CENTRAL AND SOUTHERN FLORIDA PROJECT
COMPREHENSIVE EVERGLADES RESTORATION PLAN
BISCAYNE BAY COASTAL WETLANDS PHASE 1

FINAL INTEGRATED
PROJECT IMPLEMENTATION REPORT AND
ENVIRONMENTAL IMPACT STATEMENT

Volume 1 - Main Report **July 2011 – revised March 2012**

U.S. ARMY CORPS OF ENGINEERS
JACKSONVILLE DISTRICT

SOUTH FLORIDA WATER
MANAGEMENT DISTRICT

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US Army Corps
of Engineers ®

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CENTRAL AND SOUTHERN FLORIDA PROJECT
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ADDENDUM
March 2012

Following are updated costs and benefits of the Recommended Plan, escalated to FY12 price levels.

The total project first cost of the Recommended Plan from the final PIR/EIS, escalated to FY12 price levels, is estimated at $164,070,000. Total first cost for the ecosystem restoration features is estimated to be $162,229,000, and for recreation is estimated to be $1,841,000.

In accordance with the cost-sharing requirements of Section 601(e) of the WRDA 2000, as amended, the Federal cost of the Recommended Plan is $96,209,000 and the non-Federal cost is $96,209,000. The estimated lands, easements, right-of-way, and relocation (LERRs) costs for the recommended plan are $80,985,000.

Based on FY12 price levels, a 40-year period of economic evaluation and a 4.00% discount rate, the equivalent annual cost of the proposed project is estimated to be $11,126,000, which includes OMRR&R, monitoring, interest during construction and amortization, but not sunk costs.

The Recommended Plan will produce an average annual increase of 9,276 habitat units per year at an annual cost of $11,003,000. The average annual cost per average annual habitat unit is $1,186. Based on these parameters, the Biscayne Bay Coastal Wetlands Phase I project is justified by the environmental benefits derived by the South Florida ecosystem. The recreation first cost of the recommended plan is $1,841,000. The average annual cost for recreation is $123,000 and average annual net benefits are $58,000. The benefit to cost ratio for the proposed recreation features is approximately 2.1 to 1.

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ERRATA SHEET
March 2012

The following corrections, clarifications and augmentations are made to the final PIR/EIS:

1. Section 10, page 10-4.
Replaced sentence in Local Item of Cooperation l): "Assume complete financial responsibility, except as specified in Section 7.9.16, for all necessary cleanup and response costs of any CERCLA regulated materials located in, on or under lands, easements, or right-of-ways that the Government determines necessary for the construction and OMRR&R."

With: "Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on or under lands, easements, or right-of-ways that the Government determines necessary for the construction and OMRR&R."

2. Section 10, page 10-6.
Replaced Local Item of Cooperation u): "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. The Federal Government and the non-Federal sponsor are committed to the protection of the appropriate quantity, quality, timing, and distribution of water to ensure the restoration, preservation, and protection of the natural system as defined in WRDA 2000, for so long as the project remains authorized. This quantity, quality, timing, and distribution of water shall meet applicable water quality standards and be consistent with the natural system restoration goals and objectives of the CERP, as the Plan is defined in the programmatic regulations. The non-Federal sponsor will protect the water for the natural system by taking the following actions to achieve the overarching natural system objectives of the Plan:

> 1. Ensure, through appropriate and legally enforceable means under Florida law, that the quantity, quality, timing, and distribution of existing water that the Federal Government and the non-Federal sponsor have determined in this Project Implementation Report is available and beneficial to the natural system, will be available at the time the Project Cooperation Agreement for the project is executed and will remain available for so long as the Project remains authorized.
>
> 2. (a) Prior to the execution of the Project Partnership Agreement, reserve or allocate for the natural system the necessary amount of water that will be made available by the project

that the Federal Government and the non-Federal sponsor have determined in this Project Implementation Report.

(b) After the Project Partnership Agreement is signed and the project becomes operational, make such revisions under Florida law to this reservation or allocation of water that the non-Federal sponsor determines, as a result of changed circumstances or new information, is necessary for the natural system.

3. For so long as the Project remains authorized, notify and consult with the Secretary of the Army should any revision in the reservation of water or other legally enforceable means of protecting water be proposed by the non-Federal sponsor, so that the Federal Government can assure itself that the changed reservation or legally enforceable means of protecting water conform with the non-Federal sponsor's commitments under paragraphs 1 and 2. Any change to a reservation of water made available by the project shall require an amendment to the Project Partnership Agreement."

With: "The non-Federal sponsor shall execute under State law the reservation or allocation of water for the natural system as identified in the PIR for this authorized CERP Project as required by Sections 601(h)(4)(B)(ii) of WRDA 2000 and the non-Federal sponsor shall provide information to the Government regarding such execution. In compliance with 33 CFR 385, the District Engineer will verify such reservation or allocation in writing. Any change to such reservation or allocation of water shall require an amendment to the PPA after the District Engineer verifies in writing in compliance with 33 CFR 385 that the revised reservation or allocation continues to provide for an appropriate quantity, timing, and distribution of water dedicated and managed for the natural system after considering any changed circumstances or new information since completion of the PIR for the authorized CERP Project."

3. Executive Summary, Table ES-3, page xix.
Changed footnote 1 PIR sunk cost from $22,955,000 to $22,995,000.

4. Section 7, Table 7-3, page 7-17.
Changed footnote 1 PIR sunk cost from $22,955,000 to $22,995,000.

5. Section 8, Table 8-1, page 8-7.
The ER subtotal line was corrected to be consistent with the rest of the report.

CENTRAL AND SOUTHERN FLORIDA PROJECT COMPREHENSIVE EVERGLADES RESTORATION PLAN

BISCAYNE BAY COASTAL WETLANDS PHASE 1 INTEGRATED PROJECT IMPLEMENTATION REPORT AND FINAL ENVIRONMENTAL IMPACT STATEMENT

Responsible Agencies: The lead agency is the U.S. Army Corps of Engineers, Jacksonville District. The South Florida Water Management District is the non-Federal cost-sharing partner for the project. Other agencies participating in the development of this Environmental Impact Statement include the U.S. Fish and Wildlife Service, the Florida Department of Environmental Protection, the National Park Service, the Miami-Dade Department of Environmental Resources Management, and the U.S. Environmental Protection Agency. The US Environmental Protection Agency, US Fish and Wildlife Service, National Park Service, Florida Fish and Wildlife Conservation Commission, Florida Department of Environmental Protection, US Geological Survey, Miami-Dade Department of Environmental Resources Management, and the National Oceanographic and the Atmospheric Administration / National Marine Fisheries Service were invited to be Cooperating Agencies. Of the agencies invited only the US Environmental Protection Agency has accepted (conditionally) this invitation to become a cooperating agency for this Environmental Impact Statement.

Abstract: This report documents studies for the Biscayne Bay Coastal Wetlands project, in accordance with the requirements of Section 601(d) of the Water Resources Development Act of 2000 (WRDA 2000) and recommends authorization of this project. This project addresses the need to restore the ecosystem function in southeastern Florida by rehydrating coastal wetlands and reducing 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 flow across a broad front is also expected to help restore saltwater wetlands and nearshore bay habitat.

The purpose of the Biscayne Bay Coastal Wetlands project is to contribute to the restoration of Biscayne Bay and adjacent wetlands as part of a comprehensive plan for restoring the south Florida ecosystem. The project intends 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. This project will also help restore saltwater wetlands and the nearshore bay through the re-establishment of optimal salinity concentrations for fish and shellfish nursery habitat.

This Project Implementation Report and integrated Environmental Impact Statement describes public and agency involvement in project development (including comments received and responses), explains the plan formulation and alternative evaluation and plan selection processes, and documents the selected plan features, including costs and environmental benefits.

THE OFFICIAL CLOSING DATE FOR THE RECEIPT OF COMMENT IS 30 DAYS FROM THE DATE ON WHICH THE NOTICE OF AVAILABILITY OF THIS ENVIRONMENTAL IMPACT STATEMENT APPEARS IN THE FEDERAL REGISTER.

If you require further information on this document, contact:
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NOTE: This report includes an integrated Environmental Impact Statement within the Project Implementation Report. An asterisk in the Table of Contents notes sections required for compliance with the National Environmental Policy Act.

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE), Jacksonville District, in cooperation with its cost-sharing partner, the South Florida Water Management District (SFWMD), has prepared a Integrated Project Implementation Report (PIR) and Environmental Impact Statement (EIS) for the Biscayne Bay Coastal Wetlands (BBCW) project, located in Miami-Dade County, Florida. The selected plan – Alternative O, Phase 1 – is described in this report. The Biscayne Bay Coastal Wetlands project is recommended for implementation in two PIRs. The Selected Plan for the initial PIR (Alternative O Phase 1) is the first step toward meeting restoration goals in the study area. By rehydrating coastal wetlands and reducing damaging point source freshwater discharge to Biscayne Bay, the Selected Plan is integral to the health of the south Florida ecosystem. The remaining features of Alternative O, which will be studied in a subsequent PIR, will greatly increase freshwater wetland benefits and further achieve restoration goals.

The Biscayne Bay Coastal Wetlands study examined the causes of nearshore hypersalinity and coastal wetlands degradation with the objectives of restoring more natural patterns of freshwater delivery into Biscayne Bay. By rehydrating coastal wetlands and reducing wasteful point source freshwater discharge, the Selected Plan will improve nearshore substrate and fish habitat, now stressed by high salinities in the dry season and reduce excessive freshwater outflow during the rainy season, The project will do this by redirecting freshwater - currently discharged directly and rapidly to the Bay through man-made canals - to spreaders in coastal wetlands adjacent to the Bay that are currently bypassed by the canals. This will help restore freshwater and saltwater wetlands, re-establish more natural salinity concentrations, and provide a more productive nearshore nursery habitat.

This report has been prepared in accordance with the requirements of Section 601(d) of the Water Resources Development Act of 2000 (WRDA 2000) and Programmatic Regulations for the Comprehensive Everglades Restoration Plan

(CERP) (33 Code of Federal Regulations [CFR] Part 385) and has been circulated as a Draft Report/DEIS for public and agency review and comment in accordance with the National Environmental Policy Act (NEPA); it will be circulated again as a Final Report and F-EIS. This PIR and EIS takes into consideration public and agency comments, which is the basis for the Chief of Engineers Report to be submitted to the Assistant Secretary of the Army (Civil Works) for transmittal to Congress.

PURPOSE AND NEED FOR THE PROJECT

The purpose of the study was to identify ways to re-hydrate currently over-drained coastal wetlands located in Biscayne Bay, south of the core of the city of Miami (***Figure ES-1***). The study was recommended as a component of the Comprehensive Everglades Restoration Program (CERP), which was approved by Congress in WRDA 2000. The conceptual project for Biscayne Bay Coastal Wetlands described in the CERP included a variety of management measures (pump stations, spreader swales, stormwater treatment areas, flow ways, levees and culverts, and backfill canals). The project aims to restore the overland sheetflow in an area of up to 11,000 acres, and to improve the ecology of Biscayne Bay, including its freshwater and saltwater wetlands, nearshore bay habitat, marine nursery habitat, and the oyster reef community.

Today nearly all aspects of south Florida's flora and fauna have been affected by development, altered hydrology, nutrient input and spread of non-native species that have resulted directly or indirectly from a century of water management.

Significant areas within the project study boundary are characterized by a low-productivity dwarf mangrove forest, known as the "white zone" due to its appearance on aerial photos which are caused by salt deposits on the soil surface. Recent studies in this area indicate that the landward boundary of the white zone has moved inland by an average of one and a half kilometers (0.9 miles) since 1940, and the zone is expanding in areas cut off from freshwater sources by canals or roads. The low productivity of the white zone is primarily a result of wide seasonal fluctuations in salinity and the absence of freshwater input from upstream sources, among other factors.

The distribution, life cycles, community structures, and population densities of the fauna of south Florida are intricately linked to regional hydrology. The current status of fish and wildlife has been strongly influenced by the cumulative effects of drainage activities in the early 20th Century, the Central and Southern Florida (C&SF) project, and the ensuing agricultural and urban development made possible by those activities. Reduction in the spatial extent of Everglades wetlands by half has resulted in a proportional reduction in habitat of aquatic organisms, and changes in the hydrology of the remaining wetlands east of the protective levees has further reduced their populations. Estuarine fishes and shellfishes have precipitously declined in abundance within the project area due to loss of estuarine habitat along the bay's southwestern shore. Abrupt salinity fluctuations due to canal discharges have negatively affected fish populations.

A major emphasis of the CERP is to remedy many of the hydrologic aspects of the flood control project that in hindsight have had deleterious effects on the wetland vegetative communities and fish and wildlife resources.

WHAT WILL HAPPEN WITHOUT THE PROJECT?

The study area for the Biscayne Bay Coastal Wetlands project is composed of a variety of privately-owned, local, state, and Federal lands. Privately-owned natural lands in south Florida have become scarce due to development and most currently remaining are likely to be developed in the near future. Fish and wildlife habitat within the study area will be adversely impacted by future residential, commercial and/or industrial development. The ecosystem within this area is extremely unique and fragile. The disruptive freshwater drainage caused by canals has already created hypersalinity in Biscayne Bay, as shallow marshes are overdrained through canals, and then seepage is reduced abruptly after the end of rainy episodes. Further development and creation of impervious surfaces will lead to increased runoff velocity and more frequent and higher freshwater discharges. Increased development within this area will lead to increased habitat fragmentation, decreasing the area of wildlife corridors that are imperative for larger animals to traverse these areas.

The spatial extent of the natural areas within the study area has the potential to decrease considerably in the absence of project restoration. Much of this area is not currently in public ownership or in public land acquisition plans and will likely be developed for both urban and agricultural uses. Urbanization is accompanied by an increase in stormwater runoff containing a wide range of pollutants including herbicides, pesticides, fertilizers, aromatic compounds (hydrocarbons, oils, greases, gasoline), heavy metals, and other emerging pollutants of concern (hormones, organic and inorganic compounds). The general trend for urban developments near wetlands is for the residents in the area to request and obtain frequent mosquito control spraying. Agricultural development is also accompanied by the use of herbicides, pesticides and fertilizers. The increased release of pollutants into the natural environment will result in the decline of macroinvertebrates (e.g., insects, snails), which in turn will adversely impact resident and migratory birds, as well as other insectivores.

PLAN FORMULATION, EVALUATION AND SELECTION

The plan formulation process for the proposed Biscayne Bay Coastal Wetlands project stemmed from earlier efforts like the Miami-Dade County's Biscayne Bay Management Plan, the SFWMD's Biscayne Bay Surface Water Improvement and Management Plan, and the CERP and was guided by USACE's six-step planning process. A Project Delivery Team (PDT) formed of local, state and Federal agency personnel used an iterative process to identify the merits of individual components and evaluate alternative plans to determine how well the plans met the planning objectives, performance measures and evaluation criteria. Many alternative plans were considered by the study team.

After consolidation and screening of alternative plans, a final array of six plans was evaluated.

1. No Action – The future without-project condition or "no action" alternative. This alternative includes the changes expected in the study area over the period of analysis ending in 2050 assuming that no ecosystem restoration project is built as a result of this study. It includes the continuation of the current degraded ecological state exhibited in the study area.

2. Alternative YB (Yellow Book) – Coincides with the Biscayne Bay Coastal Wetlands project as conceptualized in the CERP. This plan includes a footprint of roughly 60,000 acres of land, nine pump stations, approximately 35 culverts reconnecting wetlands, four stormwater treatment areas (STAs) covering roughly 4,000 acres, approximately 14 miles of spreader canals, approximately seven miles of conveyance canals, backfilling of approximately five miles of Military and North Canals, and plugging 2,000 feet of mosquito control ditches.

3. Alternative M – Reflects an attempt to minimize both the number of features and project extent. This plan relies on relatively small detention areas to capture and store water and focuses the restoration effort on saltwater wetlands and the nearshore Bay. Alternative M includes a footprint of roughly 6,561 acres of land, three pump stations, approximately 40 culverts reconnecting wetlands, two stormwater detention areas covering 200 acres, approximately five miles of spreader canals, and plugging 500 feet of mosquito control ditches.

4. Alternative Q – Reflects the desires to 1) align the Biscayne Bay Coastal Wetland project with a compatible, nearby, restoration effort also in the planning phase (the CERP C-111 Spreader Canal project) and 2) move water passively as much as possible. This plan includes a footprint of roughly

19,035 acres of land, ten pump stations, approximately 50 culverts reconnecting wetlands, one STA covering roughly 200 acres, approximately nine miles of spreader canals, and plugging 2000 feet of mosquito control ditches.

5. Alternative O – Introduced as an intermediate plan between Alternative M and Alternative Q. Alternative O includes a footprint of roughly 11,312 acres of land, 13 pump stations, approximately 20 culverts reconnecting wetlands, approximately seven miles of spreader canals, approximately one mile of conveyance canals, and plugging 8,000 feet of mosquito control ditches.

6. Alternative O Phase 1 – Reflects a stand-alone increment of Alternative O that provides a meaningful first step towards restoration in the study area and provides an opportunity to reduce uncertainty for subsequent features. Alternative O Phase 1 includes a footprint of roughly 3,761 acres of land, seven pump stations, approximately 10 culverts reconnecting wetlands, approximately 3 miles of spreader canals, and plugging 2,500 feet of mosquito control ditches.

As a result of the analysis based on cost and benefits, Alternative O was identified as the initial Tentatively Selected Plan. Further analysis of Alternative O determined the project would be planned and recommended through two PIRs. Alternative O Phase 1 was identified as the Selected Plan of the first PIR (this report). This alternative is an important first step towards meeting the project's planning objectives by providing substantial improvement in the much needed restoration of the Biscayne Bay nearshore and saltwater wetlands.

After the Selected Plan was identified, a Next-Added Increment (NAI) analysis was performed. The NAI analysis evaluates the effects, or outputs, of the Selected Plan as the next project to be added to the group of already approved CERP projects. This analysis describes what benefits the selected plan contributes without regard to future CERP projects. It also determines whether sufficient benefits will accrue to justify the cost of the project if no additional CERP projects (other than those already existing or authorized) are implemented. In the case of this analysis, no other CERP projects were assumed to exist. The results of the NAI analysis showed that as a stand-alone project, the Biscayne Bay Coastal Wetlands Selected Plan nearly doubles the spatial extent of the functional habitat expected to exist under the future without-project condition.

DESCRIPTION OF THE SELECTED PLAN

The Selected Plan refers to the recommended alternative, the plan put forward for implementation in this PIR, which is the same as the "preferred alternative" under NEPA guidelines.

