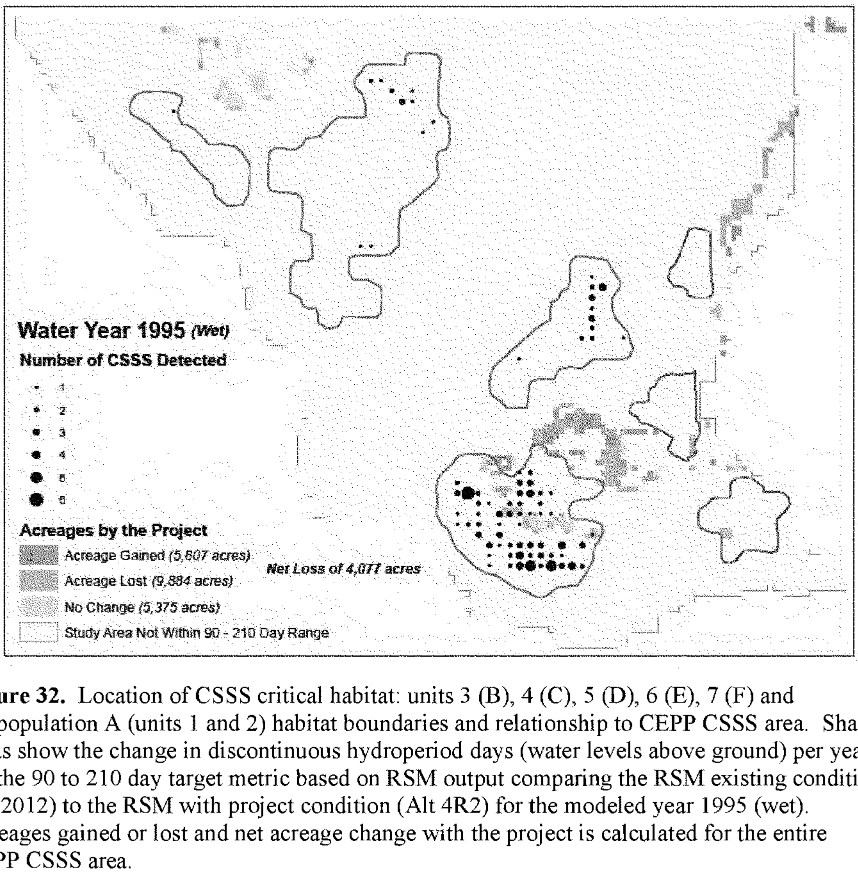


Figure 32. Location of CSSS critical habitat: units 3 (B), 4 (C), 5 (D), 6 (E), 7 (F) and subpopulation A (units 1 and 2) habitat boundaries and relationship to CEPP CSSS area. Shaded areas show the change in discontinuous hydroperiod days (water levels above ground) per year for the 90 to 210 day target metric based on RSM output comparing the RSM existing condition (EC2012) to the RSM with project condition (Alt 4R2) for the modeled year 1995 (wet). Acreages gained or lost and net acreage change with the project is calculated for the entire CEPP CSSS area.

Table 15. CEPP Alt 4R2 minus EC2012 by subpopulation/critical HU. RSM discontinuous hydroperiod for average, dry, and wet scenarios separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres either gained or lost with the project within the critical habitat/subpopulation boundary, averaged by scenario for the years analyzed; average (72, 76, 77, 82, and 01), dry (71, 89, and 90), and wet (69, 83, and 95).

AVERAGE OF WATER YEARS '72, 76, 77, 82, 01' (AVERAGE)(Alt4R2-ECB2012)							
	RANGE						
	0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	NO DATA		
CH UNIT	ACRES	ACRES	ACRES	ACRES	ACRES		TOTAL ACRES
1 - A1	49	1978	4952	-6979	0		0
2 - A2	0	0	15	-15	0		0
3 - B	17	-106	283	-194	0		0
4 - C	-189	-562	751	0	0		0
5 - D	0	-204	-465	669	0		0
6 - E	0	-1166	-942	2109	0		0
7 - F	13	-811	798	0	0		0
Total Δ (All Subpops.)	-109	-871	5391	-4410	1817		1817

AVERAGE OF WATER YEARS '72, 76, 77, 82, 01' (AVERAGE)(Alt4R2-ECB201							
	RANGE						
	0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	NO DATA		
CH UNIT	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.		TOTAL ACRES
1 - A1	0.08	3.30	8.27	-11.66	0.00		59844
2 - A2	0.00	0.00	0.13	-0.14	0.00		11393
3 - B	0.04	-0.27	0.72	-0.50	0.00		39022
4 - C	-2.34	-6.98	9.32	0.00	0.00		8053
5 - D	0.00	-1.91	-4.35	6.26	0.00		10692
6 - E	0.00	-5.24	-4.23	9.47	0.00		22261
7 - F	0.27	-16.37	16.10	0.00	0.00		4954
Total Δ (All Subpops.)	-0.07	-0.56	3.45	-2.82	1.16		156219

AVERAGE OF WATER YEARS '71, 89, 90' (DRY)(Alt4R2-ECB2012)							
	RANGE						
	0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	NO DATA		
CH UNIT	ACRES	ACRES	ACRES	ACRES	ACRES		TOTAL ACRES
1 - A1	1	1,945	-7	-1,940	0		0
2 - A2	0	0	62	-62	0		0
3 - B	40	-162	122	0	0		0
4 - C	-1,754	1,754	0	0	0		0
5 - D	-122	-531	789	-136	0		0
6 - E	-467	-657	1,124	0	0		0
7 - F	-1,853	1,853	0	0	0		0
Total Δ (All Subpops.)	-4,155	4,202	2,090	-2,137	1,817		1817

AVERAGE OF WATER YEARS '71, 89, 90' (DRY)(Alt4R2-ECB2012)							
	RANGE						
	0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	NO DATA		
CH UNIT	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.		TOTAL ACRES
1 - A1	0.00	3.25	-0.01	-3.24	0.00		59844
2 - A2	0.00	0.00	0.54	-0.54	0.00		11393
3 - B	0.10	-0.42	0.31	0.00	0.00		39022
4 - C	-21.78	21.78	0.00	0.00	0.00		8053
5 - D	-1.14	-4.97	7.38	-1.27	0.00		10692
6 - E	-2.10	-2.95	5.05	0.00	0.00		22261
7 - F	-37.40	37.40	0.00	0.00	0.00		4954
Total Δ (All Subpops.)	-2.66	2.69	1.34	-1.37	1.16		156219

AVERAGE OF WATER YEARS '69, 83, 95' (WET)(Alt4R2-ECB2012)							
	RANGE						
	0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	NO DATA		
CH UNIT	ACRES	ACRES	ACRES	ACRES	ACRES		TOTAL ACRES
1 - A1	0	0	705	-705	0		0
2 - A2	0	0	0	0	0		0
3 - B	-23	-269	-734	1027	0		0
4 - C	0	-218	-1004	1222	0		0
5 - D	0	-81	-666	747	0		0
6 - E	0	-21	-963	984	0		0
7 - F	0	-28	-1001	1030	0		0
Total Δ (All Subpops.)	-23	-617	-3664	4305	1817		1817

AVERAGE OF WATER YEARS '69, 83, 95' (WET)(Alt4R2-ECB2012)							
	RANGE						
	0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	NO DATA		
CH UNIT	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.		TOTAL ACRES
1 - A1	0.00	0.00	1.18	-1.18	0.00		59844
2 - A2	0.00	0.00	0.00	0.00	0.00		11393
3 - B	-0.06	-0.69	-1.88	2.63	0.00		39022
4 - C	0.00	-2.71	-12.46	15.18	0.00		8053
5 - D	0.00	-0.76	-6.23	6.99	0.00		10692
6 - E	0.00	-0.09	-4.33	4.42	0.00		22261
7 - F	0.00	-0.57	-20.21	20.78	0.00		4954
Total Δ (All Subpops.)	-0.01	-0.40	-2.35	2.76	1.16		156219

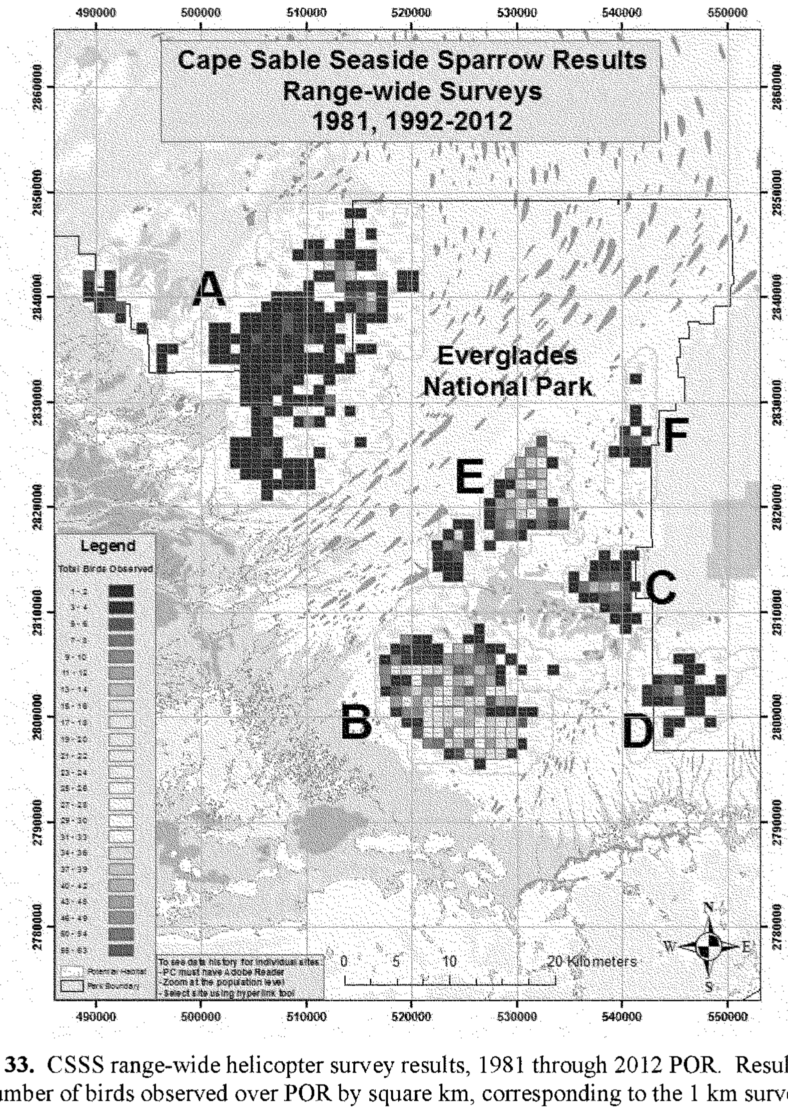


Figure 33. CSSS range-wide helicopter survey results, 1981 through 2012 POR. Results are total number of birds observed over POR by square km, corresponding to the 1 km survey grid.

Table 16. CEPP EC2012 by subpopulation/critical HU. RSM discontinuous hydroperiod for the average scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres for EC2012 for the average (72, 76, 77, 82, and 01) years analyzed.

WATER YEAR '72' (ECB2012)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			858.3	1.4	12,791.2	21.4	46,194.4	77.1			59,843.9
2 - A2					0.1	0.0	11,393.1	99.9			11,393.2
3 - B	1,205.3	3.1	8,021.7	20.5	13,929.2	35.7	15,865.9	40.6			39,022.2
4 - C	362.8	4.5	6,203.5	77.0	1,486.3	18.4					8,052.6
5 - D			1,209.8	11.3	5,438.1	50.8	2,227.4	20.8	1,817.1	17.0	10,692.4
6 - E			1,596.4	7.2	12,907.4	57.9	7,756.8	34.8			22,260.6
7 - F			2,554.1	51.5	2,399.9	48.4					4,954.0
Total	1,568.1		20,443.8		48,952.3		83,437.5		1,817.1		156,218.8

WATER YEAR '76' (ECB2012)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			61.8	0.1	14,227.4	23.8	45,554.7	76.1			59,843.9
2 - A2					43.9	0.4	11,349.3	99.5			11,393.2
3 - B	733.1	1.9	6,659.1	17.1	26,443.6	67.7	5,186.4	13.3			39,022.2
4 - C	186.5	2.3	1,457.3	18.1	6,408.8	79.5					8,052.6
5 - D			614.1	5.7	7,820.1	73.1	441.1	4.1	1,817.1	17.0	10,692.4
6 - E			171.5	0.8	17,761.1	79.7	4,327.9	19.4			22,260.6
7 - F			988.1	19.9	3,965.9	80.0					4,954.0
Total	919.6		9,951.9		76,670.8		66,859.4		1,817.1		156,218.8