The Selected Plan encompasses a footprint of approximately 3,761 acres and includes features in three of the project's four sub-components (hydrologically distinct regions of the study area): Deering Estate, Cutler Wetlands, and L-31 East Flow Way (***Figure ES-1***). There are no features in the fourth region, Model Land Basin.

Deering Estate: This region includes an approximately 500-foot extension of the C-100A Spur Canal through the Power's Addition Parcel (Power's Parcel), construction of a freshwater wetland on the Power's Parcel and delivery of fresh water to the Cutler Creek and ultimately to coastal wetlands along Biscayne Bay. The wetland will be created using a pump station to withdraw water from C-100A Spur Canal (100 cfs), 538 linear feet of 60" pipe south of the new pump station running under Old Cutler Road to Outlet, and a spreader structure on the east side of Old Cutler Road to discharge to coastal wetlands in Deering Estate.

Cutler Wetlands: Features in this region include a pump station on C-1 Canal (400 cfs), 7000 +/- linear feet of lined conveyance canal, 13,160 linear feet of spreader canal, box culverts under SW 97 Ave, SW 87 Ave and L-31E, and mosquito control ditch plugs (2,500 linear feet) to discourage the unnatural channelization of the water delivered to the area by the spreader canals. The pump station, located on C-1, will deliver water to a 7000 +/- linear feet lined conveyance canal that will run under SW 97th Avenue, SW 87th Avenue (L-31E Levee), and across the L-31E Borrow Canal via concrete box culverts and deliver water to the spreader canal located in the saltwater wetlands. This spreader canal is divided into four segments.

L-31 East Flow Way: Features in this region include a pump station (50 cfs) with outlet spreader to deliver water to saltwater wetlands, a pump station (100 cfs) to discharge south to L-31E borrow canal, an inverted siphon to isolate Military Canal from L-31E, 10 riser structures with flap gated culverts to discharge from L-31E to saltwater wetlands east of L-31E, a pump station (40 cfs) to discharge from C-103 north into L-31E, a pump station (40 cfs) and spreader canal to deliver water to freshwater wetlands south of C-103, and a pump station (40 cfs) and spreader structure to deliver water to freshwater wetlands south of C-103.

Features in this region will isolate the L-31E Borrow Canal from the major discharge canals (C-102, Military Canal and C-103) and allow freshwater flow through the L-31E Levee to the saltwater wetlands. Gated culverts and inverted siphon structures will isolate the L-31E Borrow Canal from these canals, allowing L-31E Borrow Canal to maintain higher water levels. Two pump stations and a series of culverts will move fresh water directly to the saltwater wetlands east of L-31E. Two more pump stations and a spreader canal will deliver water to the freshwater wetlands south of C-103.

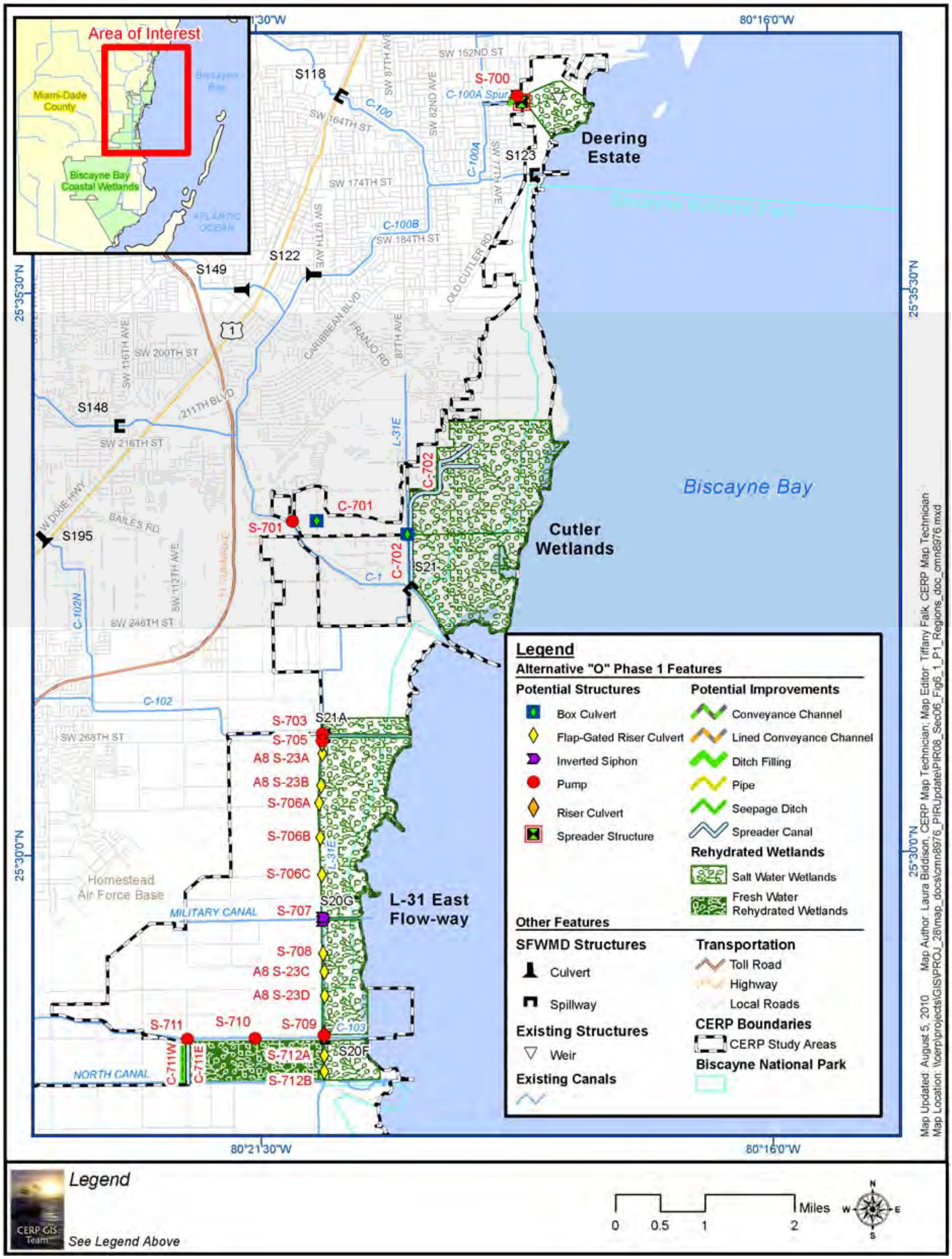

FIGURE ES-1: ALTERNATIVE O PHASE 1 (SELECTED PLAN)

REAL ESTATE REQUIRED FOR THE SELECTED PLAN - LAND ASSESSMENT MATRIX

A project-level analysis was conducted to determine the lands required for construction of the project features (approximately 154.12 acres) and the lands required for project operations (approximately 3,606.98 acres). Project modeling for the project indicated that a total of approximately 3,761.1 acres would be required or affected by the project. The SFWMD has agreed to acquire, in fee, easement, or provide by supplemental agreement, the approximately 3,761.1 acres of land that would be affected. ***Table ES-1*** shows the details of the analysis, including the project area, ownership, acreage, existing condition of the properties, current use, acres required for construction and operation, magnitude of project induced hydrologic impact, estate and potential risk to the project benefits without an interest in land.

TABLE ES-1: LAND ASSESSMENT MATRIX

Area	Current Property Ownership	# Acres	Existing Condition of Property (hydrology)	Current Use	Required for Construction (est. acres)	Operational Use Requirement (est. acres)	Magnitude of Project Induced Hydrologic Impact	Estate	Potential Risk to Benefits w/o Land Interests
Deering Estate-SEE NOTE 1	Miami-Dade (DERM)	185.65	Degraded FW Wetlands/ Freshwater to Tidal Wetlands transition	Park (passive recreation)	15	170.65	None to ≈1.1 ft/day when discharging Significant to Moderate	Fee/SA or Esmt / SA	High and High to Moderate
Deering Estate-SEE NOTE 2	Miami-Dade (Parks & Rec)	10.85	Uplands	Abandoned Farm	10.85		NA	Fee/SA	High
Cutler Ridge-SEE NOTE 3	SFWMD	29.86	Degraded FW Wetlands	Abandoned Farm	29.86		NA	Fee	High
Cutler Ridge-SEE NOTE 4	SFWMD	651.67	Degraded Tidal wetland	Abandoned Farm	20	631.67	None to≈0.5 ft/day Significant	Fee	High
Cutler Ridge-SEE NOTE 5	NPS	308.04	Degraded Tidal wetland	Park		308.04	≈0.5 ft/day Moderate	Esmt/ MOA	Moderate
Cutler Ridge-SEE NOTE 6	Private	32.25	Degraded FW Wetlands	Abandoned Farm		32.25	≈0.5 ft/day Moderate	Fee	High
Cutler Ridge-SEE NOTE 7	State	111.06	Degraded FW Wetlands	Abandoned Farm		111.06	≈0.5 ft/day Significant	Esmt / SA	High
Cutler Ridge-SEE NOTE 1	Miami-Dade (Water/ Sewer)	403.4	Degraded Tidal wetland	Abandoned Farm	20	383.4	None to ≈0.5 ft/day Significant	Fee/SA and Esmt / SA	High to Moderate
Cutler Ridge-SEE NOTE 8	M-D P&R	79.6	Degraded FW Wetlands	Abandoned Farm	20	59.6	None to ≈0.5 ft/day Significant	Fee/SA and Esmt / SA	Moderate
Cutler Ridge-SEE NOTE 8	M-D DERM	118.05	Degraded FW Wetlands	Abandoned Farm	20	98.05	None to ≈0.5 ft/day Moderate	Fee/SA and Esmt / SA	Moderate
Homestead North-SEE NOTE 8	Miami-Dade (Parks & Rec)	92.58	Degraded Tidal wetland	Abandoned Farm	2.5	90.08	None to ≈0.25 ft/day Moderate	Fee/SA and Esmt / SA	High
Homestead North-SEE NOTE 5	NPS	308.05	Degraded Tidal wetland	Park		308.05	≈0.25 ft/day Moderate	Esmt / MoA	High
Homestead North-SEE NOTE 4	Private	252.83	Degraded Tidal wetland	Abandoned Farm	2.8	250.03	None to ≈0.25 ft/day Moderate	Fee	High
Homestead North-SEE NOTE 1	Miami-Dade DERM	309.2	Degraded Tidal wetland	Abandoned Farm		309.2	≈0.25 ft/day Moderate	Esmt / SA	High
Homestead South Tidal-SEE NOTE 4	Private	94.8	Degraded FW Wetlands	Abandoned Farm	2.16	92.64	None to ≈0.20 ft/day Moderate	Fee	High

Homestead South Tidal-SEE NOTE 1	Miami-Dade (Parks & Rec)	16.52	Degraded Tidal wetland	Abandoned Farm		16.52	≈0.20 ft/day Moderate	Esmt / SA	High
Homestead South Tidal-SEE NOTE 5	NPS	321.23	Degraded Tidal wetland	Park		321.23	≈0.20 ft/day Moderate	Esmt / MoA	High
Homestead South Freshwater-SEE NOTE 4	SFWMD	251.61	Degraded FW Wetlands	Abandoned Farm	7.2	244.41	None to ≈0.40 ft/day Moderate	Fee	High
Homestead South Freshwater-SEE NOTE 9	FPL	148.9	Degraded FW Wetlands	Abandoned Farm	1.75	147.15	None to ≈0.40 ft/day Moderate	Esmt	High
Homestead South Freshwater-SEE NOTE 4	Private	34.95	Degraded FW Wetlands	Abandoned Farm	2	32.95	None to ≈0.40 ft/day Moderate	Fee	High
			TOTAL		154.12	3606.98	3761.1		

NOTE:
1-Miami-Dade Ordinances prohibit conveyance of fee without exchange. Land to be provided fee or easement thru exchange with SFWMD or by Supplemental Agreement pursuant to Master Agreement. For Operation lands-Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities compromises benefits used to justify project. Infrequent access to wetlands east of L-31 E will be necessary to conduct exotic vegetation removal and control. Additionally, as part of the adaptive management protocol, periodic access may be required to fill existing mosquito and/or drainage ditches east of the L-31 levee.

Note 2-Miami-Dade Ordinances prohibit conveyance of fee without exchange. Land to be provided fee thru exchange with SFWMD or by Supplemental Agreement pursuant to Master Agreement.

Note 3-Land required for construction of project features.

Note 4-Land required for construction of project features. For Operation lands-Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.

Note 5-Land required to flow water only. Loss of ability to flow water, and perform other activities compromises benefits used to justify project. Provided by Memorandum of Agreement (MoA).

Note 6-Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.

Note 7-State law prohibits conveyance of fee. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project.

Note 8-Miami-Dade Ordinances prohibit conveyance of fee without exchange. Land will be provided in fee or easement thru exchange of land with SFWMD or by Supplemental Agreement pursuant to Master Agreement. Operation lands- Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project.

Note 9-Land required for construction of project features and operation of project. FPL required by SFWMD, Miami-Dade DERM and USACE to provide easement for CERP BBCW project pursuant to terms of regulatory permits.

BENEFITS OF THE SELECTED PLAN

The principal benefit of the Biscayne Bay Coastal Wetlands project is restored wetland and estuarine habitats. It will do this by redirecting the fresh water runoff that is currently discharged directly to the Bay through man-made canals to coastal wetlands. As a result of the more natural water flow patterns, freshwater wetlands will become more productive, critical ecotones reestablished, and estuarine areas in Biscayne Bay improved. The Selected Plan provides the most cost-effective approach to implementing the prescribed changes. Furthermore, it meets the CERP's requirement of all selected plans: it maximizes net environmental and economic benefits on a system-wide basis - that is, to the south Florida ecosystem as a whole.

The project will divert an average of 59 percent of the annual coastal structure discharge (from structures S-123, S-21, S-21A, S-20F) into freshwater and saltwater wetlands instead of direct discharges into Biscayne Bay. Expected water quality benefits of this diversion include reducing the future nitrate load to Biscayne Bay by 162 metric tons per year which is approximately 50 percent of the projected future nitrate load to Biscayne Bay. Also, the diversion will reduce peak total phosphorus loading to the bay by approximately 50 percent over the future without-project condition.

Of the approximately 473.61 acres of freshwater wetlands acquired for this project, the selected alternative plan (Alternative O Phase 1) will provide a total of approximately 283 acres of freshwater wetland rehydration benefit which is due to rehydration of freshwater wetlands and exotic control within these wetlands. This is an increase of approximately 7.0 percent over the estimated 3,977 acres of existing functional freshwater wetland acreage within the project area. The project is expected to increase the hydroperiod in the target freshwater wetlands from approximately 70 days per year to nearly 200 days per year. This will result in high functioning graminoid wetlands which serve as critical habitat to prey fish and wading birds.

Out of the total available saltwater wetland acreage of 22,500, this project will increase saltwater wetland function from 1,002 habitat units to 7,398 habitat units (net 6,396 acres of functionality). This increase in functionality will be the result of hydrating these wetlands and reducing the salinity of the water in these areas to less than 20 psu. Increasing the hydroperiod in the saltwater wetlands should result in improved habitat for the endangered American Crocodile which requires mesohaline salinity conditions to maximize juvenile survival. This is an increase from approximately 5 percent to 32 percent habitat functionality.

This project will also benefit the nearshore area of Biscayne Bay, defined as the zone within 0 to 500 meters from the shoreline, by improving the probability that the water in this zone will meet a desired salinity concentration of less than 20 psu. The target concentration for this zone is optimal for nursery habitat for pink shrimp, better meets the requirements for estuarine species which should benefit from this project. Out of a total possible nearshore acreage of 8,585 acres, the project will provide an average of 2,950 acre of lift of nearshore habitat. This is an increase from 1,673 habitat units to 4,624 habitat units of nearshore acreage. This is an increase of approximately 30 percent over the existing nearshore acreage meeting the desired salinity conditions. This increase in habitat suitability comes from improved salinity conditions and improvement in water quality due to diversion of water through the saltwater wetlands.

A significant source of uncertainty in the selection of the project comes from the benefits assessment methodology used in the plan formulation process. While there is no standard way in which ecological benefits are to be estimated, the PDT worked diligently to produce a methodology that is logical and scientifically sound. The estimation of project benefits was done using a combination of professional judgment and hydrologic model output. The benefits methodology underwent two reviews as part of the independent external review (IEPR) process and benefited greatly from the incorporation of the reviewer's suggestions. The application of the amended benefits estimation methodology is unlikely to result in the selection of a non-optimal alternative or one that results in harm to the ecosystem.

The availability of water for diversion into the project features as well as the effect of sea level rise on the targeted habitat zones are the most significant sources of uncertainty in success of the project. Climate change impacts such as a projected reduction in rainfall of 10 percent over the next 50 years will adversely impact the project area. The impact of decreased rainfall on project benefits is assumed to be proportional to the expected decrease in rainfall over the project life. The impact of sea level rise on project benefits has been evaluated per the requirements of EC 1165-2-211. Using conservative assumptions, sea level rise impacts are expected to result in a 17 percent decrease in average annual benefits over the 50 year life of the project.

The benefits to recreation in the project area result in an average annual net benefit of $58,000.

SAVINGS CLAUSE

The Savings Clause analyses required by the WRDA 2000 and Sections 385.36 and 385.37 of the Programmatic Regulations is a means to protect users of existing legal sources of water supply and provide the same level of flood protection that was in place at the time of enactment. Based on the analyses performed, the project results in no elimination or transfer of water from existing legal sources, because canal flows and levels upstream of the coastal control structures will not be affected by the project. Analysis of each of the four geographically separate project components for potential significant and adverse impacts to flood protection concluded that the project is designed so that there will not be any significant adverse effects to the pre-CERP level of service for flood protection of adjacent properties.

IDENTIFICATION OF WATER NEEDS

Subsection 601(h)(4) of WRDA 2000, entitled "Project-Specific Assurances", and Section 385.35(b) of the Programmatic Regulations requires that a project implementation report identify the appropriate quantity, timing and distribution of water dedicated and managed for the natural system; and to identify the amount of water to be reserved or allocated for the natural system necessary to be implemented under state law.

The water made available to, and diverted by, the Biscayne Bay Coastal Wetlands Project Phase 1 for the combined C-100, C-1, C-102, and C-103 basins ranges from 113,619 acre-feet per year (10^{th} percentile) to 282,982 acre-feet per year (90^{th} percentile) based on historical records. The State of Florida will use its water reservation or allocation authority to protect the water made available for the natural system by the project as required by Section 601 of WRDA 2000. The state has elected to protect the existing water in the natural system that the PIR identifies as necessary to achieve the benefits of the project, using resource protection authority under Florida law. If the difference between the quantity indicated as Total Water Diverted and Total Available Canal Flow is required to protect the natural system, it will be reserved or allocated through a state process pursuant to Section 373.223, Florida Statutes. The SFWMD will protect water for Biscayne Bay based on the best available science to support the identification of water for the natural system at the time such protection is undertaken. The SFWMD is currently collecting and analyzing the best available science, which will be the basis for defining flows to the natural system in Biscayne Bay.