WATER YEAR '77' (ECB2012)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1	61.8	0.1	4,134.7	6.9	29,589.7	49.4	26,057.7	43.5			59,843.9
2 - A2					43.9	0.4	11,349.3	99.5			11,393.2
3 - B	1,142.5	2.9	19,208.4	49.2	17,595.8	45.1	1,075.6	2.8			39,022.2
4 - C	630.2	7.8	7,422.4	92.1							8,052.6
5 - D			2,692.9	25.2	5,484.5	51.3	697.9	6.5	1,817.1	17.0	10,692.4
6 - E			7,309.6	32.8	10,693.1	48.0	4,257.9	19.1			22,260.6
7 - F	16.5	0.3	4,937.5	99.6							4,954.0
Total	1,850.9		45,705.4		63,407.0		43,438.4		1,817.1		156,218.8

WATER YEAR '82' (ECB2012)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1					9,804.5	16.4	50,039.3	83.5			59,843.9
2 - A2					88.8	0.8	11,304.4	99.1			11,393.2
3 - B			6,045.2	15.5	25,345.5	64.9	7,631.5	19.5			39,022.2
4 - C	309.9	3.8	1,747.9	21.7	5,994.8	74.4					8,052.6
5 - D			799.5	7.5	5,532.4	51.7	2,543.4	23.8	1,817.1	17.0	10,692.4
6 - E			564.2	2.5	13,109.0	58.8	8,587.4	38.5			22,260.6
7 - F			454.1	9.2	4,499.9	90.8					4,954.0
Total	309.9		9,610.9		64,374.9		80,106.0		1,817.1		156,218.8

WATER YEAR '01' (ECB2012)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			741.3	1.2	23,269.9	38.9	35,832.6	59.8			59,843.9
2 - A2					595.2	5.2	10,798.0	94.7			11,393.2
3 - B	648.2	1.7	5,747.1	14.7	29,303.4	75.0	3,323.4	8.5			39,022.2
4 - C	83.3	1.0	6,497.4	80.6	1,471.9	18.3					8,052.6
5 - D			1,574.1	14.7	6,776.3	63.3	524.9	4.9	1,817.1	17.0	10,692.4
6 - E			1,840.4	8.3	20,405.1	91.6	15.1	0.1			22,260.6
7 - F			4,235.5	85.4	718.5	14.5					4,954.0
Total	731.6		20,635.7		82,540.3		50,494.1		1,817.1		156,218.8

Table 17. CEPP EC2012 by subpopulation/critical HU. RSM discontinuous hydroperiod for the dry scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres for EC2012 for the dry (71, 89, and 90) years.

WATER YEAR '71' (ECB2012)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			5,761.1		45,709.2	76.3	8,373.6	14.0			59,843.9
2 - A2					595.2	5.2	10,798.0	94.7			11,393.2
3 - B	1,660.8	4.3	31,305.0	17.7	6,056.4	15.5					39,022.2
4 - C	6,393.5	79.3	1,659.1	8.4							8,052.6
5 - D	737.7	6.9	6,067.9	6.3	1,960.4	18.3	109.3	1.0	1,817.1	17.0	10,692.4
6 - E	152.3	0.7	17,566.6		4,541.8	20.4					22,260.6
7 - F	4,461.3	90.0	492.7								4,954.0
Total	13,405.6		62,852.4		58,863.0		19,280.9		1,817.1		156,218.9

WATER YEAR '89' (ECB2012)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1	0.0		4,679.7	7.8	45,650.5	76.2	9,513.7	15.9			59,843.9
2 - A2					1,028.7	9.0	10,364.5	90.9			11,393.2
3 - B	8,340.7	21.4	24,036.6	61.5	6,644.8	17.0					39,022.2
4 - C	5,778.7	71.7	2,273.8	28.2							8,052.6
5 - D	428.8	4.0	4,319.3	40.4	4,017.9	37.5	109.3	1.0	1,817.1	17.0	8,875.3
6 - E	2,087.5	9.4	10,200.0	45.8	9,973.2	44.8					22,260.6
7 - F	1,269.8	25.6	3,684.2	74.3							4,954.0
Total	17,905.6		49,193.6		67,315.0		19,987.5		1,817.1		156,218.8

WATER YEAR '90' (ECB2012)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1	803.1	1.3	5,813.5	9.7	32,393.6	54.1	20,833.6	34.8			59,843.9
2 - A2					664.2	5.8	10,729.0	94.1			11,393.2
3 - B	2,306.4	5.9	23,245.6	59.5	13,413.9	34.3	56.2	0.1			39,022.2
4 - C	5,358.8	66.5	2,693.8	33.4							8,052.6
5 - D	428.8	4.0	2,492.0	23.3	5,636.9	52.7	317.5	3.0	1,817.1	17.0	10,692.4
6 - E	2,000.8	9.0	9,684.6	43.5	10,575.2	47.5					22,260.6
7 - F	2,601.9	52.5	2,352.1	47.4							4,954.0
Total	13,499.8		46,281.7		62,683.9		31,936.4		1,817.1		156,218.8

Table 18. CEPP EC2012 by subpopulation/critical HU. RSM discontinuous hydroperiod for the wet scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres for EC2012 for the wet (69, 83, and 95) years.

WATER YEAR '69' (ECB2012)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1					1,880.4	3.1	57,963.5	96.8			59,843.9
2 - A2							11,393.2	99.9			11,393.2
3 - B			2,174.4	5.6	14,710.1	37.7	22,137.8	56.7			39,022.2
4 - C	0.6	0.0	309.4	3.8	7,742.6	96.1					8,052.6
5 - D			123.6	1.2	2,500.4	23.4	6,251.4	58.4	1,817.1	17.0	10,692.4
6 - E					3,976.4	17.8	18,284.2	82.1			22,260.6
7 - F			84.7	1.7	4,447.9	89.7	421.5	8.5			4,954.0
Total	0.6		2,692.0		35,257.8		116,451.5		1,817.1		156,218.9

WATER YEAR '83' (ECB2012)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1					667.7	1.1	59,176.2	98.8			59,843.9
2 - A2							11,393.2	99.9			11,393.2
3 - B	487.7	1.2	3,854.6	9.9	5,799.9	14.9	28,879.9	74.0			39,022.2
4 - C	0.6	0.0	474.3	5.9	1,843.6	22.9	5,734.2	71.2			8,052.6
5 - D			243.5	2.3	1,142.8	10.7	7,489.0	70.0	1,817.1	17.0	10,692.4
6 - E			61.8	0.3	279.0	1.3	21,919.8	98.4			22,260.6
7 - F					281.9	5.7	4,672.1	94.2			4,954.0
Total	488.3		4,634.2		10,014.8		139,264.4		1,817.1		156,218.7

WATER YEAR '95' (ECB2012)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1							59,843.9	99.9			59,843.9
2 - A2							11,393.2	99.9			11,393.2
3 - B			627.4	1.6	3,543.0	9.1	34,851.8	89.2			39,022.2
4 - C	0.6	0.0	128.4	1.6	181.0	2.2	7,742.6	96.1			8,052.6
5 - D					243.5	2.3	8,631.8	80.7	1,817.1	17.0	10,692.4
6 - E							22,260.6	99.9			22,260.6
7 - F							4,954.0	99.9			4,954.0
Total	0.6		755.7		3,967.5		149,677.9		1,817.1		156,218.8

Table 19. CEPP Alt 4R2 by subpopulation/critical HU. RSM discontinuous hydroperiod for the average scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres for Alt 4R2 for the average (72, 76, 77, 82, and 01) years analyzed.

WATER YEAR '72' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			2,157.9	3.6	13,772.7	23.0	43,913.2	73.3			59,843.9
2 - A2					0.1	0.0	11,393.1	99.9			11,393.2
3 - B	1,289.1	3.3	8,061.5	20.6	13,496.8	34.6	16,174.8	41.4			39,022.2
4 - C	82.8	1.0	6,545.2	81.2	1,424.5	17.7					8,052.6
5 - D			1,231.9	11.5	4,321.8	40.4	3,321.6	31.0	1,817.1	17.0	10,692.4
6 - E			1,666.0	7.5	9,105.0	40.9	11,489.6	51.6			22,260.6
7 - F	32.9	0.7	1,427.2	28.8	3,493.8	70.5					4,954.0
Total	1,404.8		21,089.7		45,614.7		86,292.4		1,817.1		156,218.8

WATER YEAR '76' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			799.1	0.0	24,661.7	0.4	34,383.0	0.6			59,843.9
2 - A2					59.6	0.0	11,333.6	1.0			11,393.2
3 - B	733.1	0.0	6,597.3	0.2	26,685.6	0.7	5,006.2	0.1			39,022.2
4 - C	100.4	0.0	1,505.0	0.2	6,447.1	0.8					8,052.6
5 - D			675.9	0.1	7,736.3	0.7	463.1	0.0	1,817.1	17.0	10,692.4
6 - E			171.5	0.0	15,906.2	0.7	6,182.9	0.3			22,260.6
7 - F	16.4	0.0	409.4	0.1	4,528.2	0.9					4,954.0
Total	850.0		10,158.2		86,024.6		57,368.8		1,817.1		156,218.7

WATER YEAR '77' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1	308.9	0.5	10,791.5	18.0	25,006.1	41.8	23,737.4	39.6			59,843.9
2 - A2					86.8	0.8	11,306.4	99.2			11,393.2
3 - B	1,142.5	2.9	19,084.9	48.9	17,741.9	45.4	1,053.0	2.7			39,022.2
4 - C	281.0	3.5	7,709.8	95.7	61.8	0.8					8,052.6
5 - D			1,869.4	17.5	6,246.3	58.4	759.7	7.1	1,817.1	17.0	10,692.4
6 - E			2,981.2	13.4	13,093.0	58.8	6,186.4	27.8			22,260.6
7 - F	32.9	0.7	4,383.1	88.4	538.0	10.9					4,954.0
Total	1,765.3		46,819.8		62,773.8		43,042.9		1,817.1		156,218.8

WATER YEAR '82' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1					21,942.1	36.6	37,901.8	63.3			59,843.9
2 - A2					230.7	2.0	11,162.5	97.9			11,393.2
3 - B			5,971.3	15.3	26,977.6	69.1	6,073.3	15.6			39,022.2
4 - C	82.8	1.0	1,548.5	19.2	6,421.3	79.7					8,052.6
5 - D			861.3	8.0	3,217.6	30.1	4,796.5	44.8	1,817.1	17.0	10,692.4
6 - E			86.1	0.4	11,868.6	53.3	10,305.8	46.3			22,260.6
7 - F			93.4	1.9	4,860.6	98.0					4,954.0
Total	82.8		8,560.5		75,518.4		70,239.9		1,817.1		156,218.7

WATER YEAR '01' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			1,935.8	3.2	29,060.4	48.5	28,847.8	48.2			59,843.9
2 - A2					471.7	4.1	10,921.5	95.8			11,393.2
3 - B	648.2	1.7	5,438.2	13.9	29,129.4	74.6	3,806.4	9.7			39,022.2
4 - C	82.8	1.0	3,209.4	39.8	4,760.3	59.1					8,052.6
5 - D			1,231.9	11.5	7,202.3	67.3	441.1	4.1	1,817.1	17.0	10,692.4
6 - E			746.5	3.4	20,190.6	90.6	1,323.5	5.9			22,260.6
7 - F			2,801.2	56.5	2,152.8	43.4					4,954.0
Total	731.1		15,363.1		92,967.5		45,340.2		1,817.1		156,218.9

Table 20. CEPP Alt 4R2 by subpopulation/critical HU. RSM discontinuous hydroperiod for the dry scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres for Alt 4R2 for the dry (71, 89, and 90) years.

WATER YEAR '71' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1			7,922.7	13.2	44,745.2	74.7	7,176.0	12.0			59,843.9
2 - A2					718.8	6.3	10,674.4	93.6			11,393.2
3 - B	1,660.8	4.3	31,305.0	80.2	6,056.4	15.5					39,022.2
4 - C	4,737.8	58.8	3,314.7	41.1							8,052.6
5 - D	614.1	5.7	4,900.7	45.8	3,349.9	31.3	10.5	0.1	1,817.1	17.0	10,692.4
6 - E	152.3	0.7	15,600.7	70.0	6,507.7	29.2					22,260.6
7 - F	1,145.7	23.1	3,808.3	76.8							4,954.0
Total	8,310.8		66,852.0		61,377.9		17,860.9		1,817.1		156,218.8

WATER YEAR '89' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1	3.5	0.0	6,989.2	11.7	44,063.1	73.6	8,788.1	14.7			59,843.9
2 - A2					1,090.5	9.6	10,302.7	90.4			11,393.2
3 - B	8,402.5	21.5	23,608.0	60.5	7,011.7	18.0					39,022.2
4 - C	3,913.9	48.6	4,138.6	51.4							8,052.6
5 - D	185.3	1.7	4,078.8	38.1	4,601.8	43.0	9.4	0.1	1,817.1	17.0	10,692.4
6 - E	1,117.9	5.0	10,143.8	45.5	10,998.9	49.4					22,260.6
7 - F	721.6	14.6	4,232.4	85.4							4,954.0
Total	14,344.7		53,190.9		67,766.0		19,100.2		1,817.1		156,218.8

WATER YEAR '90' (ALT4 R2)											
	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1	803.1	1.3	7,178.8	12.0	34,923.6	58.3	16,938.3	28.3			59,843.9
2 - A2					664.2	5.8	10,729.0	94.1			11,393.2
3 - B	2,363.9	6.1	23,188.1	59.4	13,413.9	34.3	56.2	0.1			39,022.2
4 - C	3,617.9	44.9	4,434.7	55.0							8,052.6
5 - D	428.8	4.0	2,306.7	21.6	6,030.5	56.4	109.3	1.0	1,817.1	17.0	10,692.4
6 - E	1,569.1	7.0	9,736.7	43.7	10,954.8	49.2					22,260.6
7 - F	906.9	18.3	4,047.1	81.6							4,954.0
Total	9,689.7		50,892.2		65,987.0		27,832.9		1,817.1		156,218.9

Table 21. CEPP Alt 4R2 by subpopulation/critical HU. RSM discontinuous hydroperiod for the wet scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days). Figures are number of acres for Alt 4R2 for the wet (69, 83, and 95) years.

WATER YEAR '69' (ALT4 R2)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1					3,747.8	6.3	56,096.0	93.7			59,843.9
2 - A2							11,393.2	99.9			11,393.2
3 - B			1,865.5	4.8	14,405.7	36.9	22,750.9	58.3			39,022.2
4 - C	0.6	0.0	82.2	1.0	6,532.1	81.1	1,437.6	17.8			8,052.6
5 - D					1,455.3	13.6	7,420.0	69.3	1,817.1	17.0	10,692.4
6 - E					1,365.0	6.1	20,895.6	93.8			22,260.6
7 - F					1,635.4	33.0	3,318.6	66.9			4,954.0
Total	0.6		1,947.7		29,141.4		123,311.9		1,817.1		156,218.7

WATER YEAR '83' (ALT4 R2)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1					914.8	1.5	58,929.1	98.4			59,843.9
2 - A2							11,393.2	99.9			11,393.2
3 - B	418.4	1.1	3,561.4	9.1	5,392.8	13.8	29,649.6	75.9			39,022.2
4 - C	0.6	0.0	154.1	1.9	162.5	2.0	7,735.4	96.0			8,052.6
5 - D			123.6	1.2	432.4	4.0	8,319.3	77.7	1,817.1	17.0	10,692.4
6 - E							22,260.6	99.9			22,260.6
7 - F					90.3	1.8	4,863.7	98.1			4,954.0
Total	418.9		3,839.1		6,992.8		143,151.0		1,817.1		156,218.9

WATER YEAR '95' (ALT4 R2)

	RANGE										
	0 DAYS		1 - 89 DAYS		90 - 210 DAYS		211 - 365 DAYS		NO DATA		
CH UNIT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	ACRES	PERCENT	TOTAL ACRES
1 - A1							59,843.9	99.9			59,843.9
2 - A2							11,393.2	99.9			11,393.2
3 - B			422.1	1.1	2051.5	5.3	36,548.6	93.6			39,022.2
4 - C			21.3	0.3	61.5	0.8	7,969.8	98.9			8,052.6
5 - D							8,875.3	82.9	1,817.1	17.0	10,692.4
6 - E							22,260.6	99.9			22,260.6
7 - F							4,954.0	99.9			4,954.0
Total	0.0		443.3		151,845.3		2,113.1		1,817.1		156,218.8

Table 22. Results of RSM analysis for gauges located in or near CSSS subpopulations by year for PCE4: Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years. Figures are number of days exceeding the criteria, comparing EC2012 and Alt 4R2 with years in red where the depth exceeded 7.9 inches at least twice during a rolling 10-year period, yellow is indicative of a year where depth exceeds 7.9 inches but more than 10 years separated the occurrences, and green where the criteria is not exceeded.

[illegible]

Table 23. Results of RSM analysis for indicator cells in subpopulation A1 and A2, located in or near CSSS subpopulations by year for PCE4: Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years. Figures are number of days exceeding the criteria, comparing EC2012 and Alt 4R2 with years in red where the depth exceeded 7.9 inches at least twice during a rolling 10-year period, yellow is indicative of a year where depth exceeds 7.9 inches but more than 10 years separated the occurrences, and green where the criteria is not exceeded.

[illegible]

Table 24. CEPP Alt 4R2 minus EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod acre occurrence for the average scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres either gained or lost with the project averaged by scenario for the years analyzed; average (72, 76, 77, 82, and 01).

AVERAGE OF WATER YEARS '72, 76, 77, 82, 01' (AVERAGE) (ALT4R2-ECB12)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1	Zone Total	38	1,524	4,038	-5,600	0
	1-5	38	1,295	3,692	-5,025	0
	6-10	0	85	215	-300	0
	11-20	0	145	130	-275	0
A2	Zone Total	0	0	-9	9	0
	1-5	0	0	-9	9	0
B	Zone Total	15	-82	257	-190	0
	1-5	15	-67	102	-50	0
	6-10	0	-18	63	-45	0
	11-20	0	1	49	-50	0
	21-30	0	-2	50	-49	0
	31-40	0	-1	-7	9	0
	>40	0	6	-1	-5	0
C	Zone Total	-243	-331	574	0	0
	1-5	-243	-128	372	0	0
	6-10	0	-156	156	0	0
	11-20	0	-46	46	0	0
D	Zone Total	0	-163	-367	531	0
	1-5	0	-145	-360	505	0
	6-10	0	-18	1	17	0
	11-20	0	-1	-8	9	0
E	Zone Total	0	-869	-563	1,432	0
	1-5	0	-252	-265	517	0
	6-10	0	-209	9	200	0
	11-20	0	-125	-353	478	0
	21-30	0	-49	11	37	0
	31-40	0	-198	49	148	0
	>40	0	-37	-14	52	0
F	Zone Total	10	-488	475	2	0
	1-5	10	-488	475	2	0

AVERAGE OF WATER YEARS '72, 76, 77, 82, 01' (AVERAGE) (ALT4R2-ECB12)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	TOTAL ACRES
A1	Zone Total	0.1	3.2	8.5	-11.7	47,691
	1-5	0.1	2.9	8.3	-11.3	44,479
	6-10	0.0	4.9	12.4	-17.3	1,730
	11-20	0.0	9.7	8.8	-18.5	1,483
A2	Zone Total	0.0	0.0	-0.2	0.2	3,954
	1-5	0.0	0.0	-0.2	0.2	3,954
B	Zone Total	0.0	-0.3	0.8	-0.6	32,618
	1-5	0.2	-0.7	1.0	-0.5	9,884
	6-10	0.0	-0.5	1.7	-1.2	3,707
	11-20	0.0	0.0	1.2	-1.3	3,954
	21-30	0.0	0.0	0.9	-0.8	5,931
	31-40	0.0	0.0	-0.2	0.2	4,695
	>40	0.0	0.1	0.0	-0.1	4,448
C	Zone Total	-3.2	-4.3	7.5	0.0	7,660
	1-5	-4.5	-2.4	6.8	0.0	5,436
	6-10	0.0	-10.5	10.5	0.0	1,483
	11-20	0.0	-6.2	6.2	0.0	741
D	Zone Total	0.0	-2.6	-5.8	8.4	6,346
	1-5	0.0	-2.7	-6.7	9.4	5,358
	6-10	0.0	-2.4	0.1	2.3	741
	11-20	0.0	-0.3	-3.4	3.7	247
E	Zone Total	0.0	-5.4	-3.5	8.9	16,062
	1-5	0.0	-3.8	-4.0	7.7	6,672
	6-10	0.0	-7.0	0.3	6.7	2,965
	11-20	0.0	-4.2	-11.9	16.1	2,965
	21-30	0.0	-9.8	2.3	7.5	494
	31-40	0.0	-8.9	2.2	6.7	2,224
	>40	0.0	-5.0	-1.9	7.0	741
F	Zone Total	0.3	-15.2	14.8	0.1	3,212
	1-5	0.3	-15.2	14.8	0.1	3,212

Table 25. CEPP Alt 4R2 minus EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod acre occurrence for the dry scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres either gained or lost with the project averaged by scenario for the years analyzed; dry (71, 89, and 90).

AVERAGE OF WATER YEARS '71, 89, 90' (Dry) (ALT4R2-ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1	Zone Total	86	1,500	98	-1,685	0
	1-5	86	1,263	185	-1,535	0
	6-10	0	65	9	-74	0
	11-20	0	172	-96	-76	0
A2	Zone Total	0	0	26	-26	0
	1-5	0	0	26	-26	0
B	Zone Total	41	-98	57	0	0
	1-5	-1	-20	21	0	0
	6-10	0	-37	37	0	0
	11-20	11	-11	0	0	0
	21-30	9	-9	0	0	0
	31-40	21	-21	0	0	0
	>40	0	0	0	0	0
C	Zone Total	-1,685	1,685	0	0	0
	1-5	-1,094	1,094	0	0	0
	6-10	-287	287	0	0	0
	11-20	-304	304	0	0	0
D	Zone Total	-89	-419	586	-78	0
	1-5	-84	-403	566	-78	0
	6-10	-4	-9	13	0	0
	11-20	0	-8	8	0	0
E	Zone Total	-346	-512	859	0	0
	1-5	-213	-101	314	0	0
	6-10	-100	-69	169	0	0
	11-20	0	-107	107	0	0
	21-30	0	-40	40	0	0
	31-40	-33	-139	172	0	0
	>40	0	-58	58	0	0
F	Zone Total	-1,127	1,127	0	0	0
	1-5	-1,127	1,127	0	0	0

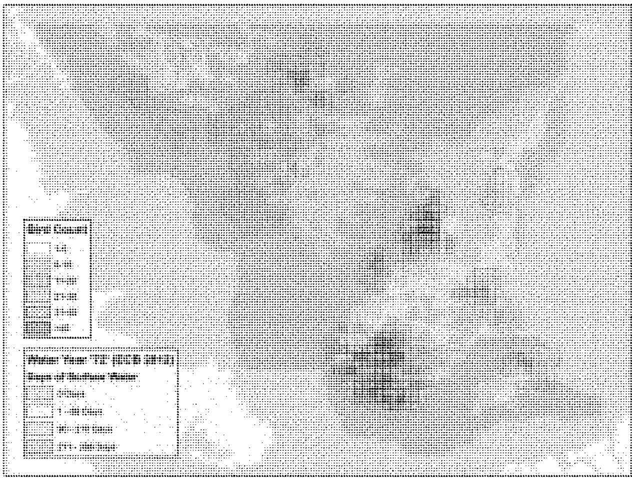
AVERAGE OF WATER YEARS '71, 89, 90' (Dry) (ALT4R2-ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	TOTAL ACRES
A1	Zone Total	0.2	3.1	0.2	-3.5	47,691
	1-5	0.2	2.8	0.4	-3.5	44,479
	6-10	0.0	3.8	0.5	-4.3	1,730
	11-20	0.0	11.6	-6.5	-5.1	1,483
A2	Zone Total	0.0	0.0	0.7	-0.7	3,954
	1-5	0.0	0.0	0.7	-0.7	3,954
B	Zone Total	0.1	-0.3	0.2	0.0	32,618
	1-5	0.0	-0.2	0.2	0.0	9,884
	6-10	0.0	-1.0	1.0	0.0	3,707
	11-20	0.3	-0.3	0.0	0.0	3,954
	21-30	0.2	-0.2	0.0	0.0	5,931
	31-40	0.4	-0.4	0.0	0.0	4,695
	>40	0.0	0.0	0.0	0.0	4,448
C	Zone Total	-22.0	22.0	0.0	0.0	7,660
	1-5	-20.1	20.1	0.0	0.0	5,436
	6-10	-19.4	19.4	0.0	0.0	1,483
	11-20	-41.0	41.0	0.0	0.0	741
D	Zone Total	-1.4	-6.6	9.2	-1.2	6,346
	1-5	-1.6	-7.5	10.6	-1.5	5,358
	6-10	-0.6	-1.2	1.7	0.0	741
	11-20	0.0	-3.0	3.0	0.0	247
E	Zone Total	-2.2	-3.2	5.3	0.0	16,062
	1-5	-3.2	-1.5	4.7	0.0	6,672
	6-10	-3.4	-2.3	5.7	0.0	2,965
	11-20	0.0	-3.6	3.6	0.0	2,965
	21-30	0.0	-8.0	8.0	0.0	494
	31-40	-1.5	-6.3	7.7	0.0	2,224
	>40	0.0	-7.8	7.8	0.0	741
F	Zone Total	-35.1	35.1	0.0	0.0	3,212
	1-5	-35.1	35.1	0.0	0.0	3,212

Table 26. CEPP Alt 4R2 minus EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod acre occurrence for the wet scenario separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres either gained or lost with the project averaged by scenario for the years analyzed; wet (69, 83, and 95).