ADVERSE EFFECTS OF THE SELECTED PLAN

Potential adverse impacts of the Selected Plan, including its effects on wetlands, soils, adjacent property and land use, and fish and wildlife, have been considered and addressed during this study. Benefits derived from implementation of the Selected Plan will far outweigh any potential adverse impacts associated with construction of the selected plan.

PROJECT COST ESTIMATES AND COST APPORTIONMENT

As of March 2011, the total estimated cost of the project, including all costs for construction, lands, easements, rights-of-way, and relocations (LERR), recreation facilities, and pre-construction, engineering and design (PED) and construction management costs and sunk PIR costs ($23 million), is approximately $191,018,000. Section 601 of WRDA 2000 and USACE policy requires that the non-Federal sponsor must obtain and provide certification of LERRs necessary for project implementation. The Project's total initial costs will be shared equally between the Federal government and the non-Federal sponsor in accordance with Section 601 of the WRDA 2000 to maintain a 50/50 cost share as measured cumulatively for the entire CERP program.

The total estimated FY 11 first cost for the Biscayne Bay Coastal Wetlands Project is $168,023,000 (does not include sunk costs). The total first cost for the Biscayne Bay Coastal Wetlands Project includes recreation features totaling $2,316,000. The first cost for the ecosystem restoration account is $165,707,000 with a total investment cost estimated at $181,040,000; which is composed of the total initial (first) costs plus interest during construction (IDC). Utilizing the discount rate officially prescribed by Federal policy for use in water resource planning analysis, currently set at 4.125 percent, and including the annual OMRR&R and monitoring costs, the average annual cost is estimated to be $11,386,000. This project will lead to an increase of 9,276 average annual habitat units with an average annual cost per unit of $1,227 per habitat unit. The initial cost of the recreation features is estimated at $2,316,000, with an average annual cost of $152,000 and net annual benefits of $58,000. The average annual recreation benefits are forecasted to be $210,000.

Table ES-2 provides additional details on initial costs for construction and non-construction items. ***Table ES-3*** describes the total project investment cost and the average annual cost. ***Table ES-4*** delineates the cost apportionment of the Selected Plan between the Federal Government and the non-Federal sponsor. Operations and maintenance (O&M) costs will be cost-shared 50/50 in accordance with the O&M cost-sharing provisions of Section 601 of WRDA 2000.

TABLE ES-2: BISCAYNE BAY COASTAL WETLANDS COSTS
(FY 11 PRICE LEVELS)

Ecosystem Restoration Cost Elements	**TOTALS***
Construction	
Deering Estate Flowway	
06 Fish and Wildlife Facilities	$1,205,000
13 Pumping Plant	$4,064,000
Cutler Wetlands	
06 Fish and Wildlife Facilities	$1,479,000
09 Channels and Canals	$12,280,000
13 Pumping Plant	$12,662,000
L-31E Wetlands	
06 Fish and Wildlife Facilities	$1,479,000
09 Channels and Canals	$2,516,000
13 Pumping Plant	$16,596,000
15 Floodway Control-Diversion Structure	$6,272,000
Sub-Total Construction Cost	**$58,555,000**
Non-Construction	
01 Lands and Damages	$80,985,000
30 Planning, Engineering, and Design*	$9,955,000
31 Construction Management	$16,212,000
Sub-Total Non-Construction Cost	**$107,152,000**
TOTAL INITIAL COST	**$165,707,000**
Recreation Cost Elements	
14 Recreation Facilities	**$2,316,000**
TOTAL INITIAL COST	**$168,023,000**

* Initial costs rounded to the nearest $1,000.
*PED does not include sunk costs of $22,995,000

TABLE ES-3: BISCAYNE BAY COASTAL WETLANDS TOTAL INVESTMENT COST AND AVERAGE ANNUAL COST OF RESTORATION ELEMENTS
(FY11 PRICE LEVELS)

Total Initial (First) Cost	**$165,707,000** [1]
Interest During Construction (IDC)	
IDC Construction	$4,890,000
IDC Real Estate	$10,440,000
TOTAL INVESTMENT	**$181,040,000**
Operations and Maintenance (O&M)	**$1,873,000**
Monitoring	$193,000
Period of Analysis (40 Years)	40
Amortized First Cost (40 Years)	**$8,972,000**
Year For First Benefits[2]	2010
Average Annual Cost	**$11,386,000**

[1]Does not include sunk PIR costs of $22,948,000 or Recreation Costs
[2] State expedited construction schedule

TABLE ES-4: COST APPORTIONMENT OF THE SELECTED PLAN
(FY 11 PRICE LEVELS)

Item	Federal Cost	Non-Federal Cost	Total
Ecosystem Restoration (ER)			
PED[1]	$ 27,690,000	$ 5,260,000	$ 32,950,000
Construction Management	$ 8,106,000	$ 8,106,000	$ 16,212,000
LER&R		$ 80,985,000	$ 80,985,000
Ecosystem Restoration Construction Cost[2]	$ 58,555,000		$ 58,555,000
ER Subtotal			
Recreation (Rec)	$ 1,158,000	$ 1,158,000	$ 2,316,000
Total Project Cost	$ 95,509,000	$ 95,509,000	$ 191,018,000
Total Project Level Monitoring Costs	$ 958,500	$ 958,500	$ 1,917,000
Annual OMRR&R	$ 936,500	$ 961,500	$ 1,898,000
OMRR&R (vegetation management)[3]	$ 96,500	$ 96,500	$ 193,000
OMRR&R (non-recreation)	$ 840,000	$ 840,000	$ 1,680,000
OMRR&R (recreation)		$ 25,000	$ 25,000

[1]PED estimates for non-recreation components are derived directly from the MCACES. PED includes development of the PIR and sunk costs of $22,995,000.
[2]The ecosystem restoration construction cost and PED cost are not detailed as being shared equally due to the non-Federal Sponsor's land costs. The Federal shares were changed to bring the total project cost to a 50/50 share basis.
[3]OMRR&R for vegetation management annual costs are greater during the first 5 years ($218,000). After the first 5 years of OMRR&R for vegetation management the costs of continued vegetation management decreases ($190,000).

With an approximate directly impacted total acreage benefit of 2,500 acres associated with Alternative O Phase 1, and a total real estate project cost estimate of $80,985,000; the cost per acre is about $32,360. (Note that directly impacted acreage refers in this case to areas where changes in salinity conditions or hydration will occur. [Estimated as 480 acres of freshwater wetland rehydration, 1,575 acres of saltwater wetland salinity acreage, and 470 acres of nearshore salinity improvement.] Other habitat suitability benefits were estimated for improvements related to vegetation control and improved water quality.)

Low levels of residual agricultural chemicals have been found on the project lands. The Corps recommends that for the BBCW Project, soils with low levels of residual agricultural chemicals be left in place if ecologically acceptable or incorporate these impacted soils into the project features if approved by the appropriate regulatory agencies. The FDEP has reviewed and approved environmental conditions reports and soil management plans, prepared to date, for the incorporation of soils with residual agricultural chemicals at two of the proposed project features. Regulatory approval of similar soil management plans for the remaining project features is anticipated. Section 7.9.3 outlines the conditions under which soils with residual agricultural chemicals can be incorporated into project features and/or left on the project lands. Unless addressed as part of normal engineering and construction activities, the costs associated with incorporating soils with residual agricultural chemicals into the project will be borne by the SFMWD in accordance with the ASA(CW) CERP policy for Residual Agricultural Chemicals (Dated September 14, 2011). Though there are no outstanding RCRA HTRW response actions identified at this time, it is possible that RCRA response actions may be required on the 810 acres of project lands that remain to be fully investigated. In the event that RCRA response actions are necessary, the SFWMD will be responsible for executing these actions and paying 100% of these costs in accordance to USACE policy ER 1165-2-132.

SELECTED PLAN IMPLEMENTATION

Detailed design of the Biscayne Bay Coastal Wetlands project will be accomplished in part by the State of Florida's Expedited Construction program. Detailed design will be coordinated with and reviewed by USACE. All features will be designed in accordance with USACE regulations and standards. Crediting for work performed by the SFWMD will be subject to project authorization and adherence to USACE design standards and regulations. LERRs will be the responsibility of the SFWMD. A Draft Operating Manual is included with this report. An Interim Operating Manual modifying the Draft Operating Manual will be completed during the Detailed Design Phase reflecting any design modifications that occur during detailed design. A Final Operating Manual will be prepared following completion of operational testing and monitoring which occurs at the end of the construction phase. USACE and SFWMD will share in the responsibilities for conducting water management operations during operational testing and monitoring of the project.

STAKEHOLDER PERSPECTIVES

Initial public and agency comments received in response to a March 7, 2003 public notice of intent to prepare an Integrated PIR and EIS focused on the amount of water required to achieve restoration goals in Biscayne Bay. It was recommended that the Biscayne Bay Coastal Wetlands project should include features that help address these issues either directly, by capturing and supplying additional water for Biscayne Bay, or indirectly, by designing the project to accommodate additional deliveries of water that will be made possible through the detailed design of other CERP projects. Other recommendations encouraged the expansion of the project in order to ensure Biscayne Bay receives the amount of fresh water required for restoration.

A number of subsequent meetings with stakeholders, local governments, and representatives of non-governmental environmental organizations have provided written comments and statements. The primary focus of their concerns have centered on the need to identify additional sources of water for delivery to Biscayne Bay, specifically in the dry season to sustain salinities conducive for estuarine biological and vegetative communities. Two components recommended were the ability to later utilize reclaimed wastewater from the South Dade Wastewater Treatment Plant; and the need to include storage features in the upstream communities, which is an important consideration for hydration during the dry season.

Additional concerns raised include the need for Alternatives to account for sea level rise and demonstrate the ability to meet project goals given the continued intrusion of salt water along the coast; the project must also define long-term management options; detected levels of contaminants should be evaluated for potential risks; and the design of the project should incorporate polishing wetland components and should allow for maximum restoration of freshwater and coastal wetlands, including restoration of the coastal gradient.

Similar issues, as well as new concerns, were raised in response to the public and agency review and comment of the Biscayne Bay Coastal Wetlands Draft PIR and EIS, for which a notice of availability was published in the Federal Register on 19 March 2010. Concurrent to the 45-day review period, a project overview was presented and questions answered during the public meeting held at Deering Estate in Miami-Dade County on 21 April 2010. While there was tremendous support for the project, additional concerns included flood protection; the need to maintain adequate groundwater and surface water in the project area; and the desire to implement Phase II of the BBCW project.

A copy of the meeting flyer and electronic announcement are contained in ***Sections B.6.1*** and ***B.6.2***; while all comments and responses are contained in ***Tables B-3*** and ***B-4*** within Annex B (***NEPA Information***).

ENVIRONMENTAL OPERATING PRINCIPLES

The proposed project is consistent with USACE "Environmental Operating Principles" (refer to:
http://www.mvn.usace.army.mil/environmental/operatingprinciples.asp),
particularly with respect to the south Florida ecosystem-wide approach for plan formulation, evaluation and selection, and a holistic consideration of water resources needs and solutions to water resources problems in the study area. The

Selected Plan incorporates monitoring, and the CERP has an adaptive assessment and management program in place to ensure that projects, including the Biscayne Bay Coastal Wetlands project, are achieving their intended purposes. Project implementation, including plan formulation, involved collaborative interactions with the multiple agencies represented on the PDT. Study area stakeholder groups and members of the general public had multiple opportunities to receive information on the project and to provide comments and recommendations via public meetings, internet postings, teleconferences, and interagency PDT meetings.

TECHNICAL REVIEW

An Agency Technical Review (ATR) was performed on both the Draft and Final PIR and EIS by a multi-disciplinary team consisting of technical staff from USACE outside of the Jacksonville District. Significant comments were addressed and incorporated into the PIR. In addition to the ATR, an Independent External Peer Review (IEPR) of the Draft PIR and EIS was completed on December 1, 2009 by a team of experts external to the Corps in accordance with procedures described in U.S. Army Corps of Engineers Engineer Circular (EC) 1165-2-209 dated 31 Jan 2010 Civil Works Review Policy. Significant comments were addressed and incorporated into the Final PIR. The recent programmatic review of the CERP program and recommendations of the National Research Council (NRC) of the National Academy of Sciences (NAS) contained in the report: **Progress Toward Restoring the Everglades: The Third Biennial Review - 2010** and the previous NAS reports were utilized in the formulation and planning process for determination of the selected plan for the BBCW Final PIR. The NRC recommendations are evident in the Adaptive Management Plan for the project as well as Incremental Adaptive Restoration to utilize the phased construction approach to enable assessments of benefits and impacts to the environment as each phase is constructed. It also allows early realization of project benefits and maintains progress in CERP restoration to minimize further degradation of the ecosystem.

UNRESOLVED ISSUES

The Selected Plan is a significant first step in restoring the nearshore waters of southwestern Biscayne Bay and the adjacent tidal wetlands. However, the Selected Plan is not a complete remedy for the problems in Biscayne Bay. The remaining features of Alternative O, to be evaluated in a subsequent PIR, are an important next step that will contribute to Biscayne Bay's health and help achieve the CERP vision for the study area. The second phase of the project would consider restoration of freshwater wetlands in the Model Land/Barnes Sound area. This is the southernmost portion of the study area. The timetable for achieving the subsequent PIR is currently a significant unresolved issue.

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* Elements marked with an asterisk (*) are required for NEPA compliance according to CEQ Regulations.

SECTION 1

INTRODUCTION

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1.0 INTRODUCTION

This section will cover the background, purpose, and contextual setting of the project within the Comprehensive Everglades Restoration Plan (CERP). It includes a brief explanation of why the Biscayne Bay Coastal Wetland (BBCW) project is being proposed and why this particular Project Implementation Report (PIR)/Environmental Impact Statement (EIS) is being prepared. This report integrates plan formulation with documentation of environmental effects. It serves to satisfy documentation requirements of the National Environmental Policy Act of 1969, as amended (NEPA).

1.1 PURPOSE AND NEED FOR THE PROJECT

The CERP (or the Plan) provides a framework for restoration of the diverse and significant habitats of the south Florida ecosystem, including the Everglades, which encompasses 18,000 square miles from Orlando to the Florida Reef Tract. Everglades National Park (ENP) (the largest national park east of the Mississippi River, comprising a significant portion of the greater Everglades Ecosystem) is a World Heritage Site, an International Biosphere Preserve and a Wetland of International Importance. The Everglades and the south Florida ecosystem are affected by many factors such as competing demands for recreation, development, and natural and commercial resources and include 68 federally listed threatened and endangered plants and animals.

First authorized by Congress in 1948, construction undertaken as a result of the Central and Southern Florida (C&SF) project expanded the existing network of canals, levees, water storage areas and water control structures in south Florida. Project objectives included flood control, regional water supply, prevention of saltwater intrusion, preservation of fish and wildlife, recreation and navigation. While fulfilling these objectives, the project has had unintended adverse effects on the natural environment that constitutes the Everglades and south Florida ecosystem by disrupting the pre-existing hydrologic regime. As a result, in 1996, the U.S. Army Corps of Engineers (USACE) in conjunction with the South Florida Water Management District (SFWMD) was directed to develop a comprehensive plan to restore, preserve and protect the south Florida ecosystem while providing for other water-related needs of the region such as water quality and flood protection. The resulting plan was submitted to Congress on July 1, 1999 and consists of proposed structural and operational modifications to the C&SF project.

The recommended plan, identified as the CERP, was approved to provide a framework for the restoration of the natural system under Section 601 of the Water Resources Development Act of 2000 (WRDA 2000). The plan consists of 68 different components that work together, to restore, preserve and protect the south Florida ecosystem while providing for other water related needs of the region. The CERP components will be implemented over an approximate 40-year period. Together, these components will benefit the ecological function of more than 2.4 million acres of the south Florida ecosystem by improving and/or restoring the proper quantity, quality, timing and distribution of water in the natural system while also addressing other concerns such as urban and agricultural water supply and maintaining existing levels of flood protection.

The Biscayne Bay Coastal Wetlands project is a component of the Comprehensive Everglades Restoration Plan (CERP) which provides for the restoration, protection and preservation of the water resources of central and south Florida. The purpose of the Biscayne Bay Coastal Wetlands project is to restore the natural hydrology and ecosystem in an area degraded by drainage systems and land development.

The Biscayne Bay Coastal Wetlands Project Implementation Report (PIR) integrates plan formulation with documentation of environmental effects. This report is also an Environmental Impact Statement (EIS) to satisfy documentation requirements of the National Environmental Policy Act (NEPA) of 1969, as amended.

This PIR provides a description of the ecosystem and other related water resource problems and opportunities in the Biscayne Bay Coastal Wetlands study area and expresses desired changes as planning objectives. The alternative plans developed for this project are included in the PIR documentation. The economic, social and environmental effects of the alternatives, which include the Selected Plan, a plan of no action, and various combinations of individual management measures, are summarized in the PIR. This PIR presents details concerning the level of participation of the U.S. Army Corps of Engineers (USACE) and the non-Federal sponsor, the South Florida Water Management District (SFWMD), required for implementation of the selected plan. The report concludes with a recommendation for authorization.

1.2 REPORT AUTHORITY

The CERP was approved in Section 601 of Water Resources Development Act of 2000 (WRDA 2000), Public Law No. 106-541, of the 106th Congress:

> *(b) COMPREHENSIVE EVERGLADES RESTORATION PLAN.–*
>
> *(1) APPROVAL.–*
>
> *(A) IN GENERAL.—Except as modified by this section, the Plan is approved as 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.

The authority for the preparation of the Biscayne Bay Coastal Wetlands PIR is contained in Section 601(d) WRDA 2000, which states:

(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).

Section 601(h)(4) of WRDA 2000 further requires that a Project Implementation Report document the following:

(4) PROJECT-SPECIFIC ASSURANCES-

(A) PROJECT IMPLEMENTATION REPORTS-

(i) IN GENERAL- The Secretary and the non-Federal sponsor shall develop project implementation reports in accordance with Section 10.3.1 of the Plan.

(ii) COORDINATION- In developing a project implementation report, the Secretary and the non-Federal sponsor shall coordinate with appropriate Federal, State, tribal, and local governments.