AVERAGE OF WATER YEARS '69, 83, 95' (Wet) (ALT4R2-ECB12)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1	Zone Total	0	0	52	-51	0
	1-5	0	0	52	-52	0
	6-10	0	0	0	0	0
	11-20	0	0	0	0	0
A2	Zone Total	0	0	0	0	0
	1-5	0	0	0	0	0
B	Zone Total	0	-169	-587	756	0
	1-5	0	-96	-159	256	0
	6-10	0	-21	-28	49	0
	11-20	0	-33	-58	91	0
	21-30	0	-7	-32	39	0
	31-40	0	-6	-215	221	0
	>40	0	-6	-94	100	0
C	Zone Total	0	-188	-575	762	0
	1-5	0	-188	-533	721	0
	6-10	0	0	-26	26	0
	11-20	0	0	-16	16	0
D	Zone Total	0	-3	-168	171	0
	1-5	0	-3	-93	97	0
	6-10	0	0	-69	69	0
	11-20	0	0	-5	5	0
E	Zone Total	0	-11	-29	40	0
	1-5	0	-11	-24	36	0
	6-10	0	0	-4	4	0
	11-20	0	0	0	0	0
	21-30	0	0	0	0	0
	31-40	0	0	0	0	0
	>40	0	0	0	0	0
F	Zone Total	0	0	0	0	0
	1-5	0	0	0	0	0

AVERAGE OF WATER YEARS '69, 83, 95' (Wet) (ALT4R2-ECB12)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	% Change of Total Ac.	TOTAL ACRES
A1	Zone Total	0.0	0.0	0.1	-0.1	**47,691**
	1-5	0.0	0.0	0.1	-0.1	**44,479**
	6-10	0.0	0.0	0.0	0.0	**1,730**
	11-20	0.0	0.0	0.0	0.0	**1,483**
A2	Zone Total	0.0	0.0	0.0	0.0	**3,954**
	1-5	0.0	0.0	0.0	0.0	**3,954**
B	Zone Total	0.0	-0.5	-1.8	2.3	**32,618**
	1-5	0.0	-1.0	-1.6	2.6	**9,884**
	6-10	0.0	-0.6	-0.8	1.3	**3,707**
	11-20	0.0	-0.8	-1.5	2.3	**3,954**
	21-30	0.0	-0.1	-0.5	0.7	**5,931**
	31-40	0.0	-0.1	-4.6	4.7	**4,695**
	>40	0.0	-0.1	-2.1	2.2	**4,448**
C	Zone Total	0.0	-2.5	-7.5	10.0	**7,660**
	1-5	0.0	-3.5	-9.8	13.3	**5,436**
	6-10	0.0	0.0	-1.7	1.7	**1,483**
	11-20	0.0	0.0	-2.1	2.1	**741**
D	Zone Total	0.0	0.0	-2.6	2.7	**6,346**
	1-5	0.0	-0.1	-1.7	1.8	**5,358**
	6-10	0.0	0.0	-9.4	9.4	**741**
	11-20	0.0	0.0	-2.0	2.0	**247**
E	Zone Total	0.0	-0.1	-0.2	0.2	**16,062**
	1-5	0.0	-0.2	-0.4	0.5	**6,672**
	6-10	0.0	0.0	-0.1	0.1	**2,965**
	11-20	0.0	0.0	0.0	0.0	**2,965**
	21-30	0.0	0.0	0.0	0.0	**494**
	31-40	0.0	0.0	0.0	0.0	**2,224**
	>40	0.0	0.0	0.0	0.0	**741**
F	Zone Total	0.0	0.0	0.0	0.0	**3,212**
	1-5	0.0	0.0	0.0	0.0	**3,212**



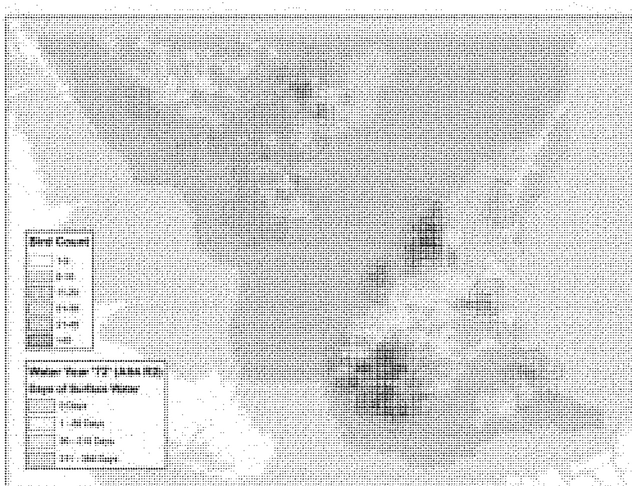
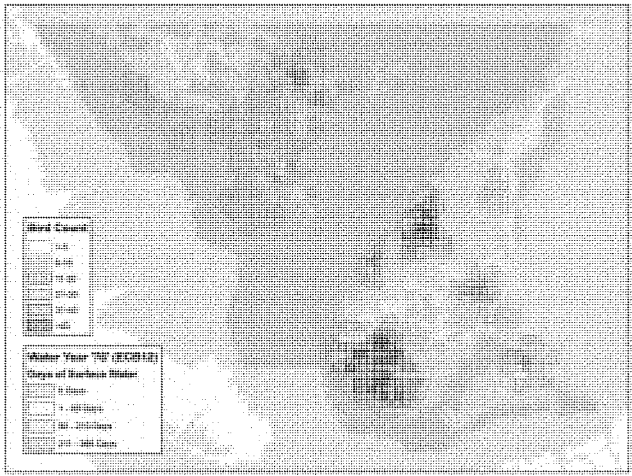


Figure 34. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1972 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1972 (average), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).



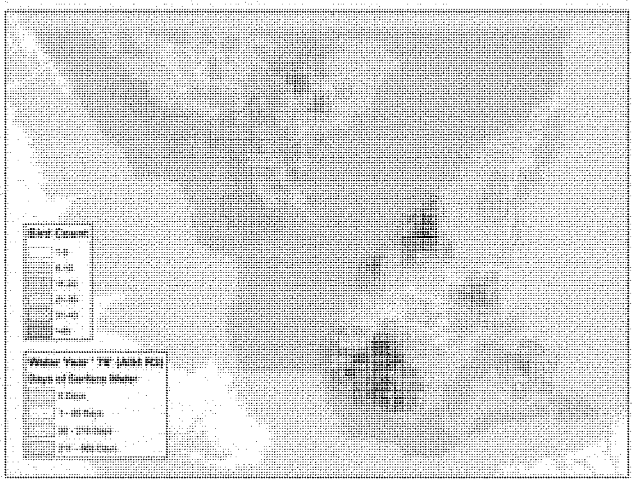
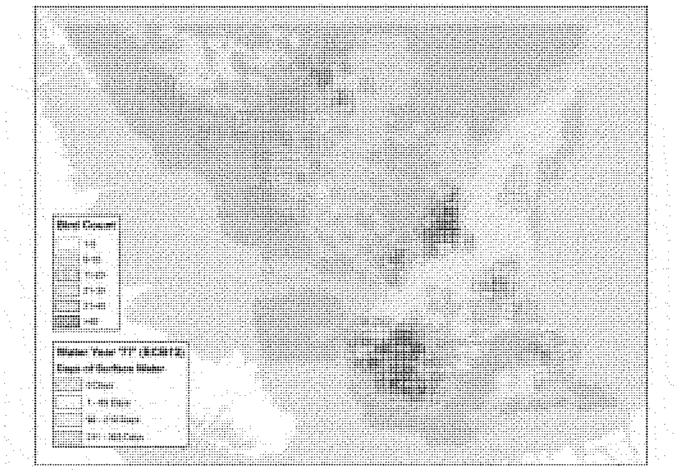


Figure 35. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1976 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1976 (average), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).



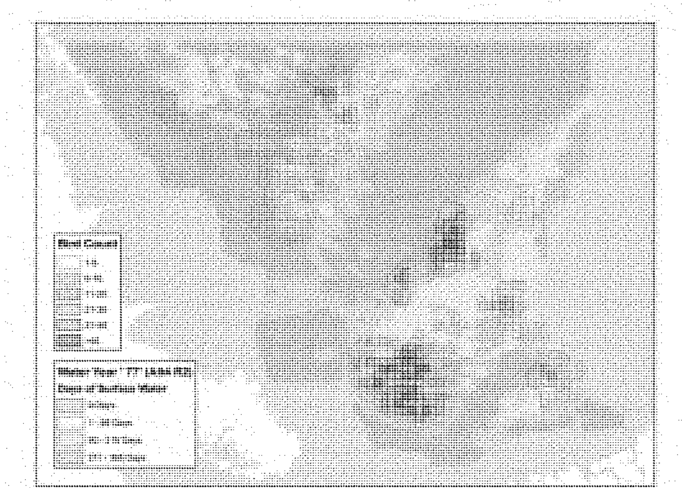


Figure 36. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1977 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1977 (average), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40)

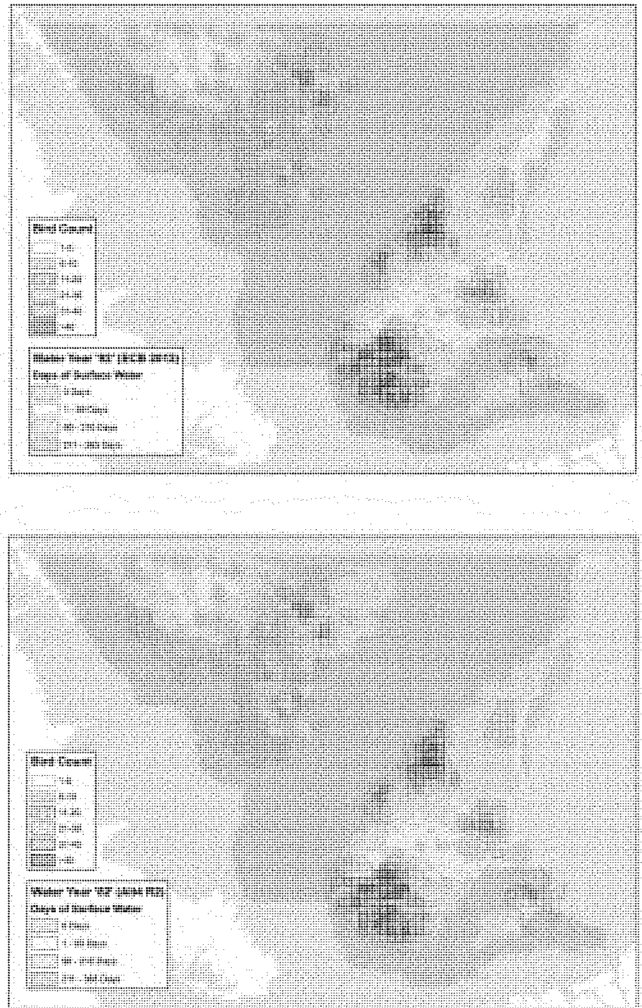


Figure 37. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1982 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1982 (average), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).

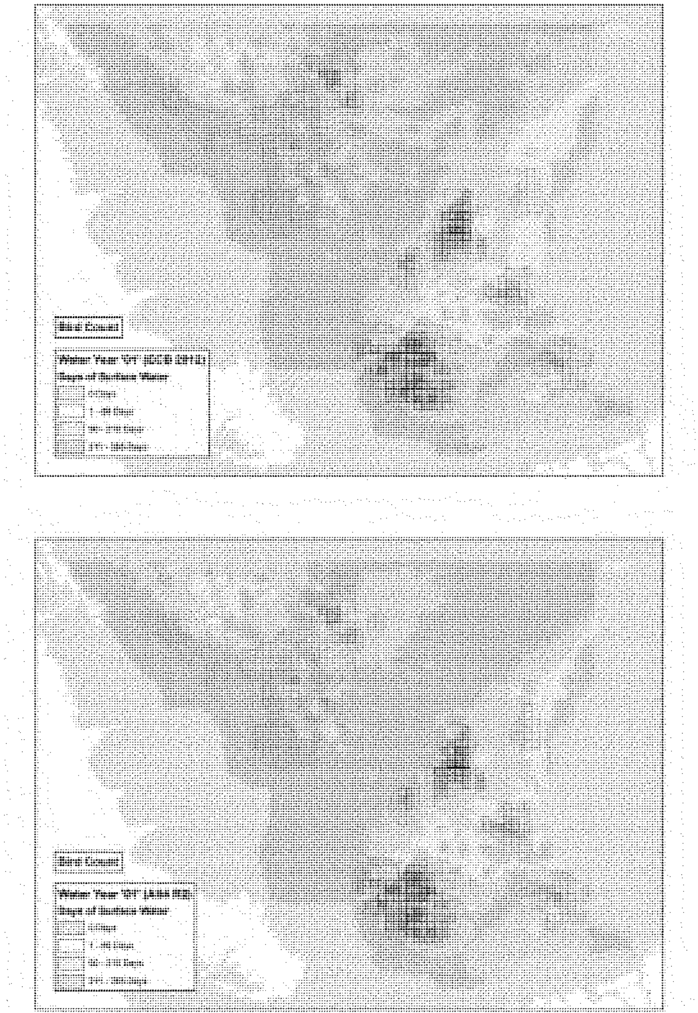
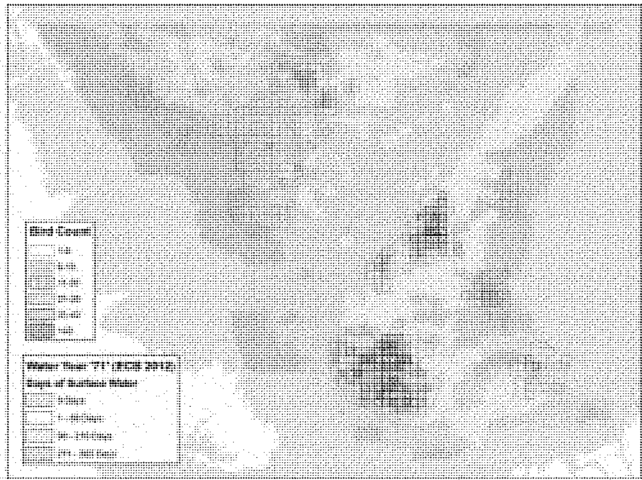


Figure 38. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 2001 (average), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 2001 (average), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).



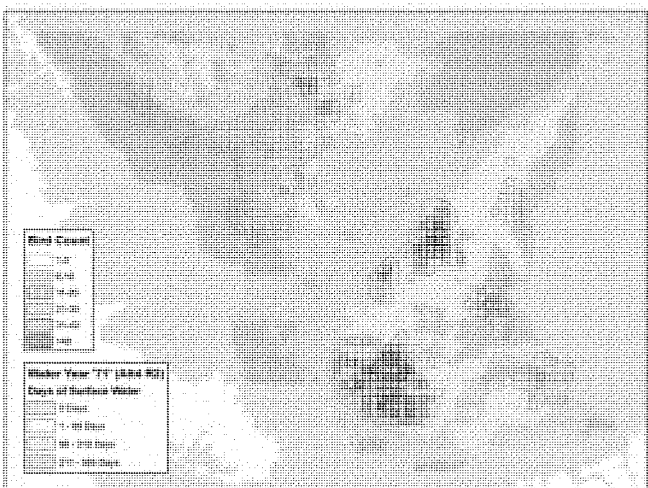


Figure 39. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1971 (dry), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1971 (dry), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).

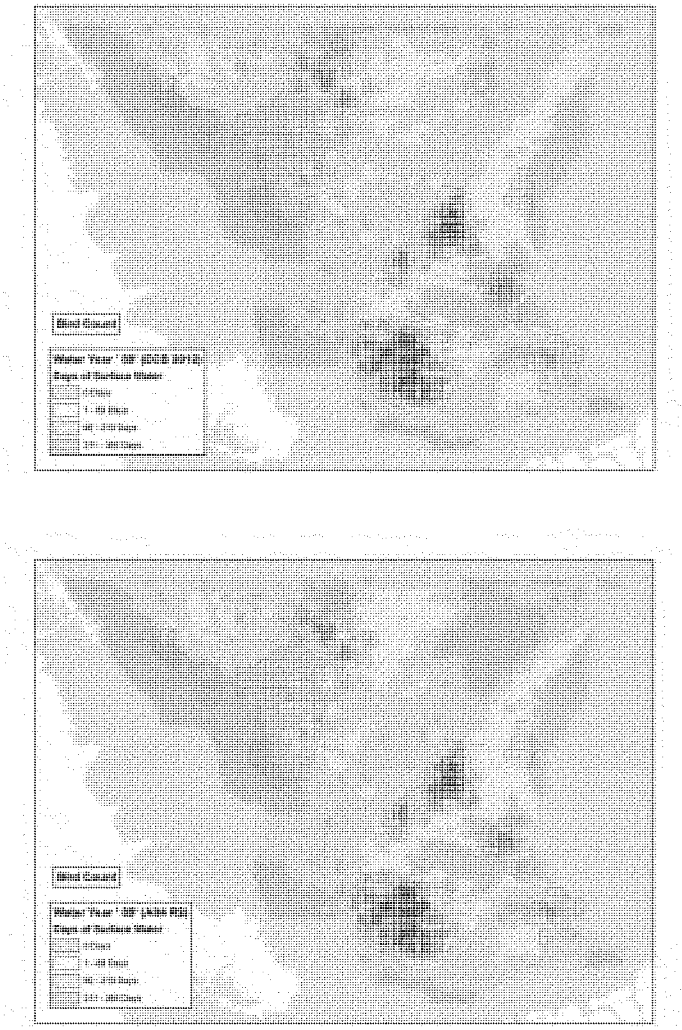
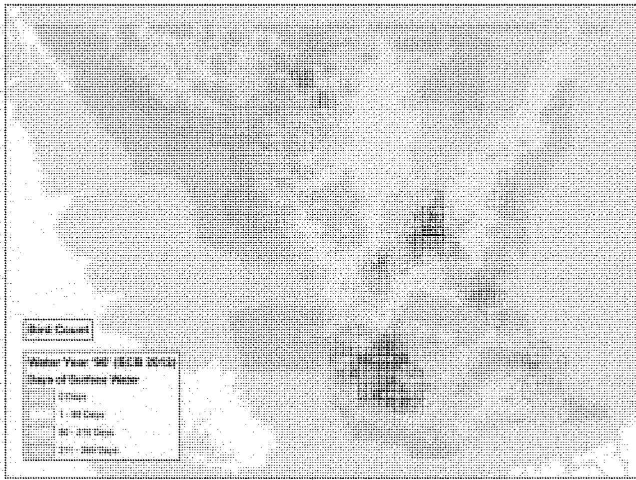


Figure 40. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1989 (dry), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1989 (dry), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40)



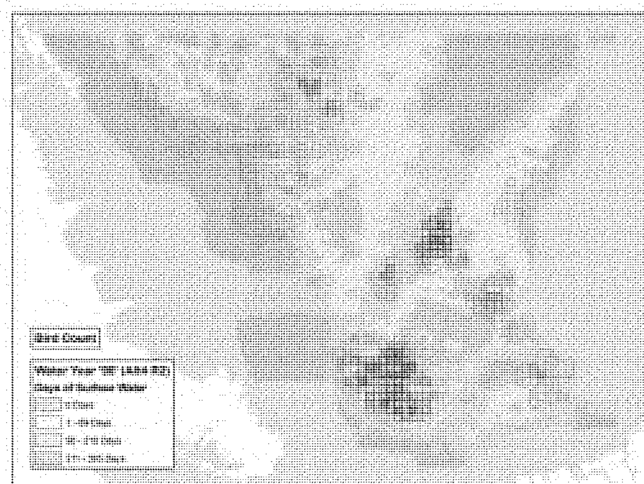


Figure 41. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1990 (dry), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1990 (dry), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).

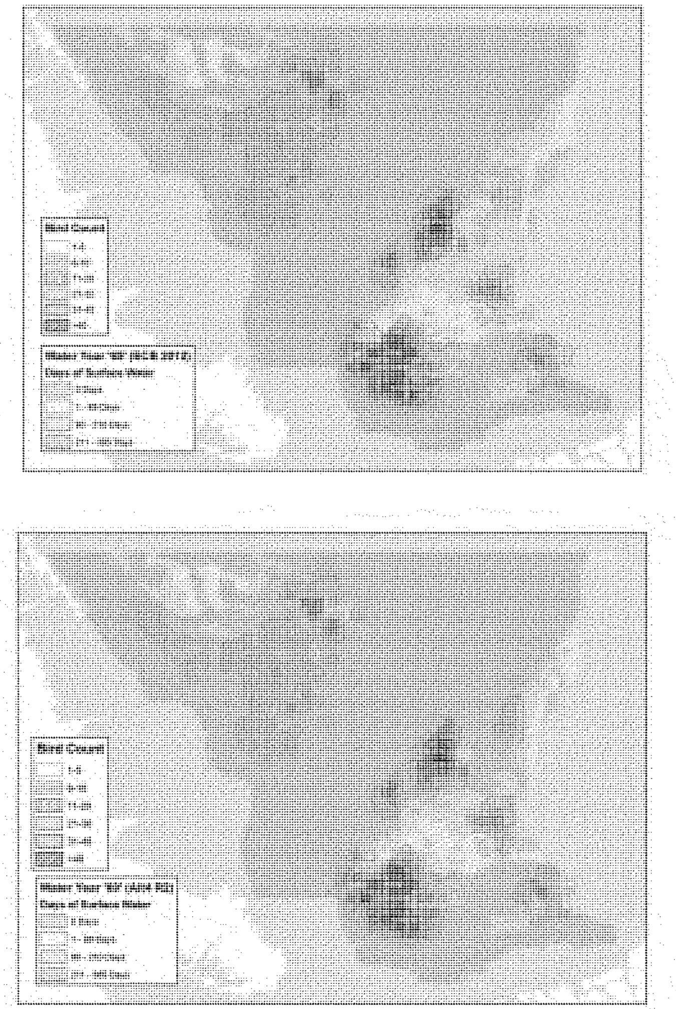


Figure 42. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1969 (wet), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1969 (wet), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).

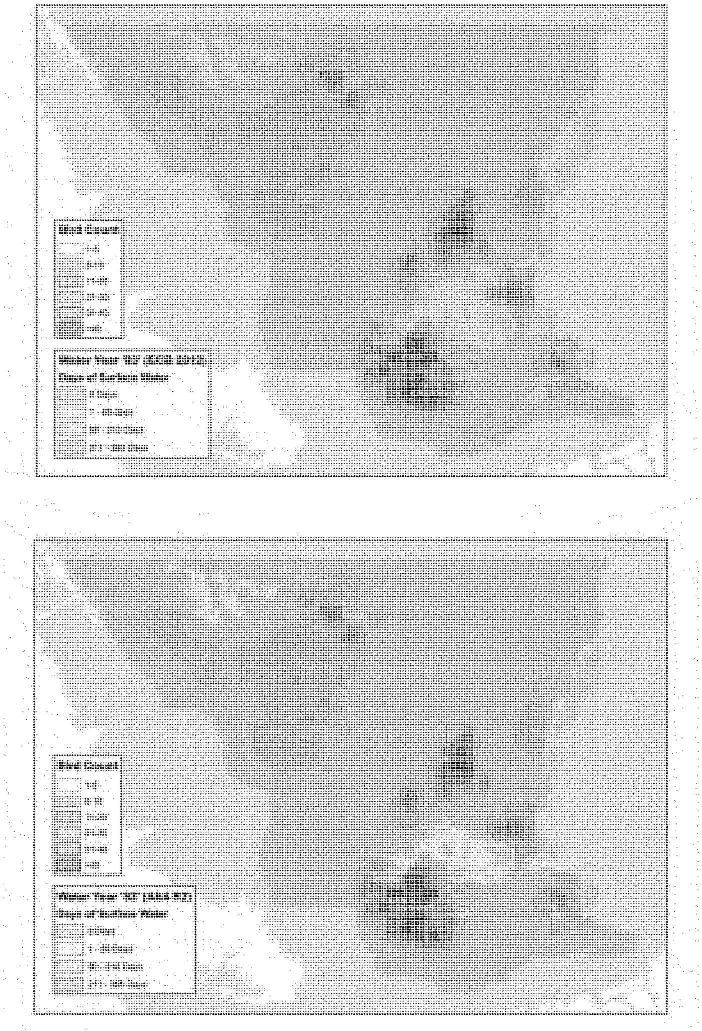


Figure 43. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1983 (wet), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1983 (wet), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40)

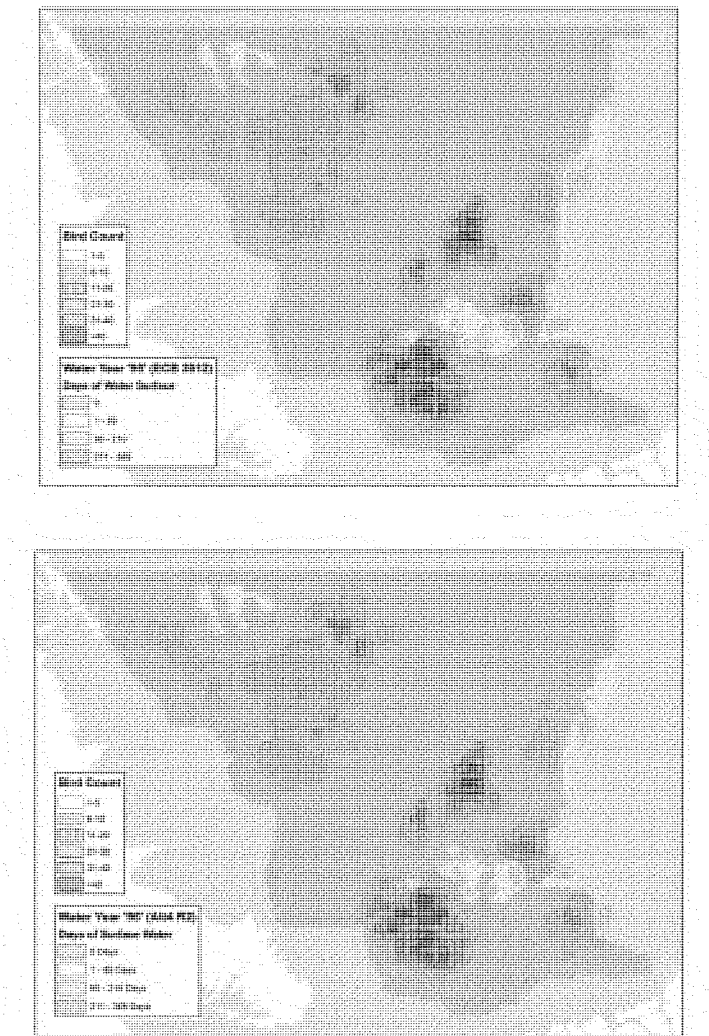


Figure 44. Location of CSSS occurrence in relation to subpopulations and CEPP CSSS area. Shaded areas show discontinuous hydroperiod days (water levels above ground) per year based on RSM output for the existing condition (EC2012) for the modeled year 1995 (wet), (upper figure), and for the with project condition (Alt 4R2) for the modeled year 1995 (wet), (lower figure). Cross-hatched cells show locations of CSSS based on total bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40).