(iii) REQUIREMENTS- A project implementation report shall—

(I) be consistent with the Plan and the programmatic regulations promulgated under paragraph (3);

(II) describe how each of the requirements stated in paragraph (3)(B) is satisfied;

(III) comply with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 et seq.);

(IV) identify the appropriate quantity, timing, and distribution of water dedicated and managed for the natural system;

(V) identify the amount of water to be reserved or allocated for the natural system necessary to implement, under State law, subclauses (IV) and (VI);
(VI) comply with applicable water quality standards and applicable water quality permitting requirements under subsection (b)(2)(A)(ii);
(VII) be based on the best available science; and
(VIII) include an analysis concerning the cost-effectiveness and engineering feasibility of the project.

1.3 PROJECT AREA

The Biscayne Bay Coastal Wetlands project area is located in southeast Miami-Dade County, south of Miami and east of Florida City and Homestead, within the SFWMD's Lower East Coast (LEC) water supply planning region (***Figure 1-1***). The study area is bounded by south-central Biscayne Bay and Biscayne National Park (BNP) to the south and east, and the Atlantic Coastal Ridge, and agricultural and suburban development to the north and west. Florida Power & Light Company's (FPL's) Turkey Point nuclear power plant, Homestead Air Reserve Base and the South Dade Landfill are located in the project area. The project area overlaps several drainage basins, six of which are named for the associated major east-west canals: Canal 100 (C-100), C-1, C-102, C-103, North Canal and Florida City Canal. These canals are operated to reduce the potential for flood damages as well as to limit salinity intrusion into the local groundwater system. To limit flood damages, water managers use the canal system to lower the groundwater elevation which increases runoff storage potential in the canal basins. Additional flood protection is provided by the L-31E Levee and Canal which runs north-south along South Central Biscayne Bay. The eastern-most water control structures are located at the intersection of the L-31E Canal and the major east-west canals. During the dry season, water managers use the east-west canal network to import water from the northwest which increases groundwater elevation and limits saltwater intrusion in to the aquifer.

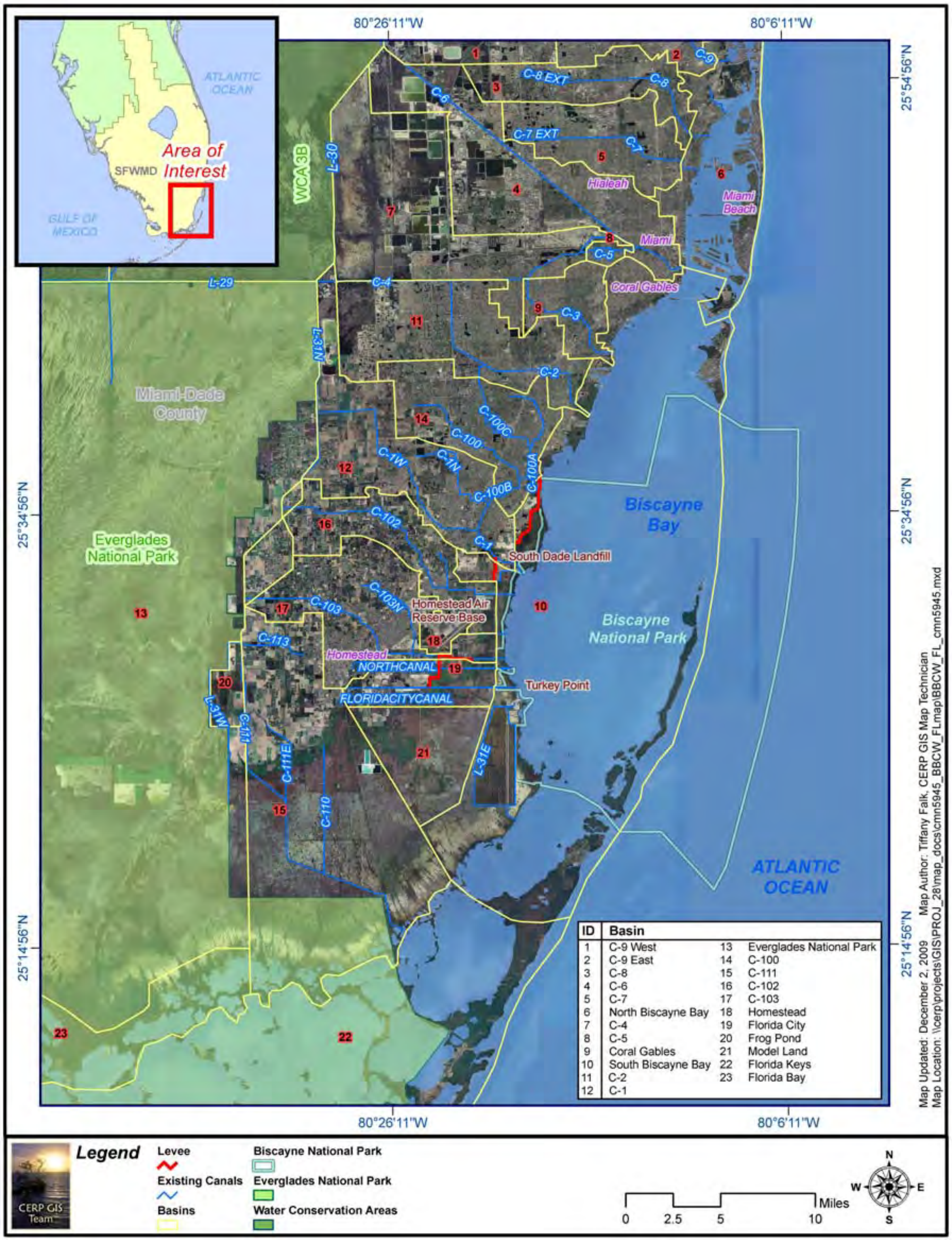
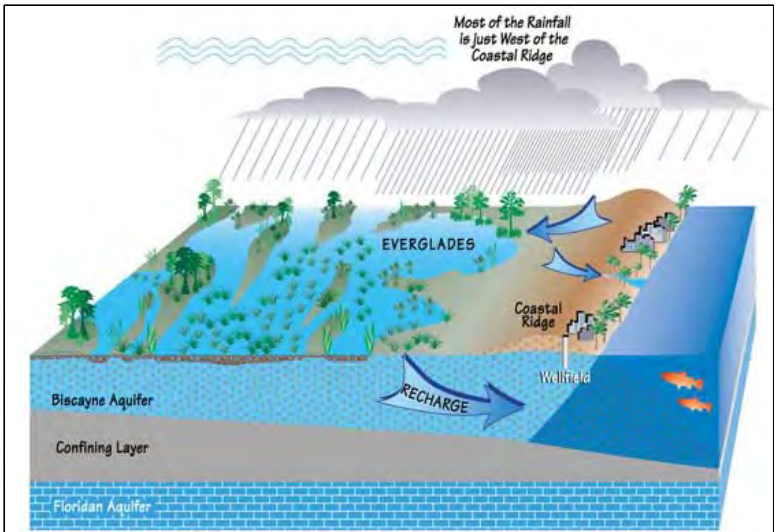


FIGURE 1-1: BISCAYNE BAY COASTAL WETLANDS LOCATION MAP

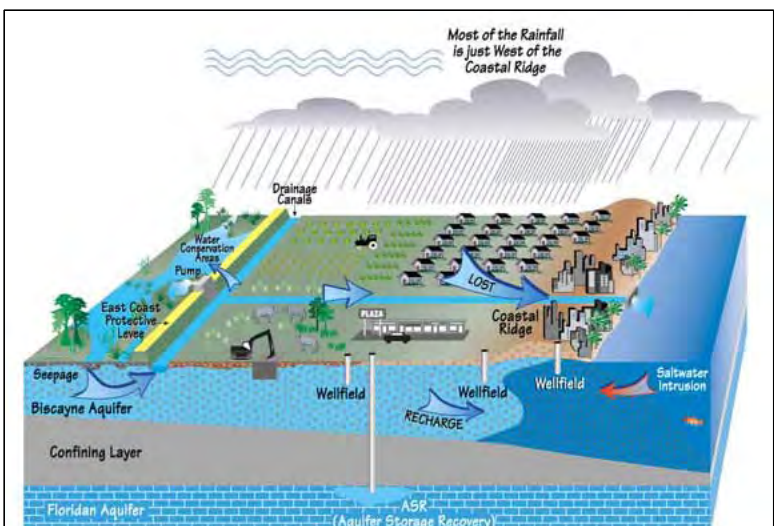
1.4 STUDY AREA DESCRIPTION

Biscayne Bay is a shallow estuarine lagoon extending nearly the entire length of Miami-Dade County, which is located in southeastern Florida. Biscayne Bay is home to over 500 species of fish and many other marine organisms. A large area of the south central portion of Biscayne Bay is contained within Biscayne National Park. The longest stretch of mangrove forest remaining on Florida's eastern seaboard occurs within Biscayne Bay. There are also extensive areas of seagrasses in Biscayne Bay, which serve as an important food source for the endangered Florida manatee, and as nursery areas for many ecologically and commercially important estuarine species, such as shrimp, crabs, lobster, and sponges. Biscayne Bay has been designated by Florida Statutes as an Outstanding Florida Water (OFW) and an Aquatic Preserve.



Pre-Drainage - Lower East Coast of Florida Circa 1900

Currently, several canals designed to provide flood risk management and protect water supplies transect the Biscayne Bay Coastal Wetlands project study area. The drainage system currently in place has transformed Biscayne Bay from a natural estuary driven by diffuse freshwater flows to an artificial system driven by controlled, point-source, freshwater pulses. Historically, Biscayne Bay received fresh water from overland flow passing through the coastal ridge and wetlands, and extensive groundwater seepage. These natural freshwater inputs produced a distinctive salinity gradient that supported the diverse habitats characteristic of Biscayne Bay (seagrass and algal meadows, oyster reefs, sponge beds, mangrove forest and marshes).



Present Day - Lower East Coast of Florida

The drainage canals disrupted interconnected physical and chemical natural processes such as hydrology, salinity patterns, and nutrient inputs. The existing canals impact freshwater flows to the Biscayne Bay estuary by lowering the region's water table and reducing water storage in contributing basins; decreasing groundwater inflow to Biscayne Bay; and eliminating or altering natural tributaries. Drainage has permitted agricultural and suburban development in areas that were once vital wetlands and increased the flow of pollutants to Biscayne Bay. Development of watershed lands and the commensurate control of water levels have also altered the timing and duration of freshwater flows to the Biscayne Bay.

As a result of changes in salinity patterns, the once extensive estuary that linked marine and freshwater zones and provided vital nursery habitat has been diminished. Increasing salinity over time has resulted in the expansion of salt tolerant mangrove wetlands into formerly freshwater zones eliminating freshwater wetlands. Changes to marine habitats include dramatic reductions in the abundance of typically estuarine species. Seagrass communities have likewise been impacted by the hydrologic modification. Diverse seagrass communities provide habitat and food to commercially and recreationally important fish and shellfish and protected marine species, act as nutrient and sediment traps, and help stabilize the bottom of Biscayne Bay.

Restoration of a healthy, productive aquatic ecosystem in Biscayne Bay is essential to maintaining the ecological integrity and associated economic activity in these publicly owned and managed areas.

1.5 STUDY SPONSOR AND PARTICIPANTS

USACE initiated the PIR at the request of the SFWMD, the non-Federal sponsor for the study. USACE and SFWMD are the lead agencies in the PIR and shared the cost of the study equally. Numerous other agencies, organizations and individuals participated in the study, including the Miami-Dade Department of Environmental Resources Management (DERM), Florida Department of Environmental Protection (FDEP), U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), National Oceanic and Atmospheric Administration (NOAA) Fisheries, and U.S. Environmental Protection Agency (USEPA). Additional information on public involvement in the study is included in ***Section 9 – Summary of Coordination, Public Views and Comments***.

1.6 RELATIONSHIP TO OTHER USACE/NON-FEDERAL SPONSOR EFFORTS, STUDIES, DOCUMENTS AND REPORTS

Listed within this section are brief descriptions of other key projects related to the Biscayne Bay Coastal Wetlands project. Included in the description are the objectives and/or study area.

1.6.1 C-111 Spreader Canal Project

The CERP C-111 Spreader Canal project includes levees, canals, pumps, water control structures and a stormwater treatment area (STA) to be constructed, modified or removed in the Model Lands and Southern Glades area of Miami-Dade County. The intent of this project is to re-establish sheetflow and hydrologic connectivity between natural areas, resulting in improved hydropatterns and a sustainable ecosystem, reduced wet season deliveries in C-111, and decreased flood risk in south Miami-Dade. This project area is adjacent to the Biscayne Bay Coastal Wetlands area. This project is in the PIR phase.

1.6.2 Wastewater Reuse Technology Pilot

This CERP Wastewater Reuse Technology Pilot project addresses water quality issues associated with discharging reclaimed water into the Biscayne Bay Coastal Wetlands Alternative O Phase 1 project. It also determines the level of superior treatment and the appropriate methodologies for that treatment.

1.6.3 Stormwater Detention and Treatment Area Project

A pilot project has been constructed in the Biscayne Bay Coastal Wetlands by DERM with funding support from the SFWMD, the FDEP and the Homestead Air Reserve Base. The main purpose of the pilot project is to evaluate a method for modifying the timing and delivery of canal discharges to Biscayne Bay in order to minimize the negative ecological effects caused by large pulse discharges of fresh water.

1.6.4 South Dade Watershed Plan

The purpose of the South Dade Watershed Plan is to formulate an integrated land use and water management strategy for all of the lands that comprise the major drainage basins in southeastern Miami-Dade County: the C-2, C-100, C-1, C-102, C-103, North Canal and Florida City basins. The entire footprint of the Biscayne Bay Coastal Wetlands project is located in the South Dade Watershed Plan area. The South Dade Watershed serves two national parks, as well as urban and agricultural areas. The South Florida Regional Planning Council, Miami-Dade County Department of Planning and Zoning (MDPZ) and the South Florida Water Management District (SFWMD) are participating in the Plan.

The South Dade Watershed Plan directs the comprehensive growth management of land uses consistent with CERP projects within Miami-Dade County that consider protection of the environment, including land and water resources.

1.7 PROGRAMMATIC REGULATIONS GUIDANCE MEMORANDA

The WRDA 2000 required the development of Programmatic Regulations to provide additional guidance for implementation of the CERP. Section 385.5 of the Programmatic Regulations specifically requires the development of six program-wide Guidance Memoranda (GM) that are consistent with the Programmatic Regulations and applicable law. It also requires the establishment of additional procedures to achieve the goals and purposes of the Plan. The GMs are fundamental to the integrated framework; provide direction for using the tools for planning, implementation and evaluation; and provide assurances that the goals and purposes of the Plan would be achieved. The GMs address numerous topics including common methods, general procedures and guidance to implement the Plan.

1.7.1 Project Level Monitoring Guidance

The BBCW project area encompasses a large portion of south-central Biscayne Bay and extends from Shoal Point south to Barnes Sound. This area has been significantly altered by human activities that have degraded nearshore habitat along the south-central area of western Biscayne Bay, as well as the function and spatial extent of adjacent coastal wetlands.

A Monitoring and Assessment Program (MAP) through RECOVER will be incorporated with this project to detect system-wide or regional changes, and will be measured across large spatial scales. Changes affecting Biscayne Bay, such as the BBCW project, however, may not be adequately detected using the MAP parameters and sampling site arrays. For restoration purposes, it is very important to be able to measure and detect ecological and water quality changes resulting from project specific activities. Therefore, in order to detect project-specific changes, additional parameters and sampling sites will be required and are addressed in the Project Monitoring Plan contained in ***Annex E*** of this document.

Monitoring guidance is contained in the Implementation Guidance for Section 2039 of WRDA 2007 - Monitoring Ecosystem Restoration, dated 31 August 2009. The guidance allows project-level monitoring for a period of 10 years from completion of construction of a project. Justification for implementing the project-level monitoring plan in its entirety is based on the need for greater spatial and temporal resolution in its monitoring data in order to detect ecological changes resulting from project operations.

1.8 RELEVANT DOCUMENTS AND REPORTS

Restoration in the project area was investigated in the early 1980s in Miami-Dade County's Biscayne Bay Management Plan (Metropolitan Dade County Board of County Commissioners 1986). The SFWMD's Biscayne Bay Surface Water Improvement and Management Plan (Alleman et al*.,* 1995) further considered restoration opportunities. A conceptual restoration plan for the area was included in the CERP. The Biscayne Bay Coastal Wetlands project includes two components of the authorized and approved Yellow Book (YB) selected alternative D13R: (1) Biscayne Bay Coastal Wetlands (designated as an Other Project Element) and (2) Biscayne Bay Coastal Canals (component FFF of the CERP). The YB plan for the project includes pump stations, spreader swales, STAs, flow ways, levees, culverts, and backfilling canals located in southeast Miami-Dade County. The project area, approximately 60,000 acres, is depicted in the YB subteam conceptual plan (***Figure 1-2***). Overland sheet flow from the Deering Estate at C-100C, south to the FPL Turkey Point power plant, generally along L-31E would be restored. The restoration of component 5 (Barnes Sound) would require re-establishing sheetflow across the Model Lands south of Turkey Point. Conceptual plans for both elements are included in the YB.