Table 27. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the years 72 and 76 (average) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '72' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			1,772	10,991	34,929	47,691
	1-5		1,701	9,509	33,268	44,479
	6-10			788	941	1,730
	11-20		71	693	719	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B		1,021	7,605	12,475	11,517	32,618
	1-5	662	2,474	2,571	4,177	9,884
	6-10		384	612	2,711	3,707
	11-20		1,357	1,693	903	3,954
	21-30	41	1,112	2,817	1,960	5,931
	31-40	212	1,560	1,897	1,026	4,695
	>40	105	718	2,884	740	4,448
C		56	6,414	1,190		7,660
	1-5	56	4,360	1,020		5,436
	6-10		1,312	170		1,483
	11-20		741			741
D			751	3,416	2,179	6,346
	1-5		524	2,942	1,893	5,358
	6-10		213	370	158	741
	11-20		15	104	128	247
E			941	7,661	7,460	16,062
	1-5		468	1,953	4,251	6,672
	6-10		387	1,553	1,024	2,965
	11-20		17	1,168	1,781	2,965
	21-30			431	63	494
	31-40		68	1,889	267	2,224
	>40			667	74	741
F		23	724	2,465		3,212
	1-5	23	724	2,465		3,212

WATER YEAR '72' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			748	9,595	37,348	47,691
	1-5		748	8,525	35,205	44,479
	6-10			575	1,155	1,730
	11-20			495	988	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B		944	7,550	12,871	11,252	32,618
	1-5	586	2,489	2,831	3,978	9,884
	6-10		384	674	2,649	3,707
	11-20		1,357	1,693	903	3,954
	21-30	41	1,112	2,784	1,994	5,931
	31-40	212	1,511	2,004	968	4,695
	>40	105	697	2,886	759	4,448
C		380	6,010	1,271		7,660
	1-5	380	3,984	1,073		5,436
	6-10		1,284	198		1,483
	11-20		741			741
D			665	4,357	1,325	6,346
	1-5		437	3,838	1,083	5,358
	6-10		213	392	137	741
	11-20		15	127	106	247
E			864	10,506	4,692	16,062
	1-5		392	2,948	3,332	6,672
	6-10		387	1,993	584	2,965
	11-20		17	2,173	776	2,965
	21-30			494		494
	31-40		68	2,155		2,224
	>40			741		741
F			1,361	1,851		3,212
	1-5		1,361	1,851		3,212

WATER YEAR '76' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			578	19,618	27,495	47,691
	1-5		578	17,145	26,756	44,479
	6-10			1,265	464	1,730
	11-20			1,207	275	1,483
A2				14	3,940	3,954
	1-5			14	3,940	3,954
B		444	6,260	23,483	2,431	32,618
	1-5	444	2,031	5,940	1,470	9,884
	6-10		258	2,633	816	3,707
	11-20		1,085	2,810	59	3,954
	21-30		795	5,096	39	5,931
	31-40		1,514	3,134	47	4,695
	>40		577	3,871		4,448
C		91	1,503	6,066		7,660
	1-5	91	1,423	3,923		5,436
	6-10		54	1,429		1,483
	11-20		27	715		741
D			212	5,811	323	6,346
	1-5		199	4,836	323	5,358
	6-10		13	728		741
	11-20			247		247
E			53	12,607	3,401	16,062
	1-5		53	4,147	2,472	6,672
	6-10			2,740	225	2,965
	11-20			2,262	704	2,965
	21-30			494		494
	31-40			2,224		2,224
	>40			741		741
F		13	234	2,965		3,212
	1-5	13	234	2,965		3,212

WATER YEAR '76' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 366 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			63	11,443	36,185	47,691
	1-5		63	9,773	34,642	44,479
	6-10			639	1,091	1,730
	11-20			1,030	452	1,483
A2				14	3,940	3,954
	1-5			14	3,940	3,954
B		444	6,334	23,315	2,525	32,618
	1-5	444	2,122	5,755	1,564	9,884
	6-10		302	2,588	816	3,707
	11-20		1,059	2,836	59	3,954
	21-30		774	5,118	39	5,931
	31-40		1,508	3,140	47	4,695
	>40		569	3,879		4,448
C		248	1,256	6,156		7,660
	1-5	248	1,236	3,953		5,436
	6-10		21	1,462		1,483
	11-20			741		741
D			266	5,757	323	6,346
	1-5		251	4,783	323	5,358
	6-10		15	727		741
	11-20			247		247
E			53	13,943	2,066	16,062
	1-5		53	4,888	1,731	6,672
	6-10			2,951	15	2,965
	11-20			2,645	320	2,965
	21-30			494		494
	31-40			2,224		2,224
	>40			741		741
F			415	2,797		3,212
	1-5		415	2,797		3,212

Table 28. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the years 77 and 82 (average) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '77' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1		240	8,250	19,972	19,229	47,691
	1-5	240	6,906	18,601	18,732	44,479
	6-10		428	1,033	269	1,730
	11-20		917	339	227	1,483
A2				31	3,922	3,954
	1-5			31	3,922	3,954
B		869	18,339	13,005	405	32,618
	1-5	758	4,174	4,548	405	9,884
	6-10	87	781	2,838		3,707
	11-20	17	2,646	1,290		3,954
	21-30	7	3,623	2,301		5,931
	31-40		3,492	1,203		4,695
	>40		3,623	825		4,448
C		167	7,442	51		7,660
	1-5	167	5,218	51		5,436
	6-10		1,483			1,483
	11-20		741			741
D			1,255	4,489	602	6,346
	1-5		1,001	3,829	528	5,358
	6-10		240	427	74	741
	11-20		15	233		247
E			1,880	10,446	3,736	16,062
	1-5		1,080	3,501	2,092	6,672
	6-10		522	2,080	363	2,965
	11-20		60	1,886	1,019	2,965
	21-30			494		494
	31-40		218	1,780	225	2,224
	>40			704	37	741
F		23	2,884	305		3,212
	1-5	23	2,884	305		3,212

WATER YEAR '77' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1		51	2,936	23,669	21,035	47,691
	1-5	51	2,667	21,333	20,428	44,479
	6-10		5	1,393	332	1,730
	11-20		265	943	275	1,483
A2				14	3,940	3,954
	1-5			14	3,940	3,954
B		869	18,401	12,943	405	32,618
	1-5	758	4,174	4,548	405	9,884
	6-10	87	812	2,807		3,707
	11-20	17	2,646	1,290		3,954
	21-30	7	3,654	2,270		5,931
	31-40		3,492	1,203		4,695
	>40		3,623	825		4,448
C		535	7,125			7,660
	1-5	535	4,901			5,436
	6-10		1,483			1,483
	11-20		741			741
D			1,915	3,891	540	6,346
	1-5		1,569	3,323	466	5,358
	6-10		328	339	74	741
	11-20		18	229		247
E			5,370	8,218	2,474	16,062
	1-5		1,960	3,190	1,521	6,672
	6-10		1,165	1,528	273	2,965
	11-20		634	1,652	680	2,965
	21-30		239	255		494
	31-40		1,185	1,039		2,224
	>40		187	554		741
F		10	3,202			3,212
	1-5	10	3,202			3,212

WATER YEAR '82' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1				17,480	30,211	47,691
	1-5			15,429	29,050	44,479
	6-10			796	934	1,730
	11-20			1,255	227	1,483
A2				14	3,940	3,954
	1-5			14	3,940	3,954
B			5,360	23,970	3,288	32,618
	1-5		2,028	5,898	1,959	9,884
	6-10		160	2,633	914	3,707
	11-20		860	2,991	103	3,954
	21-30		557	5,176	197	5,931
	31-40		1,209	3,371	115	4,695
	>40		547	3,901		4,448
C		48	1,598	6,014		7,660
	1-5	48	1,489	3,900		5,436
	6-10		83	1,400		1,483
	11-20		27	715		741
D			389	2,522	3,435	6,346
	1-5		327	2,075	2,955	5,358
	6-10		61	328	352	741
	11-20			119	128	247
E			34	8,927	7,101	16,062
	1-5		34	2,902	3,736	6,672
	6-10			2,046	920	2,965
	11-20			1,108	1,857	2,965
	21-30			308	186	494
	31-40			1,969	255	2,224
	>40			594	148	741
F			41	3,159	12	3,212
	1-5		41	3,159	12	3,212

WATER YEAR '82' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1				7964	39728	47691
	1-5			6983	37495	44479
	6-10			368	1362	1730
	11-20			612	870	1483
A2				14	3940	3954
	1-5			14	3940	3954
B			5422	22540	4655	32618
	1-5		2028	5394	2462	9884
	6-10		160	2271	1276	3707
	11-20		860	2718	376	3954
	21-30		557	4967	407	5931
	31-40		1270	3296	129	4695
	>40		547	3895	5	4448
C		350	1543	5766		7660
	1-5	350	1368	3717		5436
	6-10		106	1377		1483
	11-20		69	672		741
D			336	4376	1635	6346
	1-5		275	3843	1240	5358
	6-10		61	391	289	741
	11-20			141	106	247
E			342	10152	5568	16062
	1-5		209	2818	3645	6672
	6-10		133	2172	660	2965
	11-20			1769	1196	2965
	21-30			431	63	494
	31-40			2220	4	2224
	>40			741		741
F			147	3065		3212
	1-5		147	3065		3212

Table 29. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the year 01 (average) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '01' (ALT4 R2)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			1,365	23,506	22,821	47,691
	1-5		1,364	21,038	22,077	**44,479**
	6-10		1	1,084	645	**1,730**
	11-20			1,384	99	**1,483**
A2				145	3,808	3,954
	1-5			145	3,808	**3,954**
B		334	5,148	25,208	1,927	32,618
	1-5	334	1,580	6,827	1,143	**9,884**
	6-10		302	2,693	711	**3,707**
	11-20		858	3,074	21	**3,954**
	21-30		576	5,302	52	**5,931**
	31-40		1,298	3,397		**4,695**
	>40		533	3,915		**4,448**
C		48	3,241	4,372		7,660
	1-5	48	2,621	2,767		**5,436**
	6-10		392	1,090		**1,483**
	11-20		227	514		**741**
D			751	5,272	323	6,346
	1-5		524	4,511	323	**5,358**
	6-10		213	528		**741**
	11-20		15	233		**247**
E			293	15,507	262	16,062
	1-5		156	6,254	262	**6,672**
	6-10		75	2,890		**2,965**
	11-20		17	2,949		**2,965**
	21-30			494		**494**
	31-40		46	2,178		**2,224**
	>40			741		**741**
F			1,567	1,645		3,212
	1-5		1,567	1,645		**3,212**

WATER YEAR '01' (ECB12)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			597	18,706	28,388	47,691
	1-5		597	16,645	27,237	44,479
	6-10			916	814	1,730
	11-20			1,145	337	1,483
A2				207	3,746	3,954
	1-5			207	3,746	3,954
B		334	5,417	25,186	1,681	32,618
	1-5	334	1,812	6,744	994	9,884
	6-10		319	2,753	635	3,707
	11-20		879	3,075		3,954
	21-30		576	5,302	52	5,931
	31-40		1,298	3,397		4,695
	>40		533	3,915		4,448
C		114	5,917	1,628		7,660
	1-5	114	4,263	1,059		5,436
	6-10		1,212	271		1,483
	11-20		442	299		741
D			993	4,967	386	6,346
	1-5		766	4,207	386	5,358
	6-10		213	528		741
	11-20		15	233		247
E			918	15,144		16,062
	1-5		436	6,236		6,672
	6-10		344	2,621		2,965
	11-20		66	2,899		2,965
	21-30		3	491		494
	31-40		68	2,155		2,224
	>40			741		741
F			2,764	449		3,212
	1-5		2,764	449		3,212

Table 30. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the years 71 and 89 (dry) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '71' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			6,767	35,477	5,447	47,691
	1-5		5,732	33,299	5,447	44,479
	6-10		256	1,474		1,730
	11-20		778	704		1,483
A2				360	3,593	3,954
	1-5			360	3,593	3,954
B		1,326	27,838	3,454		32,618
	1-5	620	7,353	1,911		9,884
	6-10		2,562	1,145		3,707
	11-20	229	3,548	177		3,954
	21-30	101	5,718	111		5,931
	31-40	348	4,238	109		4,695
	>40	28	4,420			4,448
C		4,355	3,305			7,660
	1-5	3,209	2,227			5,436
	6-10	858	625			1,483
	11-20	289	453			741
D		204	3,809	2,333		6,346
	1-5	199	3,090	2,069		5,358
	6-10	5	601	136		741
	11-20		119	128		247
E		105	12,144	3,812		16,062
	1-5	44	3,957	2,671		6,672
	6-10	62	2,481	423		2,965
	11-20		2,247	718		2,965
	21-30		494			494
	31-40		2,224			2,224
	>40		741			741
F		627	2,585			3,212
	1-5	627	2,585			3,212

WATER YEAR '71' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			4,762	36,444	6,485	47,691
	1-5		4,169	33,874	6,436	44,479
	6-10		86	1,643	1	1,730
	11-20		507	927	48	1,483
A2				302	3,652	3,954
	1-5			302	3,652	3,954
B		1,328	27,837	3,454		32,618
	1-5	684	7,289	1,911		9,884
	6-10		2,562	1,145		3,707
	11-20	195	3,581	177		3,954
	21-30	72	5,747	111		5,931
	31-40	348	4,238	109		4,695
	>40	28	4,420			4,448
C		5,920	1,740			7,660
	1-5	4,310	1,126			5,436
	6-10	1,168	315			1,483
	11-20	442	299			741
D		274	4,742	1,299	31	6,346
	1-5	251	4,019	1,056	31	5,358
	6-10	23	582	137		741
	11-20		141	106		247
E		105	13,508	2,448		16,062
	1-5	44	4,738	1,890		6,672
	6-10	62	2,806	97		2,965
	11-20		2,505	460		2,965
	21-30		494			494
	31-40		2,224			2,224
	>40		741			741
F		2,881	331			3,212
	1-5	2,881	331			3,212

WATER YEAR '89' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1		249	5,298	35,399	6,746	47,691
	1-5	249	4,947	32,639	6,644	44,479
	6-10		86	1,639	5	1,730
	11-20		265	1,120	98	1,483
A2				463	3,491	3,954
	1-5			463	3,491	3,954
B		8,004	20,278	4,335		32,618
	1-5	1,815	5,924	2,145		9,884
	6-10	328	1,948	1,430		3,707
	11-20	1,350	2,136	468		3,954
	21-30	1,178	4,466	287		5,931
	31-40	2,048	2,647			4,695
	>40	1,286	3,156	5		4,448
C		3,989	3,672			7,660
	1-5	2,929	2,507			5,436
	6-10	672	811			1,483
	11-20	388	354			741
D		62	3,035	3,249		6,346
	1-5	62	2,527	2,769		5,358
	6-10		390	352		741
	11-20		119	128		247
E		527	8,214	7,321		16,062
	1-5	308	2,925	3,439		6,672
	6-10	157	1,849	960		2,965
	11-20	17	1,340	1,609		2,965
	21-30		282	212		494
	31-40	46	1,397	781		2,224
	>40		421	321		741
F		432	2,780			3,212
	1-5	432	2,780			3,212

WATER YEAR '89' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1			3,802	36,600	7,288	47,691
	1-5		3,539	33,753	7,186	44,479
	6-10		74	1,652	5	1,730
	11-20		189	1,196	98	1,483
A2				444	3,510	3,954
	1-5			444	3,510	3,954
B		7,942	20,513	4,163		32,618
	1-5	1,753	6,049	2,082		9,884
	6-10	328	2,058	1,321		3,707
	11-20	1,350	2,136	468		3,954
	21-30	1,178	4,466	287		5,931
	31-40	2,048	2,647			4,695
	>40	1,286	3,156	5		4,448
C		5,832	1,829			7,660
	1-5	4,176	1,260			5,436
	6-10	969	514			1,483
	11-20	686	55			741
D		195	3,234	2,886	31	6,346
	1-5	195	2,725	2,406	31	5,358
	6-10		390	352		741
	11-20		119	128		247
E		1,239	8,345	6,478		16,062
	1-5	693	2,611	3,367		6,672
	6-10	446	1,642	877		2,965
	11-20	17	1,378	1,571		2,965
	21-30		308	186		494
	31-40	83	1,813	328		2,224
	>40		594	148		741
F		541	2,672			3,212
	1-5	541	2,672			3,212

Table 31. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the year 90 (dry) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '90' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1		647	5,466	28,003	13,575	47,691
	1-5	646	5,125	25,232	13,476	44,479
	6-10	1	89	1,638	2	1,730
	11-20		252	1,133	98	1,483
A2				365	3,589	3,954
	1-5			365	3,589	3,954
B		1,950	21,651	9,017		32,618
	1-5	902	4,707	4,274		9,884
	6-10	87	1,433	2,186		3,707
	11-20	212	3,437	305		3,954
	21-30	131	4,794	1,006		5,931
	31-40	512	3,920	264		4,695
	>40	105	3,360	982		4,448
C		3,748	3,913			7,660
	1-5	2,942	2,494			5,436
	6-10	585	898			1,483
	11-20	220	521			741
D		133	1,752	4,430	31	6,346
	1-5	128	1,412	3,788	31	5,358
	6-10	5	323	413		741
	11-20		18	229		247
E		791	8,084	7,187		16,062
	1-5	341	2,457	3,874		6,672
	6-10	412	1,447	1,106		2,965
	11-20	17	1,426	1,523		2,965
	21-30		344	150		494
	31-40	22	1,816	386		2,224
	>40		594	148		741
F		524	2,688			3,212
	1-5	524	2,688			3,212

WATER YEAR '90' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1		637	4,465	25,541	17,048	47,691
	1-5	636	4,305	22,988	16,550	44,479
	6-10	1	77	1,431	221	1,730
	11-20		82	1,123	277	1,483
A2				365	3,589	3,954
	1-5			365	3,589	3,954
B		1,888	21,713	9,017		32,618
	1-5	902	4,707	4,274		9,884
	6-10	87	1,433	2,186		3,707
	11-20	212	3,437	305		3,954
	21-30	131	4,794	1,006		5,931
	31-40	450	3,981	264		4,695
	>40	105	3,360	982		4,448
C		5,394	2,266			7,660
	1-5	3,876	1,561			5,436
	6-10	840	643			1,483
	11-20	679	62			741
D		195	1,878	4,070	203	6,346
	1-5	195	1,492	3,467	203	5,358
	6-10		367	374		741
	11-20		18	229		247
E		1,117	8,125	6,819		16,062
	1-5	595	2,292	3,784		6,672
	6-10	422	1,535	1,008		2,965
	11-20	17	1,450	1,498		2,965
	21-30		437	57		494
	31-40	83	1,817	324		2,224
	>40		594	148		741
F		1,544	1,668			3,212
	1-5	1,544	1,668			3,212

Table 32. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the years 69 and 83 (wet) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '69' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1				1,408	46,283	47,691
	1-5			1,408	43,071	44,479
	6-10				1,730	1,730
	11-20				1,483	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B			1,708	13,954	16,956	32,618
	1-5		795	3,652	5,437	9,884
	6-10			510	3,197	3,707
	11-20		181	2,239	1,534	3,954
	21-30		187	2,658	3,086	5,931
	31-40		285	2,476	1,933	4,695
	>40		261	2,419	1,769	4,448
C			350	7,310		7,660
	1-5		350	5,086		5,436
	6-10			1,483		1,483
	11-20			741		741
D			9	1,842	4,496	6,346
	1-5		9	1,496	3,853	5,358
	6-10			328	413	741
	11-20			18	229	247
E				2,861	13,201	16,062
	1-5			1,222	5,450	6,672
	6-10			896	2,070	2,965
	11-20			175	2,790	2,965
	21-30				494	494
	31-40			552	1,672	2,224
	>40			17	725	741
F			38	2,923	251	3,212
	1-5		38	2,923	251	3,212

WATER YEAR '69' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1				1,408	46,283	47,691
	1-5			1,408	43,071	44,479
	6-10				1,730	1,730
	11-20				1,483	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B			1,708	13,954	16,956	32,618
	1-5		795	3,652	5,437	9,884
	6-10			510	3,197	3,707
	11-20		181	2,239	1,534	3,954
	21-30		187	2,658	3,086	5,931
	31-40		285	2,476	1,933	4,695
	>40		261	2,419	1,769	4,448
C			350	7,310		7,660
	1-5		350	5,086		5,436
	6-10			1,483		1,483
	11-20			741		741
D			9	1,842	4,496	6,346
	1-5		9	1,496	3,853	5,358
	6-10			328	413	741
	11-20			18	229	247
E				2,861	13,201	16,062
	1-5			1,222	5,450	6,672
	6-10			896	2,070	2,965
	11-20			175	2,790	2,965
	21-30				494	494
	31-40			552	1,672	2,224
	>40			17	725	741
F			38	2,923	251	3,212
	1-5		38	2,923	251	3,212

WATER YEAR '83' (ALT4 R2)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1				767	46,925	47,691
	1-5			767	43,712	44,479
	6-10				1,730	1,730
	11-20				1,483	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B		231	3,259	5,062	24,066	32,618
	1-5	231	828	1,386	7,439	9,884
	6-10		98	149	3,459	3,707
	11-20		466	1,189	2,299	3,954
	21-30		367	1,081	4,483	5,931
	31-40		1,061	667	2,968	4,695
	>40		439	590	3,419	4,448
C			156	160	7,344	7,660
	1-5		156	160	5,120	5,436
	6-10				1,483	1,483
	11-20				741	741
D			9	238	6,099	6,346
	1-5		9	233	5,116	5,358
	6-10			5	736	741
	11-20				247	247
E					16,062	16,062
	1-5				6,672	6,672
	6-10				2,965	2,965
	11-20				2,965	2,965
	21-30				494	494
	31-40				2,224	2,224
	>40				741	741
F				41	3,171	3,212
	1-5			41	3,171	3,212

WATER YEAR '83' (ECB12)

		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1				612	47,079	47,691
	1-5			612	43,867	44,479
	6-10				1,730	1,730
	11-20				1,483	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B		231	3,571	5,412	23,403	32,618
	1-5	231	967	1,479	7,208	9,884
	6-10		160	146	3,401	3,707
	11-20		521	1,264	2,169	3,954
	21-30		389	1,093	4,449	5,931
	31-40		1,079	738	2,878	4,695
	>40		456	694	3,298	4,448
C			535	1,765	5,360	7,660
	1-5		535	1,642	3,259	5,436
	6-10			77	1,405	1,483
	11-20			47	695	741
D			18	723	5,605	6,346
	1-5		18	496	4,844	5,358
	6-10			213	528	741
	11-20			15	233	247
E			34	87	15,941	16,062
	1-5		34	73	6,565	6,672
	6-10			13	2,952	2,965
	11-20				2,965	2,965
	21-30				494	494
	31-40				2,224	2,224
	>40				741	741
F				41	3,171	3,212
	1-5			41	3,171	3,212

Table 33. CEPP Alt 4R2 and EC2012 analyzed for occupied habitat within or in the vicinity of each subpopulation/critical HU. RSM discontinuous hydroperiod occurrence for the year 95 (wet) separated by hydroperiod ranges (0, 1-89, 90-210, 211-365 days) and total CSSS bird count (1981 through 2012) ranges (1-5, -10, 11-20, 21-30, 31-40, and >40). Figures are number of acres occurring under either the EC2012 or Alt 4R2 condition.

WATER YEAR '95' (ALT4 R2)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1					47,691	47,691
	1-5				44,479	44,479
	6-10				1,730	1,730
	11-20				1,483	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B			116	1,815	30,687	32,618
	1-5		116	488	9,281	9,884
	6-10			98	3,609	3,707
	11-20			517	3,436	3,954
	21-30			303	5,628	5,931
	31-40			141	4,554	4,695
	>40			268	4,180	4,448
C			28	19	7,612	7,660
	1-5		28	19	5,389	5,436
	6-10				1,483	1,483
	11-20				741	741
D					6,346	6,346
	1-5				5,358	5,358
	6-10				741	741
	11-20				247	247
E					16,062	16,062
	1-5				6,672	6,672
	6-10				2,965	2,965
	11-20				2,965	2,965
	21-30				494	494
	31-40				2,224	2,224
	>40				741	741
F					3,212	3,212
	1-5				3,212	3,212

WATER YEAR '95' (ECB12)						
		RANGE				
		0 DAYS	1 - 89 DAYS	90 - 210 DAYS	211 - 365 DAYS	
ZONE	BIRD COUNT	ACRES	ACRES	ACRES	ACRES	TOTAL ACRES
A1					47,691	47,691
	1-5				44,479	44,479
	6-10				1,730	1,730
	11-20				1,483	1,483
A2					3,954	3,954
	1-5				3,954	3,954
B			310	3,225	29,083	32,618
	1-5		266	874	8,745	9,884
	6-10			185	3,521	3,707
	11-20		45	617	3,292	3,954
	21-30			386	5,544	5,931
	31-40			714	3,981	4,695
	>40			448	4,000	4,448
C			213	138	7,310	7,660
	1-5		213	138	5,086	5,436
	6-10				1,483	1,483
	11-20				741	741
D				18	6,328	6,346
	1-5			18	5,340	5,358
	6-10				741	741
	11-20				247	247
E					16,062	16,062
	1-5				6,672	6,672
	6-10				2,965	2,965
	11-20				2,965	2,965
	21-30				494	494
	31-40				2,224	2,224
	>40				741	741
F					3,212	3,212
	1-5				3,212	3,212

A.7 Endangered Species Act Correspondence

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

28 JAN 2013

Mr. Larry Williams, Field Supervisor
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, FL 32960

Dear Mr. Williams,

The U.S. Army Corps of Engineers (Corps), Jacksonville District, is preparing a National Environmental Policy Act assessment for the 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, including Water Conservation Area 3 and Everglades National Park.