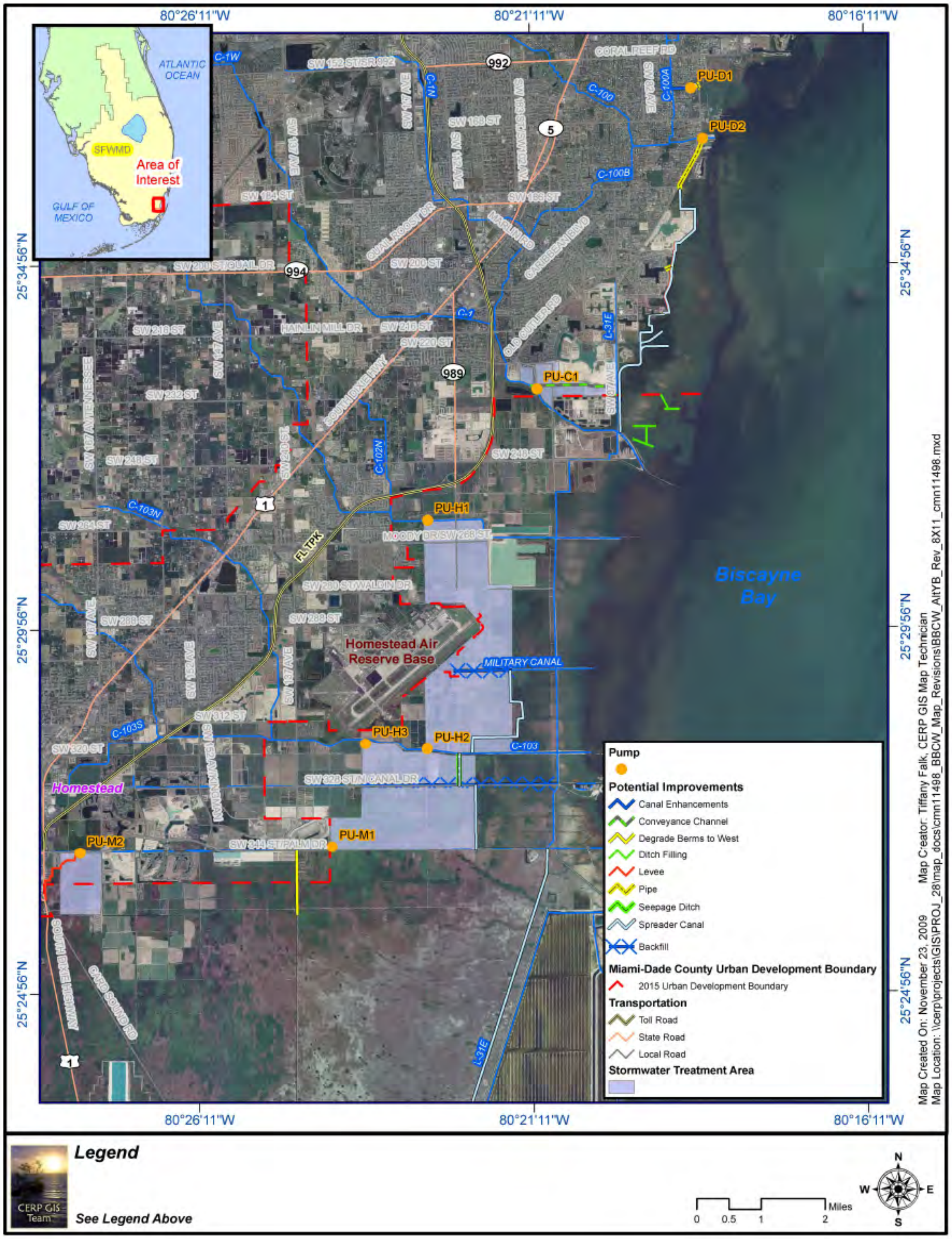


FIGURE 1-2: YELLOW BOOK (YB) CONCEPTUAL PLAN

1.9 COMPREHENSIVE EVERGLADES RESTORATION PLAN MASTER IMPLEMENTATION SEQUENCING PLAN

The sequencing plan for the implementation of the CERP was included in Section 10 of the YB. Subsequent to the completion of the YB, the implementation plan was updated in July 2001, and was known as the Master Implementation Schedule (MIS 1.0). The Master Implementation Sequencing Plan 1.0 (MISP 1.0), dated March 2005, built on these previous efforts and incorporated new information, implementation experience to date, and changes in legislation. The new information included the requirements in WRDA 2000 and the subsequent programmatic regulations, as well as the effects of streamlining contained in the State of Florida's expedited construction effort, an accelerated implementation schedule for several CERP components. The expedited effort hastens the CERP implementation while maintaining the relationship of the MISP 1.0 and the partnership between SFWMD and USACE. The MISP 1.0 identified the Biscayne Bay Coastal Wetlands project as a Band 1 project (completion in 2010) that would be constructed by the State of Florida under their expedited construction program.

1.10 STATE OF FLORIDA EXPEDITED CONSTRUCTION

The State of Florida developed an expedited construction program for the purpose of expediting design and construction of a number of critical restoration projects consistent with the CERP, but prior to one or more of the following: Administration approval, Congressional committee resolution, Congressional authorization, or Federal construction funding. The State anticipates that the expedited construction effort will provide immediate environmental, social and economic benefits in the south Florida region. State expedited construction must be consistent with the Congressionally authorized CERP project in order to be eligible for funding under the CERP. The SFWMD is the state agency responsible for water resources management in south Florida and acts as the non-Federal sponsor for Federal water resources projects, including the CERP. The SFWMD is the lead agency for the State on implementing the expedited construction projects and will need to acquire the Department of the Army permits under Section 404 of the Clean Water Act prior to construction. As of the generation of this document, the expedited features within the selected plan have been fully designed by SFWMD, and SFWMD intends to begin phased construction of the expedited features early in 2011.

1.11 LAND ACQUISITION ACTIVITIES

There are approximately 3,761 acres required for the project. The SFWMD owns approximately 934.14 acres within the footprint of the project with an additional approximately 414.83 acres to be acquired from private landowners. These acres would be provided in fee. Florida Power and Light (FPL) owns approximately 148.9 acres within the footprint of the project and will convey a perpetual flowage easement to the SFWMD for the project. The United States of America, National Park Service owns approximately 937.27 acres which will be provided by Letter Agreement or Memorandum of Agreement.

The Trustees of the Internal Improvement Trust Fund (TIIF), State of Florida, owns fee title to approximately 111.06 acres within the project footprint. The State will convey a perpetual easement to the SFWMD or execute a Supplemental Agreement which will contain language sufficient to ensure that TIIF and SFWMD provide the interest held by TIIF to the project for the life of the project.

Miami-Dade County Water and Sewer Department owns approximately 403.4 acres and Miami-Dade Parks and Recreation owns approximately 198.55 acres within the project footprint. Miami-Dade County regulations prohibit the conveyance of an interest to the SFWMD. Miami-Dade County DERM owns or controls approximately 612.9 acres within the Alternative O Phase 1 portion of the project footprint. These Miami-Dade County governmental entities will execute Supplemental Agreements which will contain language sufficient to ensure that Miami-Dade County and SFWMD provide the interest held by Miami-Dade County to the project for the life of the project.

Refer to the ***Real Estate Appendix***, ***Appendix D***, Paragraph D.17 for the Analysis of Estates Required for the Project. Refer to ***Appendix D***, Paragraph D.18 for the Proposed Estates required for the Project.

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SECTION 2

IDENTIFICATION OF PROBLEMS AND OPPORTUNITIES

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2.0 PROBLEMS AND OPPORTUNITIES

Identifying problems and opportunities is the most important step in the planning process. Problems are defined as existing, negative conditions. Opportunities are defined as desirable, future conditions. From these, objectives are formed and constraints identified that will guide efforts to solve the problems and achieve the opportunities. Objectives are the results that the project alternatives are trying to achieve; constraints are things that must be avoided (such as negative impacts to protected species) or things that cannot be changed (such as no reduction in flood protection benefits). These items are the basis of the planning process and by which each alternative will be measured.

2.1 ECOSYSTEM PROBLEMS

Today, freshwater flows to Biscayne Bay through canals produce periods of abnormally high salinity (>40 practical salinity units [psu] at times) alternating with low salinity in nearshore areas due to the pulsed nature of canal flows (Alleman et al., 1995). The survival of many estuarine organisms depends upon a stable seasonal availability of low salinity environments (Serafy et al., 1997; Montegue and Ley, 1993; Brooke et al., 1982; Kohout and Kolipinski, 1967), and the reduction or loss of these environments has resulted in concomitant reduction or loss of species dependent on such conditions. Spotted seatrout that was once common, for example, is now uncommon. Red drum was once abundant (Smith, 1896), but this species, which requires stable mesohaline (5–25 psu) habitat conditions (Serafy et al., 1997), has been lost from Biscayne Bay because of disruption of natural freshwater flow patterns and loss of the appropriate salinity regime (J. Serafy, NOAA, personal communication). The unnatural canal flows that are composed of many more peak flows during the wet season and often no flow in the dry season do not support a habitat that is suitable for the Eastern oyster. Once abundant at the mouths of creeks, oyster reefs no longer exist near the outlets of the canals. High velocity water moving out through canals and into Biscayne Bay can behave as a coherent and discrete stable water mass of low salinity that may not immediately mix with marine water due to the density difference between fresh water and salt water (Chin-Fatt and Wang, 1987). Pulsed point-discharge releases cause large and rapid shifts in salinity as water masses move into Biscayne Bay, and severely impact, or kill, attached or rooted benthic organisms and plants, as well as impacting fish communities (Serafy et al., 1997; Irlandi et al., 1997; Lorenz et al., 1997; Montegue and Ley, 1993; Brook, 1982). Species diversity and numbers of fish, mollusks, crustaceans and algae are lower in the vicinity of canals in Biscayne Bay (Thorhaug et al., 1976). In addition, modeling of these high flows shows that the zone of influence extends much further into Biscayne Bay than it did historically. Lower salinity water pushed out from the canals can move out into the hardground areas of sponges and soft corals creating unfavorable conditions for these organisms. Paleoecological studies from nearshore sites in central and southern Biscayne Bay indicate that salinity levels have become increasingly and consistently more marine over the last 100 years (Wingard et al., 2003) promoting a habitat that favors marine biota rather than estuarine, which has significantly altered the composition of the Biscayne Bay coastal wetlands.

Prior to construction of the canal and levee system in the study area, water flowed overland and through a series of creeks and small rivers into Biscayne Bay. Compelling historical evidence indicates that fresh water flowed into Biscayne Bay year-round, peaking in the wet season, and diminishing in the dry season. Since the morphology of the creeks were shallow, narrow and sinuous, flow velocity was not large and did not ordinarily vary greatly from day to day. The continuous flow resulted in a range of salinity patterns from fresh to salt. The freshwater/saltwater ecotone is the transitional zone where fresh and saltwater meets, and then mix. Today, salinity control structures, berms and levees have created an abrupt difference between saline and freshwater habitats. The very low and moderate salinity habitats are now almost entirely non-existent. The absence of continuous low to moderate salinity habitats has impacted life stages of many estuarine species such as blue crabs that depend on these zones for portions of their life cycles. Fish biomass is positively affected by freshwater inflow to the coastal ecotone (Lorenz et al., 1997). Even endangered species such as juvenile crocodiles and manatees are likely affected by the absence of these low to moderate salinity habitats. Historically, freshwater wetland vegetation extended almost to the coastline within the study area (Davis, 1943). Today, salt-tolerant vegetation such as mangroves now covers these wetlands inland to the levees.

Rapid drainage afforded by the canals and the reduced water table now maintained in the study area have reduced the functional habitat value of the remaining freshwater wetlands. Hydroperiods, the period of time during which a wetland is covered by water, that were once as long as an entire year have been reduced to days or weeks. And nearly all of the remaining freshwater wetlands in the area have been invaded by non-native vegetation as a result of the drier conditions. These wetlands were important feeding area for wading birds, including roseate spoonbills, wood storks, and white ibis, whose south Florida breeding populations have declined substantially in the past 60 years (Ogden, 1994). The low functional values of these wetlands have made them a target for conversion to other types of land uses such as agriculture, rock mining and urbanization. Consequently, over time, any of the original freshwater wetland areas have been converted to other land uses and their ecological values have been lost.

In addition to supporting natural habitats in the project area, water is needed for urban and agricultural uses, but the region's water supply is limited. The growing demand for inexpensive, high quality water to meet present and future needs throughout the region is already creating conflicts among water users. As rainfall declines and sea level rises, salt water is steadily encroaching into the aquifer within the study area. Actions that preserve open land and wetlands may help inhibit further water supply degradation.

2.2 PROBLEM STATEMENTS

1. Estuarine species have declined in diversity and number due to hypersalinity and extreme salinity fluctuations in Biscayne Bay.
2. Freshwater/saltwater ecotones (transitional areas where fresh and saltwater meet and mix) that are important to estuarine species have been nearly eliminated.
3. Freshwater and saltwater wetlands have been altered or eliminated.
4. Freshwater is being discharged directly to Biscayne Bay and is therefore not available for use by coastal wetlands.
5. Loss of wetlands has decreased the amount of natural water storage.

The identified problems may be addressed within the Corps' ecosystem restoration mission and the authorized purposes of CERP.

2.2.1 Opportunities

Point-source canal discharges can be redirected to wetlands, creating overland flow, restoring creeks and re-establishing more diffuse freshwater flows into Biscayne Bay. Redistribution of freshwater could reduce the impacts caused by the pulsed discharges and begin to establish the freshwater/saltwater ecotones. This would also reduce the velocity of discharges because the water would be stored in the wetlands and be released more slowly- overland flow seepage discharge is slower than direct canal discharge. This water diversion would promote more natural gradual groundwater and overland flow which would help to reestablish productive nursery habitat for estuarine species along the shoreline areas of Biscayne Bay by stabilizing salinity concentrations in the saltwater wetlands and nearshore areas.

Establishing an infrastructure to redistribute fresh water into wetlands, creeks and impoundments could set the stage to accept proposed wastewater reuse flows as described in the CERP. This additional source of fresh water would have its largest benefit in the dry season when watershed runoff is insufficient to prevent hypersaline conditions in the bay.

Diverting fresh water from the canals into freshwater wetlands can increase the average water levels in the wetlands. Higher water level would inhibit the growth of non-native, nuisance and woody vegetation, and increase periphyton productivity and fish biomass.
South Florida's climate, shorelines and national parks attract millions of tourists and residents to the area each year. A stable and healthy area ecology could directly benefit the region's economy, primarily through increased tourism and recreational spending. Opportunities for fishing, boating, camping and hiking attract visitors to areas in and around Biscayne Bay. Tourism is a vital component of south Florida's economy, employing more than 57,000 local residents in businesses catering to the needs of tourists, including:

- Hotels and restaurants
- Boating and water sports related businesses
- Marinas, tackle shops, boat retailers and suppliers
- Fishing guides, charter boats
- Outdoor recreation supply businesses

About 65 million person-days per year are expended by both tourists and residents participating in recreation related to Biscayne Bay (Hazen and Sawyer, 2005), with an annual expenditure of about $3.8 billion. Economic studies have determined that the net gain in restoring the Biscayne Bay coastal systems is $41 million (Lee and Bwenge, 2007) just by controlling invasive vegetative species.

The dedication of lands towards restoration of freshwater and estuarine wetlands can also help restore the natural coastal glades habitat within the study area. This may also help to maintain or reestablish ecological and hydrological connectivity between Biscayne Bay coastal wetlands, the C-111 Basin, the Model Lands, and other adjacent basins.

2.2.2 Opportunity Statements

1. Reduce point source discharges and redistribute freshwater flows to Biscayne Bay.
2. Improve storage of freshwater to augment dry season flows to Biscayne Bay.
3. Restore water levels in freshwater wetlands.
4. Preserve and restore the spatial extent of natural coastal glades habitat within the study area.
5. Increase tourism, recreation and economic value.

2.3 OBJECTIVES AND CONSTRAINTS

Planning objectives are the purposes of a study. They are what the project is trying to achieve and give direction to the management measures and alternatives. Objectives were developed by integrating the problem statements with the CERP programmatic goals that include increasing the spatial extent of natural areas, improving habitat function and quality, and improving native plant and animal abundance. The planning objectives for Biscayne Bay Coastal Wetlands would be attained within the period of analysis for the study which ends in Year 2050.

1. Reestablish productive nursery habitat along the shoreline.
2. Redistribute freshwater flow to minimize point source discharges to improve freshwater and estuarine habitat.
3. Restore and improve quantity, quality, timing, distribution of freshwater to the bay, including Biscayne National Park.
4. Preserve and restore spatial extent of natural coastal glades habitat.
5. Reestablish connectivity between Biscayne coastal wetlands, C-111 Basin, Model Lands, and adjacent basins.
6. Restore nearshore and saltwater wetland salinity regimes.

Planning constraints restrict plan formulation. Alternative plans are formulated to achieve planning objectives, but they are also formulated to avoid violating the constraints. There are two types of planning constraints- universal constraints and study-specific constraints. Universal planning constraints are the legal and policy constraints that need to be included in every planning study. They are defined by local, State, and Federal laws, regulations, and applicable guidance and policies. Examples of these include:

- Complying with all Federal, state and local laws, regulations and policies.
- Maintain existing levels of flood protection to agricultural and urban lands (Savings Clause [Section 601 (h)(5)(B) of WRDA 2000]).
- Maintain levels of service for existing legal water users (Savings Clause [Section 601 (h)(5)(A) of WRDA 2000]).
- Minimizing impacts to cultural, historical and archaeological resources.
- Minimizing adverse socioeconomic impacts on the local and regional economies.
- Avoiding, minimizing, or providing compensatory mitigation for any impacts to pre-existing compensatory mitigation sites within the project area under Section 404 of the Clean Water Act.

Study-specific planning constraints are restrictions that limit the extent of the planning process within a particular study. They are unique to a specific planning study that alternative plans should avoid. The study-specific planning constraints for the Biscayne Bay Coastal Wetlands project are:

- Do not increase salinity intrusion into the freshwater Biscayne aquifer within the study area.
- Do not adversely affect the habitats of threatened or endangered species in the study area, such as the American crocodile or the West Indian manatee.
- Do not use water that violates State water quality standards for discharge into the wetlands being rehydrated / restored in the project.

SECTION 3

EXISTING CONDITIONS/AFFECTED ENVIRONMENT

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3.0 EXISTING CONDITIONS/AFFECTED ENVIRONMENT

3.1 STUDY AREA

Biscayne Bay is a shallow saline tropical bay/coastal lagoon located along the southeastern coast of Florida, formed as rising sea levels filled a limestone depression. It is bordered to the west by the mainland of Florida, which includes the densely populated area of Miami-Dade County. To the east, Biscayne Bay is bordered by a series of barrier islands. The Biscayne Bay is connected to the Atlantic Ocean by a series of channels and cuts, some natural and some artificial, and it contains a number of islands. In contrast to many other estuaries, Biscayne Bay does not receive a sediment load from major river systems; most of the sediment in Biscayne Bay is produced by local biota. Most of the shoreline in the northern portion of Biscayne Bay is bulkheaded and the majority of the bottom has been dredged. In the South Central portion of Biscayne Bay, dredging and bulkheading are not extensive.

The Biscayne Bay system can be divided in three major areas. The North Biscayne Bay area extends south from Broward County to Rickenbacker Causeway. Major tributaries to North Bay include Arch Creek, the Biscayne Canal, Little River and Miami River. Tidal exchange with the Atlantic Ocean occurs at Bakers Haulover Cut, Government Cut and Norris Cut.

Central Biscayne Bay ranges from Rickenbacker Causeway south to the boundary of Featherbed Bank just north of Sands Key. Tidal exchange occurs through the Safety Valve, a series of shoals and shallow cuts which make up the eastern boundary of this part of the Bay. The Coral Gables Waterway, Snapper Creek and Cutler Drain are the main tributaries to this section. Development along the coastline is not as pronounced in this section; many of the natural mangrove wetlands are still intact, along with large seagrass beds and small areas of soft coral and sponges.