The CEPP is located in South Florida and includes portions of several counties as well as 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 (specifically focused on Florida Bay), and portions of the Lower East Coast (Figure 1). The CEPP will be composed of increments of project components that were identified in the Comprehensive Everglades Restoration Plan (CERP). The term "increment" is used to underscore that this study will formulate an initial portion of individual CERP components. The scope of CEPP will include increments of the following components that were part of CERP:

- Everglades Agricultural Storage Reservoirs
- Flow to Northwest and Central Water Conservation Area 3A
- Water Conservation Area 3 Decompartmentalization and Sheetflow Enhancement
- Dade-Broward Levee/Pennsuco Wetlands
- Bird Drive Recharge Area
- L-31N Improvements for Seepage Management and S-356 Structures
- Everglades Rain-Driven Operations

The CEPP will include a draft preliminary operations manual for new features identified in the tentatively selected plan.

Pursuant to the Endangered Species Act, as amended, the Corps is requesting confirmation of species or their critical habitat either listed or proposed for listing that may be present within the referenced project area. The Corps has tentatively determined that the following list of threatened and endangered species may be present within the project area as illustrated in Table 1.

Table 1. List of federally Threatened and Endangered Species within the CEPP project area (E: Endangered, T: Threatened, SC: Species of Special Concern, SA: Similarity of Appearance, CH: Critical Habitat)

Common Name	Scientific Name	Status	Agency
Mammals			
Florida panther	*Puma concolor coryi*	E	Federal
Florida manatee	*Trichechus manatus*	E, CH	Federal
Big Cypress fox squirrel	*Sciurus niger avicennia*	T	State
Florida black bear	*Ursus americanus floridanus*	T	State
Everglades mink	*Mustela vison evergladensis*	T	State
Florida mouse	*Podomys floridanus*	SC	State
Florida mastiff bat	*Eumops glaucinus floridanus*	E	State
Shermann's fox squirrel	*Sciurus niger shermani*	SC	State
Blue whale*	*Balaenoptera musculus*	E	Federal
Finback whale*	*Balaenoptera physalus*	E	Federal
Humpback whale*	*Megaptera novaeangliae*	E	Federal
Sei whale*	*Balaenoptera borealis*	E	Federal
Sperm whale*	*Physeter macrocephalus*	E	Federal
Birds			
Cape Sable seaside sparrow	*Ammodramus maritimus mirabilis*	E, CH	Federal
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	E, CH	Federal
Northern crested caracara	*Caracara cheriway*	T	Federal
Piping plover	*Charadrius melodus*	T	Federal
Red-cockaded woodpecker	*Picoides borealis*	E	Federal
Roseate tern	*Sterna dougallii dougallii*	T	Federal
Wood stork	*Mycteria americana*	E	Federal
American oystercatcher	*Haematopus palliatus*	SC	State
Black skimmer	*Rynchops niger*	SC	State
Brown pelican	*Pelecanus occidentalis*	SC	State
Burrowing owl	*Athene cunicularia*	SC	State
Florida sandhill crane	*Grus canadensis pratensis*	T	State
Least tern	*Sterna antillarum*	T	State
Limpkin	*Aramus guarauna*	SC	State
Little blue heron	*Egretta caerulea*	SC	State
Reddish egret	*Egretta rufescens*	SC	State
Roseate spoonbill	*Ajaja ajaja*	SC	State
Snowy egret	*Egretta thula*	SC	State
Snowy plover	*Charadrius alexandrinus*	T	State
Tricolored heron	*Egretta tricolor*	SC	State
White-crowned pigeon	*Columba leucocephalus*	T	State
White ibis	*Eudocimus albus*	SC	State
Reptiles			
American alligator	*Alligator mississippiensis*	T/SA	Federal

Common Name	Scientific Name	Status	Agency
American crocodile	*Crocodylus acutus*	T, CH	Federal
Eastern indigo snake	*Drymarchon corais couperi*	T	Federal
Green sea turtle*	*Chelonia mydas*	E, CH**	Federal
Hawksbill sea turtle*	*Eretmochelys imbricata*	E, CH**	Federal
Kemp's Ridley sea turtle*	*Lepidochelys kempii*	E	Federal
Leatherback sea turtle*	*Dermochelys coriacea*	E, CH**	Federal
Loggerhead sea turtle*	*Caretta caretta*	T	Federal
Gopher tortoise	*Gopherus polyphemus*	SC	State
Miami black-headed snake	*Tantilla oolitica*	T	State
Fish			
Gulf sturgeon*	*Acipenser oxyrinchus desotoi*	T, CH**	Federal
Smalltooth sawfish*	*Pristia pectinata*	E, CH	Federal
Mangrove rivulus	*Rivulus marmoratus*	SC	State
Invertebrates			
Elkhorn coral*	*Acropora palmata*	T, CH	Federal
Staghorn coral*	*Acropora cervicornis*	T, CH	Federal
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	E	Federal
Stock Island tree snail	*Orthalicus reses* (not incl. *nesodryas*)	T	Federal
Florida tree snail	*Liguus fasciatus*	SC	State
Miami blue butterfly	*Cyclargus [=Hermiargus] thomasi bethunebakeri*	E	Federal
Plants			
Crenulate lead plant	*Amorpha crenulata*	E	Federal
Deltoid spurge	*Chamaesyce deltoidea* spp. *deltoidea*	E	Federal
Garber's spurge	*Chamaesyce garberi*	T	Federal
Johnson's seagrass*	*Halophila johnsonii*	E, CH	Federal
Okeechobee gourd	*Cucurbita okeechobeensis* ssp. *okeechobeenis*	E	Federal
Small's milkpea	*Galactia smallii*	E	Federal
Tiny polygala	*Polygala smallii*	E	Federal
Eatons spikemoss	*Selaginella eatonii*	E	State
Lattace vein fern	*Thelypteris reticulate*	E	State
Mexican vanilla	*Manilla mexicana*	E	State
Pine-pink orchid	*Bletia purpurea*	T	State
Tropical fern	*Schizaea pennula*	E	State
Wright's flowering fern	*Anemia wrightii*	E	State

*Marine species under the purview of National Marine Fisheries Service (NMFS), the Corps will conduct a separate consultation with NMFS.

** Indicates Critical Habitat for the designated species is not within the action study area (in status column).

If you have any questions, or need further information, please contact Stacie Auvenshine by email stacie.j.auvenshine@usace.army.mil or telephone 904-232-3694. Thank you for your assistance in this matter.

Sincerely,

Eric P. Summa
Chief, Environmental Branch

Enclosure

Copy Furnished:
Mr. Kevin Palmer, U.S. Fish and Wildlife Service, 1339 20th Street, Vero Beach, Florida 32960

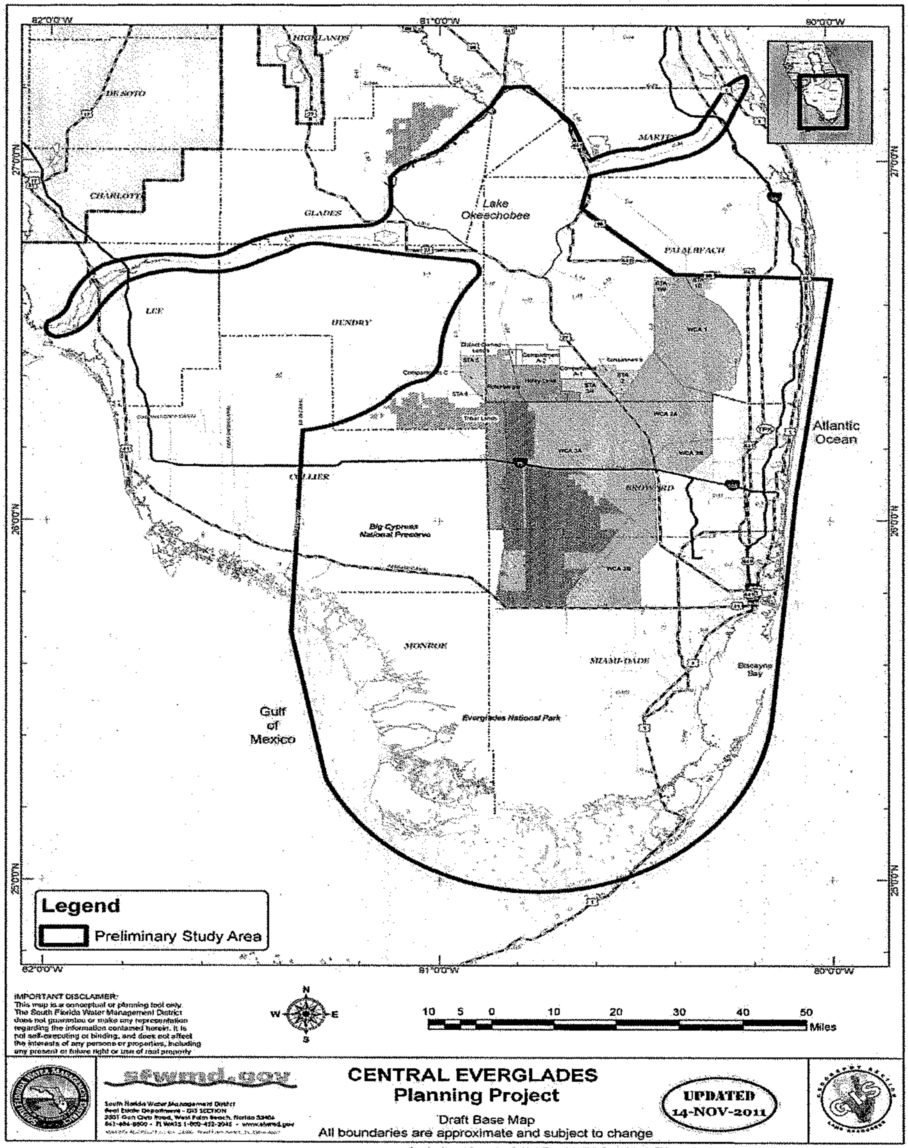


Figure 1. CEPP Project Study Area

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Planning and Policy Division
Environmental Branch

18 DEC 2013

Mr. Larry Williams, Field Supervisor
South Florida Ecological Services Field Office
U.S. Fish and Wildlife Service
1339 20th Street
Vero Beach, Florida 32960-3559

Dear Mr. Williams,

In a letter dated August 5, 2013, the U.S. Army Corps of Engineers (Corps) requested formal consultation on the Cape Sable seaside sparrow and its critical habitat, Everglade snail kite and its critical habitat, wood stork, Florida panther and Eastern indigo snake and transmitted the Endangered Species Act Biological Assessment for the Central Everglades Planning Project (CEPP) to the U.S. Fish and Wildlife Service (FWS). The Biological Assessment also included the Corps' "no effect" and "may affect, not likely to adversely affect" species determinations as well as critical habitat determinations for all other threatened, endangered and candidate species that occur or are likely to occur throughout the CEPP Action Area. In response, the FWS sent a Request for Additional Information (RAI) to the Corps on September 4, 2013. In a letter dated October 24, 2013, the Corps provided a Supplemental Technical Analysis in Response to Fish and Wildlife Service Request for Additional Information on the CEPP Endangered Species Act Biological Assessment. In that letter, the Corps requested written FWS acknowledgement of receipt of a complete Biological Assessment; however, the requested acknowledgement has not yet been received. In a meeting held November 12, 2013, FWS requested the Corps to change the request for formal consultation to a request for early consultation allowing the FWS to provide a Preliminary Biological Opinion. In order to move CEPP forward, the Corps concedes to the FWS request for the change from formal to early consultation. This concession allows the FWS to submit a Preliminary Biological Opinion. The Corps requests that the Preliminary Biological Opinion include concurrence or objection to the Corps' species determinations, critical habitat determinations, enumerated incidental take statements and preliminary terms and conditions. The Corps also reiterates the request to review a "draft" Preliminary Biological Opinion prior to final submission on December 17, 2013.

We look forward to continuing Section 7 consultation with you with the receipt of the Preliminary Biological Opinion. We sincerely appreciate the effort that you and your staff have put into this tremendously important restoration project. We look forward to our continued partnership as we move forward with Everglades restoration through the implementation of CEPP. If you have any questions or need additional information, please contact Gretchen Ehlinger, Ph.D. at gretchen.s.ehlinger@usace.army.mil or 904-232-1682.

Sincerely,

Gina Paduano Ralph for

Eric Summa
Chief, Environmental Branch

FOR CONTINUATION OF HOUSE DOCUMENT 114-65

COMPREHENSIVE EVERGLADES RESTORATION PLAN, CENTRAL EVERGLADES PLANNING PROJECT, INTEGRATED PROJECT IMPLEMENTATION REPORT AND ENVIRONMENTAL IMPACT STATEMENT: FINAL JULY 2014, REVISED DECEMBER 2014

SEE PART 6