South Biscayne Bay extends from the Featherbed Bank to Cutter Bank. The area is fringed by mangrove wetlands, with dense seagrass beds, large hard ground areas and algal communities. Black Creek, Princeton Canal, Military Canal and Mowry Canal, drain into this part of the Bay, with tidal exchange with the Straits of Florida through the Safety Valve and Caesar's Creek. The southern end of the Bay is connected by restricted openings to Card Sound and Barnes Sound, with limited exchange between the two.

The Biscayne Bay Coastal Wetlands study area lays in southeast Miami-Dade County (refer to the Biscayne Bay Coastal Wetlands project maps in ***FIGURE 3-1*** and ***FIGURE*** 3-2). The project area includes the South Dade Wetlands (SDW), southeast of the Miami Rock Ridge. The SDW form a contiguous habitat corridor with Everglades National Park (ENP), BNP, Crocodile Lakes National Wildlife Refuge, the north Key Largo conservation and recreational lands purchases, John Pennekamp State Park and the National Marine Sanctuary. Approximately 80 percent of the land in the SDW has not been directly disturbed by human use. The most frequent source of physical disturbance is agricultural activity; currently, most farming activities within the management area have ceased. In some cases, previously farmed lands have been invaded by exotic species.

The western portion of the Model Land basin is made up of the wetlands in the north C-111 Basin, located adjacent to the C-111 Canal, east of ENP, west of U.S. Highway 1, north of SW 424th Street and south of State Road 9336, with the exception of active agricultural land. The eastern portion includes the wetlands south of SW 344th Street (Palm Drive), east of U.S. Highway 1, and South to Biscayne Bay, Card Sound and Barnes Sound. The SFWMD and Miami-Dade County currently own over 12,000 acres of the approximately 32,000 acres included in the joint acquisition project. The remaining 20,000 acres is made up of over 1,200 individual tracts, including large parcels of land owned by FPL in the Model Land basin.

The Southern Glades region is bounded by ENP to the south and west, U.S. Highway 1 to the east and the Model Land basin to the north except for the far western edge, west of C-111E, which extends further north to the boundary of the Frog Pond. The SFWMD owns nearly all of this property totaling over 30,000 acres.

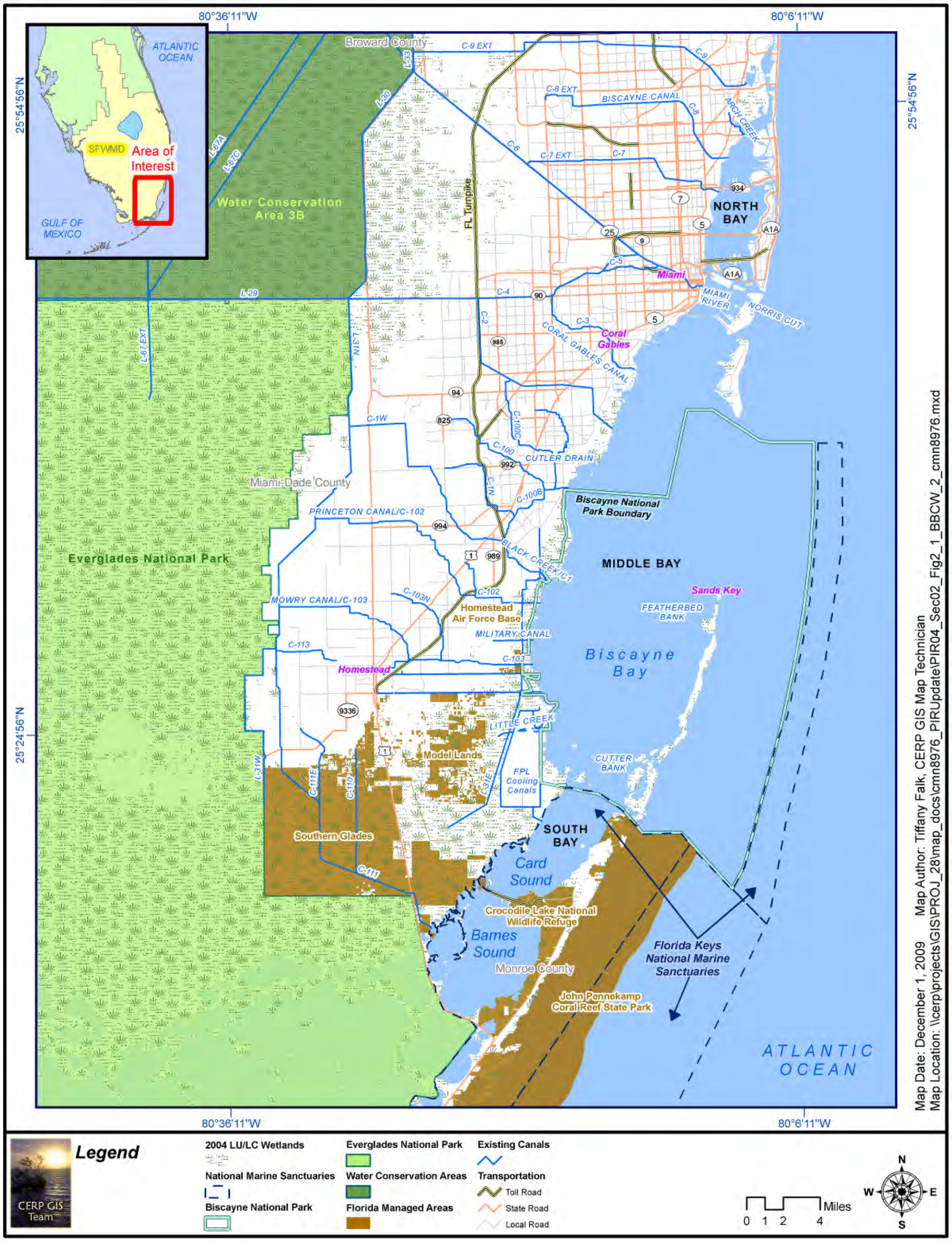


FIGURE 3-1: BISCAYNE BAY COASTAL WETLANDS GENERAL LOCATION MAP

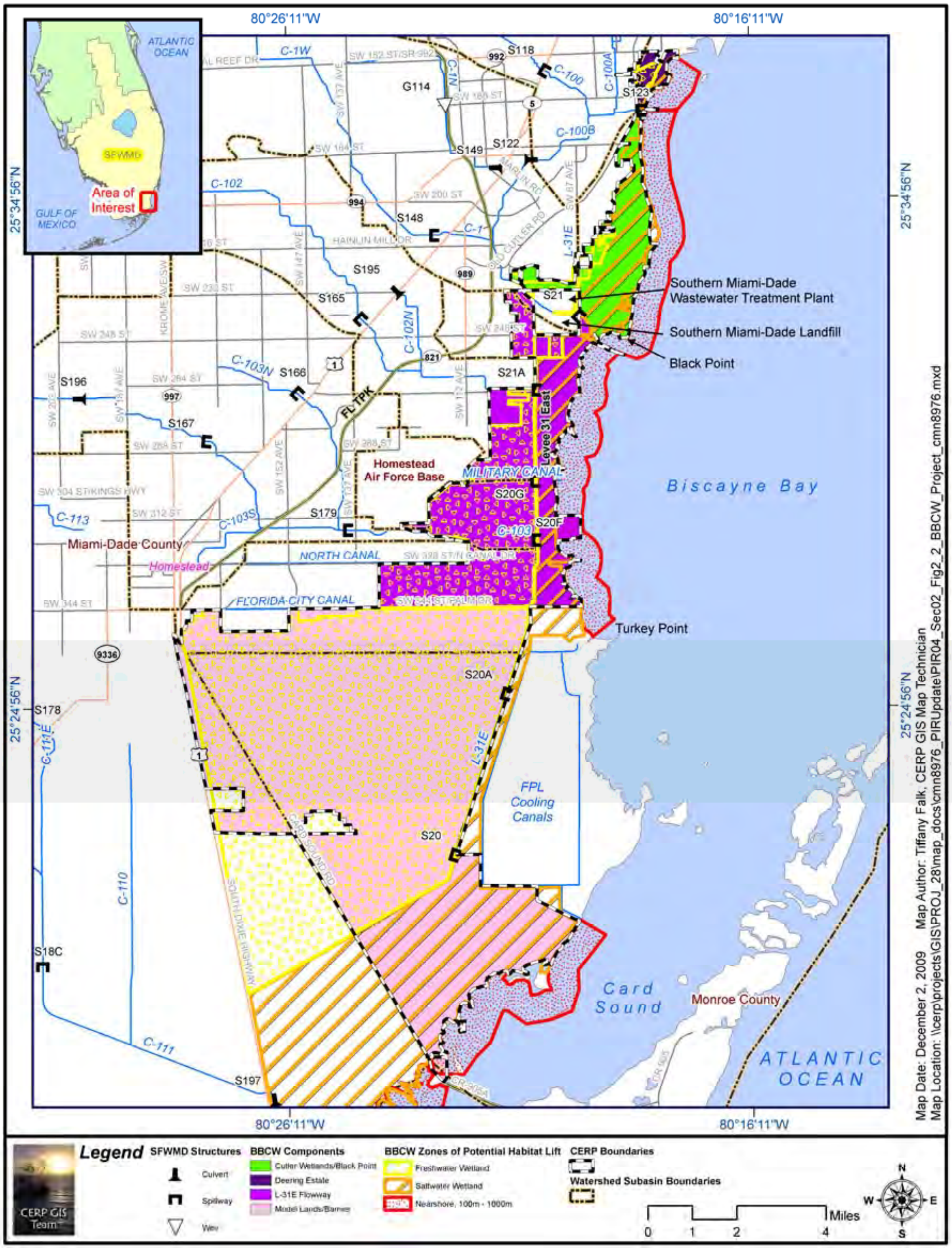


FIGURE 3-2: BISCAYNE BAY COASTAL WETLANDS PROJECT AREA MAP

3.1.1 Climate

The subtropical climate of south Florida, with distinct wet and dry seasons, high rates of evapotranspiration, and climatic extremes of floods, droughts and hurricanes, represents a major physical driving force that sustains the Everglades while creating water supply and flood control issues in the agricultural and urban segments. South Florida's climate, in combination with low topographic relief, delayed the development of south Florida until the twentieth century and provided the main motivation for the creation of the Central and Southern Florida (C&SF) Project 50 years ago. It continues to drive the water management planning of the CERP today.

Seasonal rainfall patterns in south Florida resemble the wet and dry season patterns of the humid tropics more than the winter and summer patterns of temperate latitudes; rainfall over the basin can be quite varied both in annual amount and seasonal distribution. Of the 60 inches of rain that south Florida receives annually on average, 75 percent falls during the wet season months of May through October. Wet season rainfall follows a bimodal pattern with peaks during May-June and September-October. The wet season rainfall events are normally of short duration and amounts are quite variable spatially. Tropical storms and hurricanes provide major contributions to wet season rainfall with a high level of inter-annual variability. During the dry season, rainfall is generally associated with mid-latitude systems and is spatially distributed in a relatively uniform pattern. High evapotranspiration rates in south Florida roughly equal annual precipitation. Recorded annual rainfall in south Florida has varied from 37 to 106 inches, and inter-annual extremes in rainfall result in frequent years of flood and drought. Multi-year high and low rainfall periods often alternate on a time scale approximately on the order of decades.

Additional hydrologic and climatic information for the Biscayne Bay vicinity can be obtained from the SFWMD's corporate environmental database, DBHYDRO. The database stores hydrological, meteorological, hydrogeological, and water quality data.

3.1.2 Physical Landscape: Geology, and Soils

3.1.2.1 Geology

The geological conditions of the Biscayne Bay Coastal Wetlands study area is limited to the units encountered within the unconfined surficial Biscayne Aquifer. The Biscayne Aquifer is a hydrologic unit of water bearing rocks ranging in age from lower Pleistocene to upper Pliocene. The geometry of the aquifer deposits is a seaward thickening wedge that varies from zero feet at the western boundary of Miami-Dade County to a maximum of 240 feet thick at the coast. The aquifer is comprised, from top to bottom, of some, or of all of the following formations: 1) Lake Flint Marl; 2) Miami Oolite; 3) Anastasia Formation; 4) Key Largo Limestone; 5) Fort Thompson Formation; and 6) Caloosahatchee Marl (relatively insignificant erosion remnants and isolated reefs not present in the area of concern). The base of the Biscayne Aquifer is determined as the top of the low permeability sand (marl) of the Tamiami Formation.

3.1.2.2 Soils

Surficial materials consist of several soil types, including peat, Everglades peat, Lake Flint Marl, and weathered Miami Oolite. Each is fine grained and varies in thickness from one foot to approximately ten feet thick. The hydraulic conductivity for these materials is low.

The basic soil types found in the coastal areas and creeks of Biscayne Bay are: 1) marl; 2) marly peat; 3) red mangrove peat; 4) black mangrove peat; 5) sandy mud, and 6) skeletal sand gravel. The marls are predominately calcium carbonate and form dense, impermeable sediments with either a freshwater or low salinity gradient. A carbonate mud, rich red mangrove peat (marly peat), rarely more than ten centimeters in thickness is found at the surface in small areas near the center of large basins which lacked dense mangrove cover. Red mangrove peat is found at the surface throughout most of the coastal wetlands. Black mangrove peats are found as thin shoestring deposits along old tidal creeks and behind the coastal levee. Black mangrove peat differed from red mangrove peat in color and in the presence of pnuemataphores (black mangrove root system), as well as root material as common soil constituents.

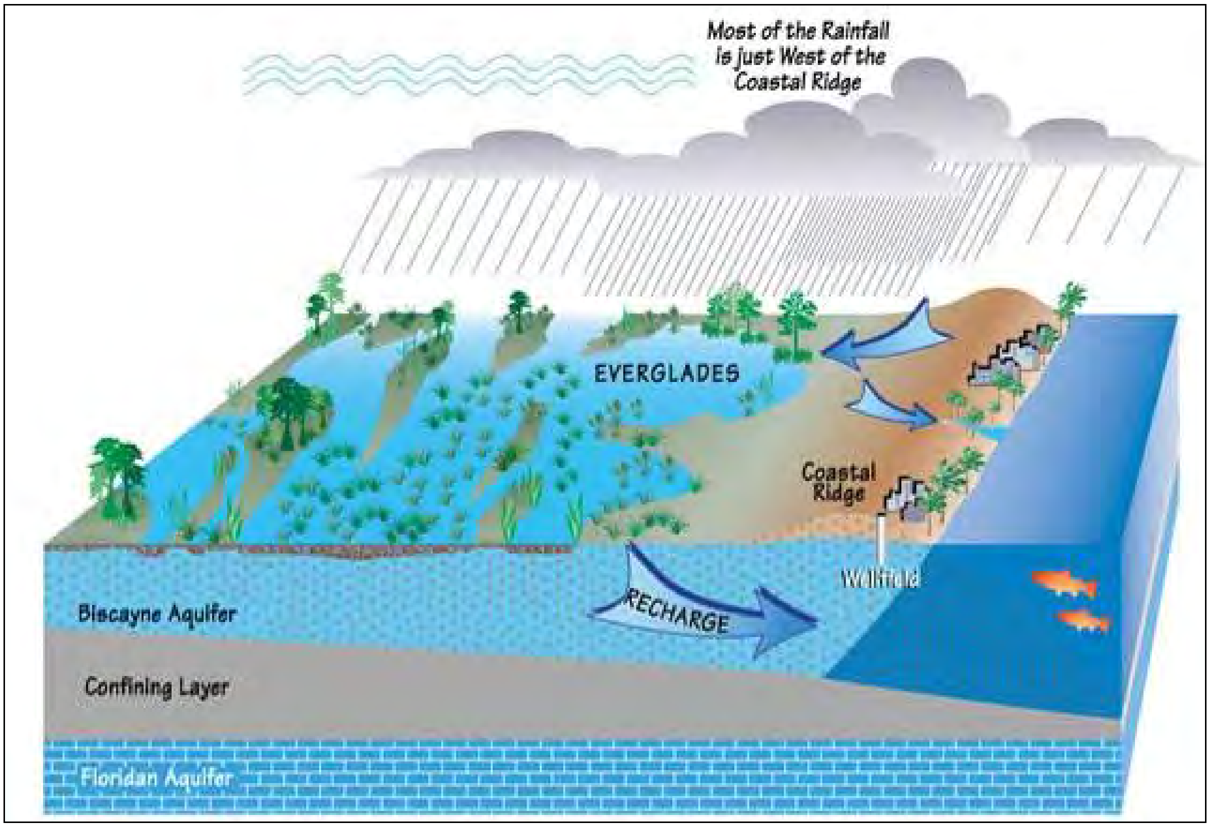
Offshore of the fringing mangroves, along most of the coastline, is a thin marine mud or inundated red mangrove peat, which is exposed during most wet season low tides and most of the dry season. This narrow zone frequently has very little aquatic vegetation cover. The bottom deepened at a rather constant rate from the shoreline to the depth of approximately 125 centimeters, where the water depth increased at a faster rate. In the zone, a gray to light brown, sandy mud with varying amounts of marine mollusk skeletal material is the dominant surface sediment type. Oyster gravels with a matrix of marine sand and mud form thin, local lenses and one sizeable oyster bar were found.

3.1.3 Hydrology

This section provides an overall characterization of the current conditions and those that existed in the Biscayne Bay Coastal Wetlands project area and adjacent south Florida area prior to the C&SF project and development activities.

The hydrology of the south Miami-Dade area is greatly influenced by the highly permeable surficial Biscayne Aquifer and the extensive drainage canal system that is essential for water supply and flood protection. There are four major drainage canals within the project area. The C-100 canal system drains the northern portion of the study area in the vicinity of the Deering Estates. The C-1 canal system extends from central Miami-Dade County east to Black Point where the S-21A structure controls discharge to the bay from this basin. The C-102 canal runs from the L-31N Basin in Southwestern Miami-Dade County east to Biscayne Bay at the northern end of the L-31E Coastal Wetlands. The C-103 canal network which includes Florida City Canal and North Canal connects the southern portion of the study area with Biscayne Bay. Flows in these canals are heavily influenced by groundwater levels in the unconfined surficial Biscayne Aquifer which is an extremely transmissive geologic formation. The base of the surficial Biscayne Aquifer system ranges from a depth of about 175 to 210 feet below land surface in westernmost Miami-Dade County to greater than 270 feet in northeastern Miami-Dade County. This aquifer serves as the primary source of municipal and agricultural water supplies in the area.

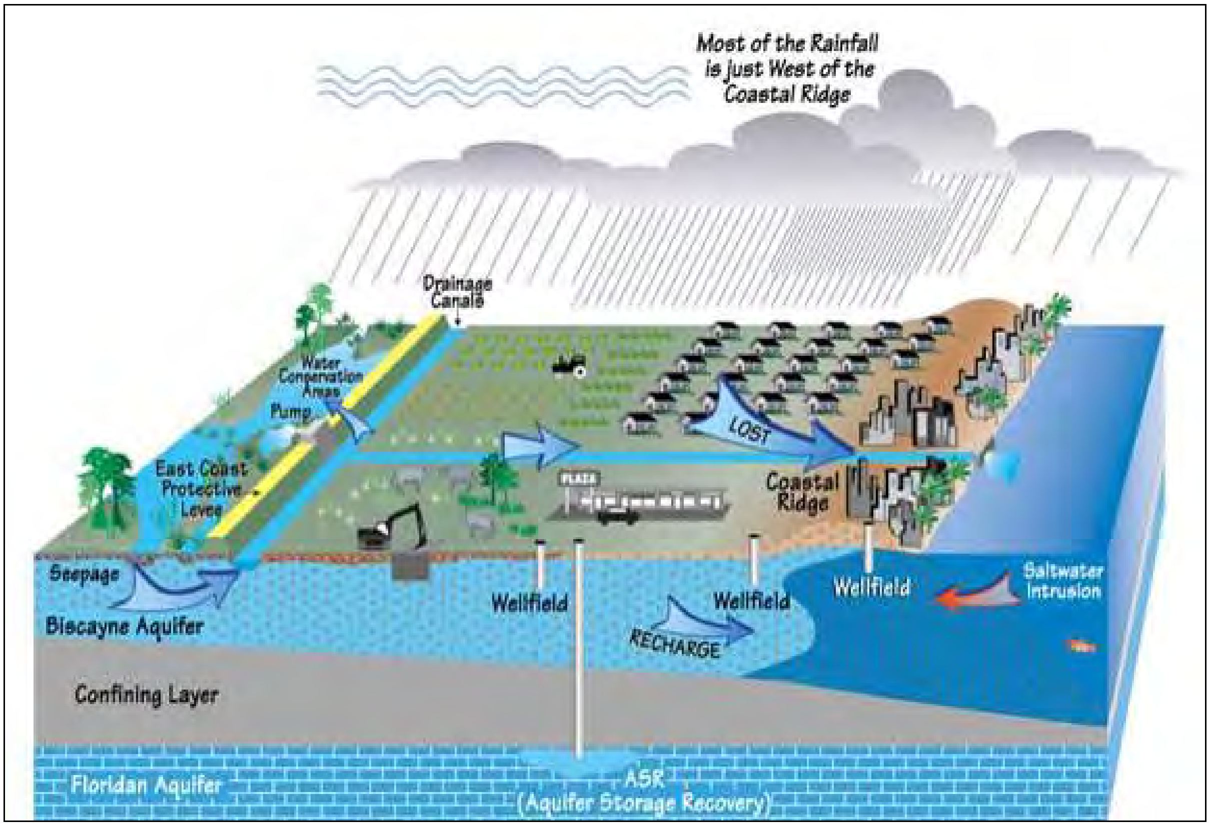
Drainage as a result of extensive canal systems and large-scale pumping from municipal well fields has greatly altered the pre-development flow system in eastern Miami-Dade County by: 1) eliminating or greatly reducing a seasonal and coastal ground-water ridge; 2) reducing groundwater flow in the lower portion of the Biscayne Aquifer; 3) reducing or eliminating seasonal westward movement of groundwater; 4) causing accelerated stormwater runoff and short groundwater flow paths; and 5) lowering the water table and inducing saltwater intrusion (***FIGURE 3-3***). Under pre-development conditions in western Miami-Dade County, water entered the gray limestone aquifer by lateral movement from Broward and Collier counties and by downward seepage from the Everglades and the Biscayne Aquifer, and moved southward and southeastward into Miami-Dade County to coastal discharge areas. Groundwater flow direction in the Biscayne Aquifer inland was primarily to the south and southeast. In eastern Miami-Dade County, the seasonal groundwater ridge that formed under predevelopment conditions supported both easterly and westerly groundwater flow away from the ridge axis (Fish and Stewart, 1991).



Source : http://sofia.usgs.gov/publications/posters/challenge/

FIGURE 3-3: PRE-DRAINAGE LOWER EAST COAST OF FLORIDA CIRCA 1900

Sources of recharge to the Surficial Aquifer System in Miami-Dade County include: 1) infiltration of rainfall or irrigation water through surface materials to the water table; 2) infiltration of surface water imported by overland flow from the north in the Water Conservation Areas (WCAs) or by canal; 3) infiltration of urban runoff by way of drains, wells, or ponds; and 4) groundwater inflow from southwestern Broward County. Soil types and seasonal rainfall variations exert significant control on the rate of recharge. Recharge by rainfall is greatest during the wet season, generally from June to November, and recharge by canal seepage is greatest during the dry season, from December to May. Discharge from the Surficial Aquifer System is by: 1) evapotranspiration; 2) groundwater flow to canals, to the sea, and to Monroe County along western Miami-Dade County; and 3) wells pumped for municipal, industrial, domestic and agricultural supplies. Evapotranspiration and groundwater discharge are greatest during the wet season when water levels, temperature and plant growth rates are high. Most of the water that circulates within the Surficial Aquifer System is discharged by canals (***FIGURE 3-4***).



Source : http://sofia.usgs.gov/publications/posters/challenge/

FIGURE 3-4: PRESENT DAY-LOWER EAST COAST OF FLORIDA

Four primary canals transect the project area (C-100, C-1, C-102 and C-103), and outfall into Biscayne Bay. In addition, three secondary canals convey water from west to east: Military Canal, North Canal and Florida City Canal. Of these three, only Military Canal discharges directly into Biscayne Bay. Canal stages within the primary canals and Military Canal are controlled with movable gates, and operated according to established criteria to maintain minimum and maximum water stages. Operation of the coastal gates controls the quantity and timing of surface water discharged into Biscayne Bay in order to maintain minimum levels of service for flood control and water supply protection. In addition, a coastal levee system (L-31 East) was constructed in the mid-1960s to protect low-lying lands from storm surge and saltwater intrusion. Innumerable ditches, rock pits, berms and roads also affect the hydrology within the project area.

Overall, surface water makes up the largest input of freshwater to Biscayne Bay within the project area. However, groundwater influence becomes proportionally greatest at the end of the dry season, typically in April and May. Groundwater discharge to Biscayne Bay occurs in two ways: seepage from the aquifer and flow through subsurface leakage channels (Parker et al., 1955). A zone of seepage occurs around the periphery of the bay where the water table elevation is above sea level. Current average water elevations at the coastal ridge are controlled at less than three to four feet above mean sea level in the project area year round. Present day groundwater discharge rates to Biscayne Bay are sufficient to produce flowing springs in some areas. In the more active springs, salinity ranges between 9 practical salinity units (psu) and 30 psu.

3.1.3.1 Historic Canal Flows within the Project Area

Using the historic flow records maintained in the SFWMD's DBHYDRO database, exceedance probability plots were generated using monthly flow records for the period from January 1986 through December 2006. ***FIGURE 3-5*** shows the exceedance frequency flows by month for the ten percentile, fifty percentile and 90 percentile return periods for the C-100 basin as measured by flows through the S-123 coastal structure. From this plot it is apparent that there is little flow in this basin under extreme drought conditions. Median flow conditions show that flow occurs in the wet months (June through October) in the C-100 basin. Under high flow conditions (90th percentile flows) show discharge from the basin in all months though it is limited in the dry months.

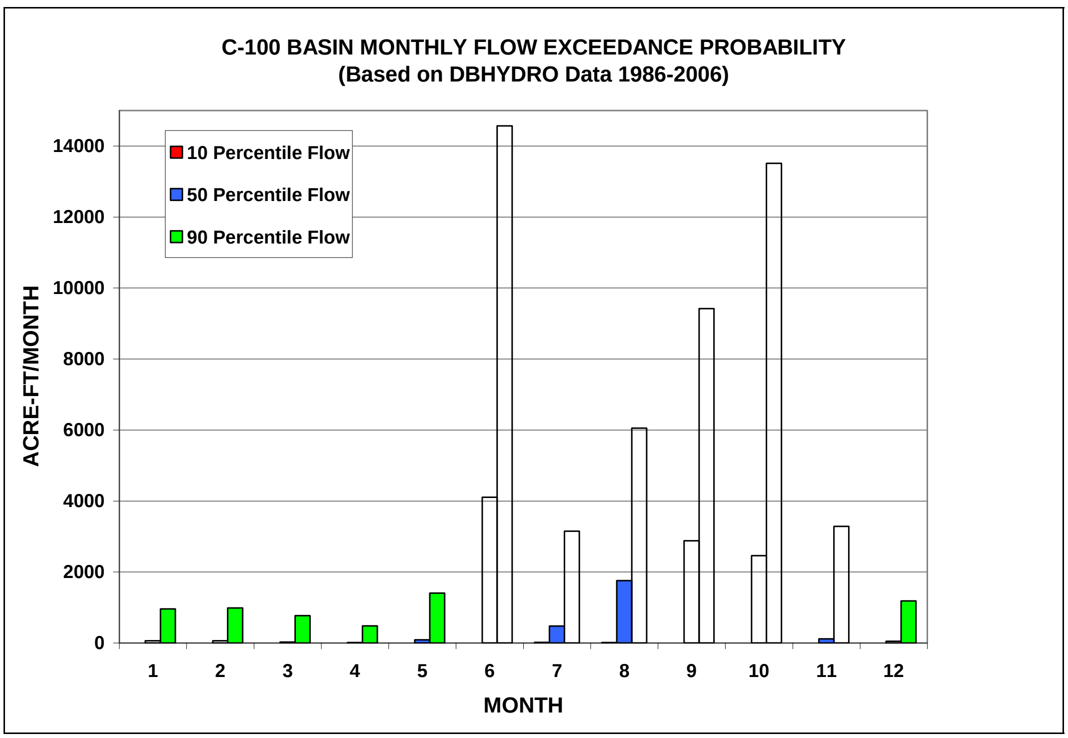


FIGURE 3-5: MONTHLY EXCEEDANCE FREQUENCY FLOWS FOR C-100 BASIN

The exceedance frequency of flow through the S-21 structure at the mouth of the C-1 canal is shown in ***FIGURE 3-6***. From this figure it appears that under one in ten year drought (10th percentile) conditions, there is very little to no flow during most months of the dry season while wet season flows are between 10 and 20 percent of the median flows. Under median flow conditions (50th percentile), the minimum monthly flow is approximately 1,000 acre-ft which occurs in the month of March. Under high flow conditions (90th percentile) the monthly flow varies from 5,000 acre-ft in March to more than 30,000 acre-ft which occurs in the months of June, August, September, and October.

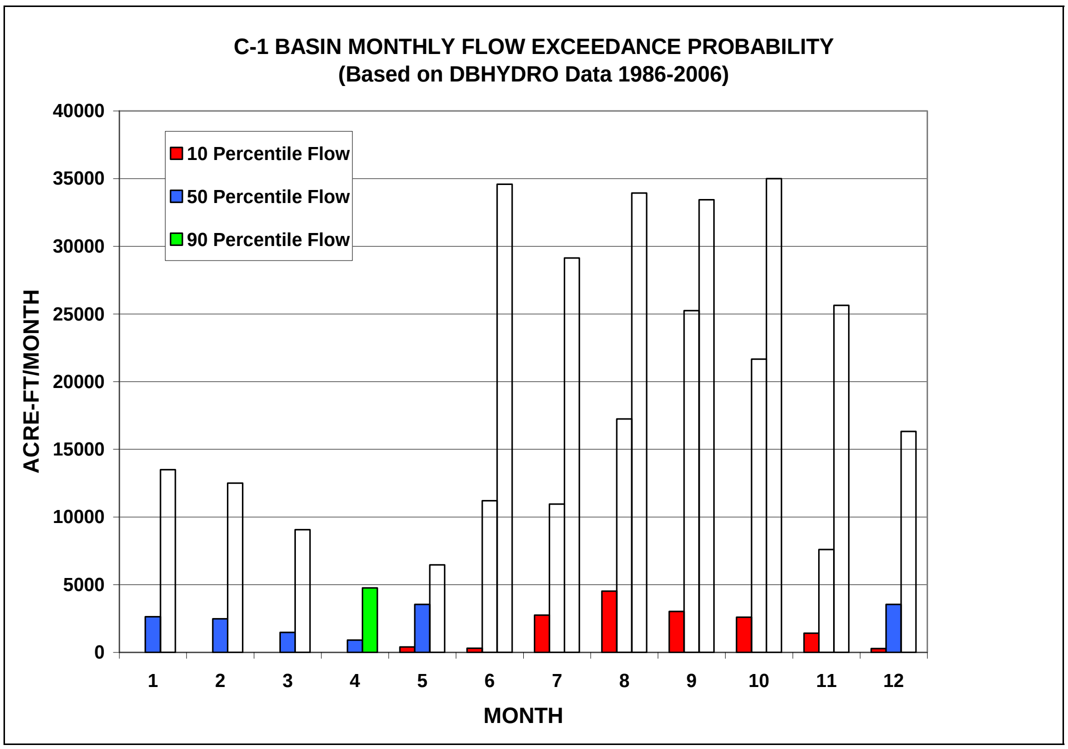


FIGURE 3-6: MONTHLY EXCEEDANCE FREQUENCY FLOWS FOR C-1 BASIN

The exceedance frequency of flow through the S-21A structure at the mouth of the C-102 canal is shown in ***FIGURE 3-7***. From this figure it appears that under one in ten year drought (10th percentile) conditions, there is very little to no flow during most months of the dry season which is similar to the pattern in the C-1 basin. Wet season flows under the 1 in 10 drought conditions are between 20 and 50 percent of that expected under median flow conditions (50th percentile). Under median flow conditions (50th percentile), the minimum monthly flow is approximately 1,000 acre-ft which occurs in the month of April. Under high flow conditions (90th percentile) the monthly flow varies from 5,000 acre-ft in March to approximately 30,000 acre-ft which occurs in the month of October.

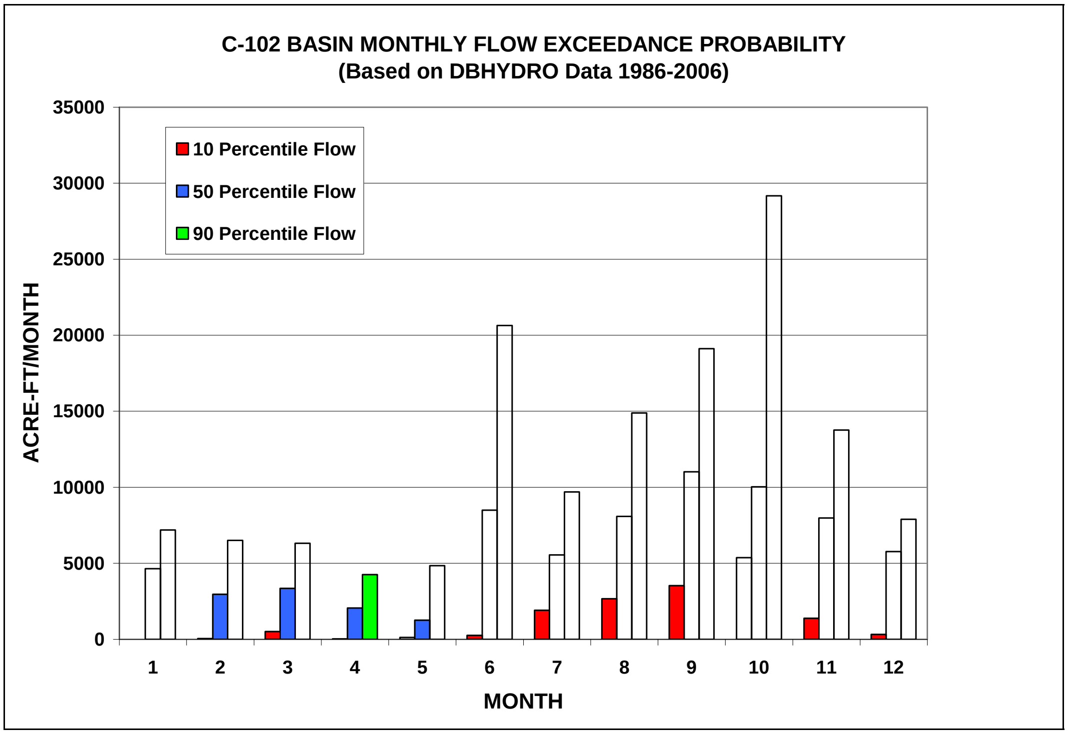


FIGURE 3-7: MONTHLY EXCEEDANCE FREQUENCY FLOWS FOR C-102 BASIN

The exceedance frequency of flow through the S-20F structure at the mouth of the C-103 canal is shown in ***FIGURE 3-8***. From this figure it appears that under one in ten year drought (10th percentile) conditions, there is a limited amount of flow available in four of the six driest months. Wet season flows under the 1 in 10 drought conditions are between 5 and 50 percent of that expected under median flow conditions (50th percentile). Under median flow conditions (50th percentile), the minimum monthly flow is approximately 2,000 acre-ft which occurs in the months of April and May. Under high flow conditions (90th percentile) the monthly flow varies from 5,000 acre-ft in March to approximately 40,000 acre-ft which occurs in the month of October.

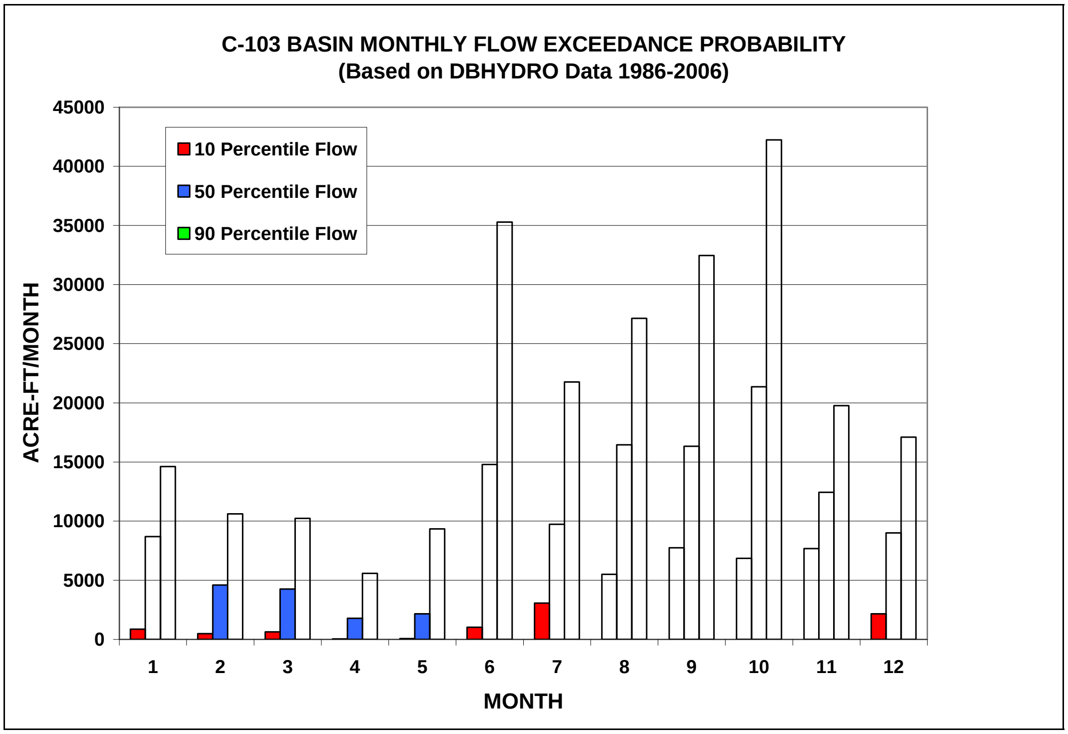


FIGURE 3-8: MONTHLY EXCEEDANCE FREQUENCY FLOWS FOR C-103 BASIN

3.1.3.2 Hydrodynamics of South Central Biscayne Bay

The six regions of Biscayne Bay are hydrodynamically distinct due to unique physical features such as volume, tidal inlets and bottom bathymetry. Freshwater inflows vary significantly between the regions as well. The south central region of Biscayne Bay (***FIGURE 3-9***) coincides with the project area, which includes a portion of BNP, and the freshwater flows from the adjacent watershed. Most of the south central portion of Biscayne Bay is separated from the Straits of Florida by barrier islands. The south central region of the bay is a well-mixed, vertically homogeneous area with salinity contours that run in a north to south direction, roughly parallel to the western shoreline. The tidal range is 1.6 feet over the Featherbed Bank (Swakon and Wang, 1977). Tidal exchange occurs primarily through narrow cuts between the barrier islands to the south and over a series of shoals to the north. Wind speed and direction strongly influence the direction of currents, particularly along the western shore, because of the shallow depths. The predominant wind directions are from the east and southeast, consistent with the direction of tropical low pressure systems occurring in the wet season. Higher wind speeds from the east and northeast are typically associated with high-pressure systems occurring in the dry season. Southeasterly winds cause a northward nearshore current and pockets of low salinity form as these currents are entrained behind points of land.

Due to the large area of open water and long fetch distances, the rate of water exchange in south central bay is primarily controlled by tidal fluctuations and wind driven circulation. Estimated residence times for this area range from six days to 22 days (Miami-Dade County Planning Department, 1986). South central bay has a smaller tidal range than the more northern portions of the bay and has correspondingly smaller tidal velocities, less circulation and longer residence times. Partly due to these factors, hyper-saline conditions commonly occur at the end of the dry season (Lee, 1975). Freshwater inflows play a role in balancing evaporation and oceanic exchange in nearshore areas during these events.

Vertical stratification has been observed along the western shore after periods of large freshwater inflow from drainage canals. Nearshore salinity can be strongly affected by freshwater discharges for up to four days, and influenced for a period of 16 days (Luo and Serafy, 2002). In open areas of the central bay, salinity is relatively unaffected by freshwater discharges over short periods of time; sustained high levels of freshwater inflow over a period of days are required to significantly affect salinity levels.

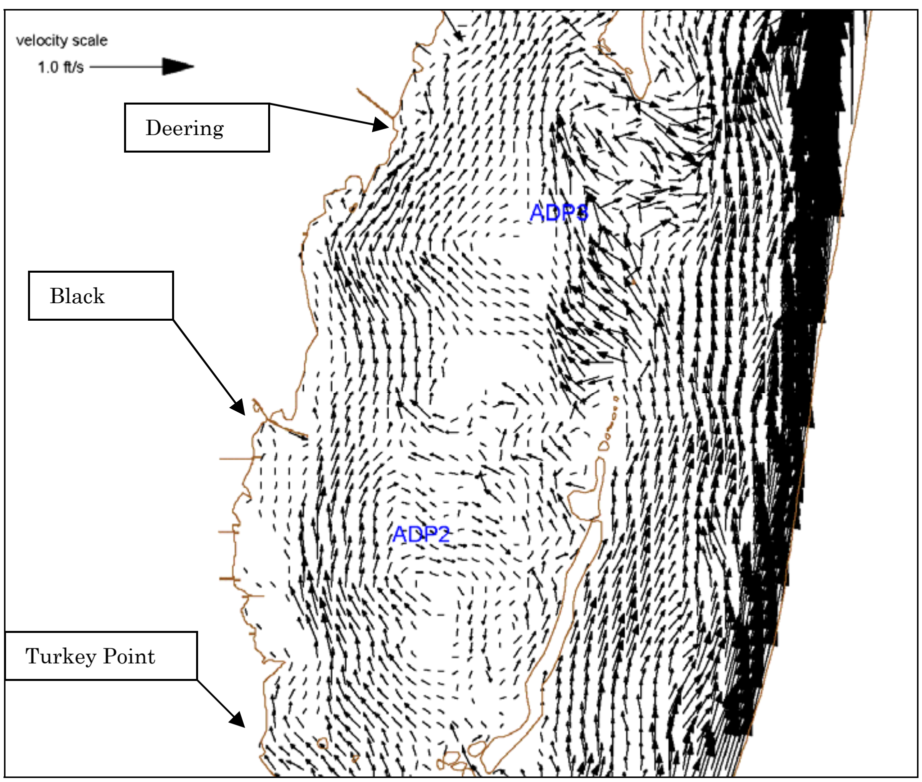


FIGURE 3-9: TYPICAL FLOW PATTERN IN SOUTH CENTRAL BISCAYNE BAY

3.1.3.3 Sea-Level Rise

Over the last 100 years, sea-level rise has resulted in significant impact on coastal canals and communities, with loss of flood protection and increased saltwater intrusion being the primary effects. Additionally, coastal ecosystems and estuaries have been adversely affected and require additional deliveries of fresh water to maintain desirable salinity patterns and healthy ecosystems. An example of this is the expansion of the "white zone" mangrove areas south of the Florida City Canal that has been impacted both by rising sea level and depressed groundwater stages.

Sea-level rise is one of the more certain consequences of climate change, and because it affects the land/ocean interface, it has the potential for environmental impacts on coastal areas. Sea-level rise is discussed in ***Section 7.14.2.3*** of ***Section 7, The Selected Plan***.

3.1.4 Groundwater

Groundwater in south Florida consists of the Floridan Aquifer and the surficial Biscayne Aquifer. The Biscayne Aquifer is a principal source of drinking water for Miami-Dade County. The Biscayne Aquifer has been classified as a Sole Source Aquifer under the Federal Safe Drinking Water Act. Within the Biscayne Aquifer, groundwater can be found at or near the ground surface and generally conforms to the undulating topography. The water table commonly slopes eastward toward the coast, although in the Everglades it slopes southward. The construction and operation of the East Coast Canals for flood protection and the lowering of the groundwater table on the East Coast ridge significantly affected freshwater deliveries to Biscayne Bay and BNP. The patterns of freshwater discharge into the bay changed from long, slow releases over a broad front to "pulse" releases from canals following rain events.

Because the Biscayne Aquifer is highly permeable and is at, or near, the land surface in many locations, it is readily susceptible to groundwater contamination. ***FIGURE 3-10*** shows the historic groundwater stage at monitoring well G-1183. The surface elevation in the vicinity of this monitoring well is approximately 2.4 ft NGVD29. Based on the historical data shown here, the average hydroperiod for wetlands in this area is approximately 70 days per year. Saltwater intrusion into the aquifer remains a continuing problem due to the introduction of drainage canals and increased groundwater withdrawal to satisfy potable water demand. Water management programs have been implemented to control the intrusion rate.

A network of canals and control structures provides for water and salinity control in the area. Salinity monitoring sensors near the coastal structures indicated that the installation of salinity control structures were effective in controlling saltwater intrusion decades ago. Well-fields, which are the source of municipal water supplies, are significantly recharged by water from the Water Conservation Areas (WCAs) which are located northwest of the project area. Water stored in the WCAs is used to maintain groundwater levels in the coastal area for public water supply, to irrigate the vast agricultural areas interspersed within the project area, and to maintain a freshwater head along the lower east coast for salinity control. Minimum stages are maintained in lower east coast canals, principally to provide the volume of water needed to protect the Biscayne Aquifer from saltwater intrusion. The head created in the canals raises groundwater levels, recharging the aquifer and the urban well-fields.

Additional information on groundwater conditions and contamination in south Florida is presented in *Appendix H* and *K*, of the C&SF Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement dated April 1999, including specific Superfund (National Priority List [NPL]) and Resource Conservation and Recovery Act (RCRA) hazardous waste sites in south Florida.

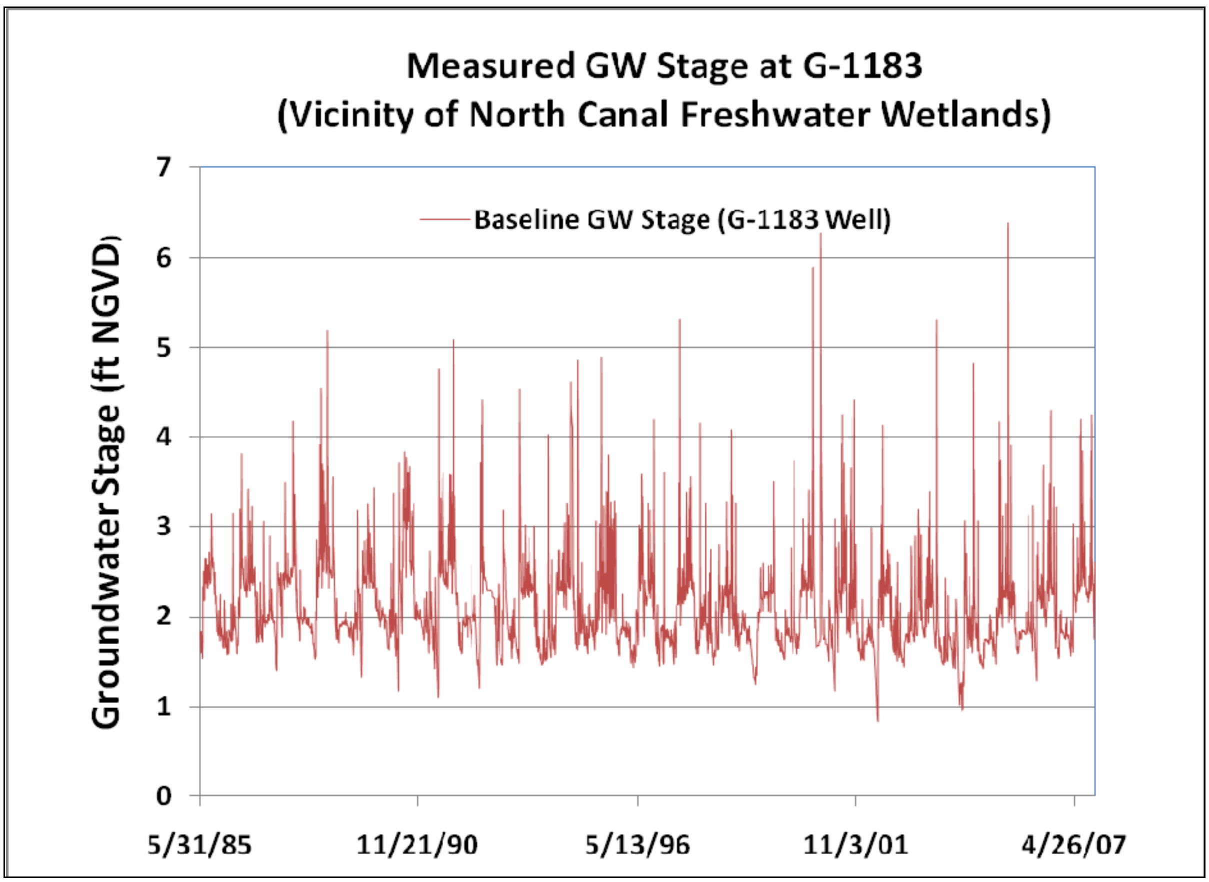
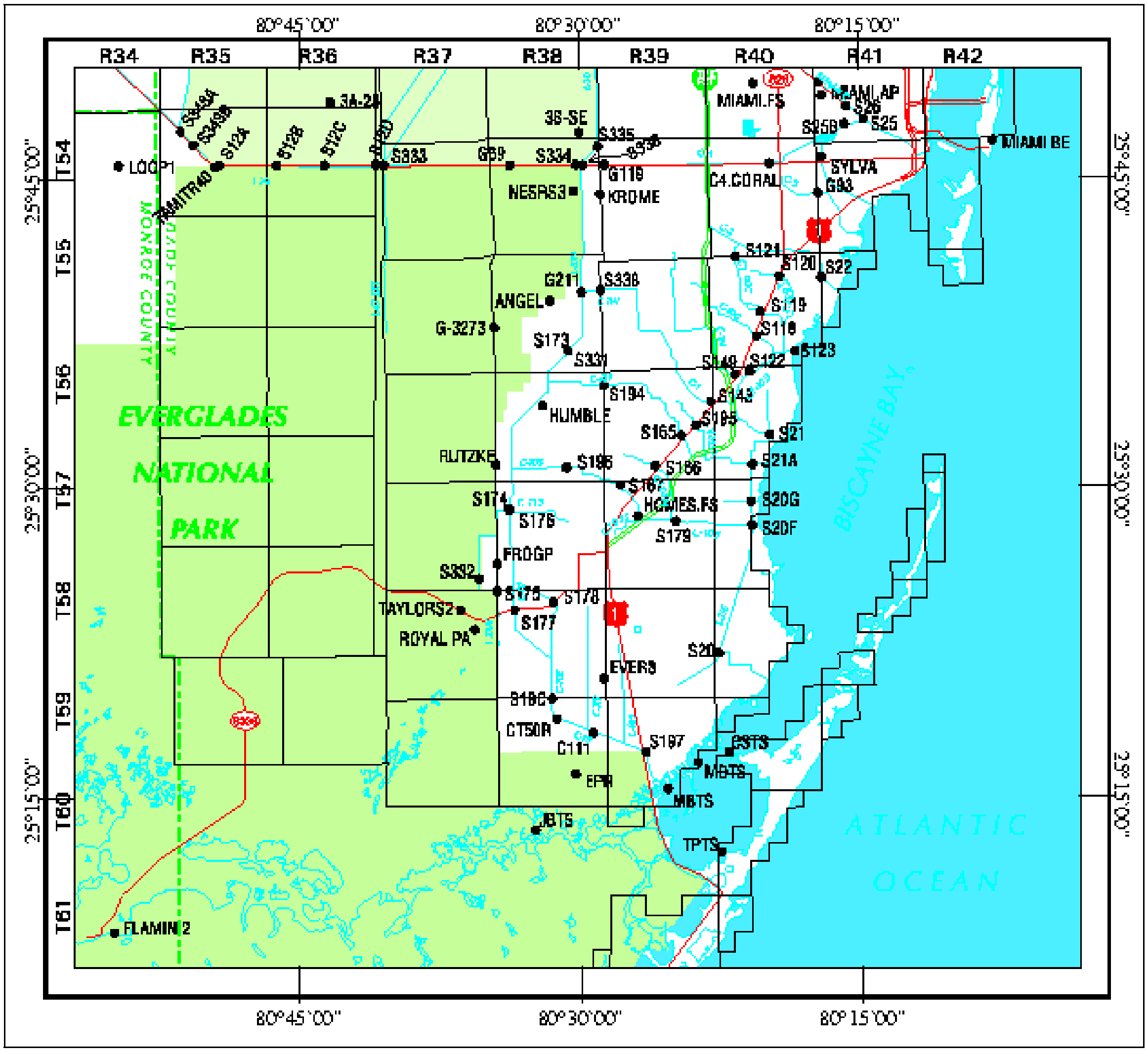


FIGURE 3-10: HISTORIC GROUNDWATER STAGE AT G-1183 MONITORING WELL (LOCATED ADJACENT TO NORTH CANAL)

3.1.5 Water Management

The existing water management features in the project area are managed to provide flood protection and minimize salinity intrusion into the Biscayne Aquifer. During and after storm events, the coastal structures are opened to allow excess flood water to be discharged into the bay.



Source: http://www.sfwmd.gov/curre/sitemaps/metadade.htm

FIGURE 3-11: DBHYDRO SITES IN THE MIAMI-DADE COUNTY VICINITY

3.1.5.1 Water Supply

The primary urban and agricultural water supply source is the Biscayne Aquifer. This aquifer is a surficial, highly permeable, wedge-shaped aquifer that is approximately 200 feet thick at the coast but reduces to a few feet near its western boundary, 35–40 miles inland. This aquifer provides water for municipal and industrial (M&I) water supply and agricultural irrigation along the southeast coast.

The existing network of canals and control structures provides for water level and salinity control to prevent saltwater intrusion. They also serve as method to promote recharge of the surficial Biscayne Aquifer. Water supply releases can be made from the WCAs, or transferred from Lake Okeechobee, to the coastal areas via the South Dade Conveyance System (SDCS). Water stored in the WCAs can be used to maintain groundwater levels for public water supply, to irrigate the vast agricultural areas interspersed within the project area, and to maintain a freshwater head along the lower east coast for prevention of saltwater intrusion. The coastal spillways prevent salt water from moving up the canals, and maintain sufficient freshwater head to prevent agricultural and municipal groundwater withdrawals from allowing saltwater intrusion in wells. Optimum and design water levels in the project canals are established on the basis of groundwater levels, intake and/or discharge structure elevations.

3.1.5.2 Flooding

The C&SF canals and structures maintain optimum stages for the purposes of flood control, water supply, groundwater recharge, and prevention of saltwater intrusion. They are designed to permit rapid removal of floodwaters from their immediately adjacent drainage areas. The degree of flood protection provided by outlet capacity is dependent on whether the protected area is urban or agricultural. Maximum rates of removal vary from 40 percent to 100 percent Standard Project Flood (SPF). The canals and structures are regulated automatically or manually and in accordance with the optimum water control and design elevations, with the exception of hurricane or tropical storm regulation. Both federal and state laws require protection of certain water supply and flood control benefits in the implementation of CERP projects. Section 373.1501(5)(d), Florida Statutes, requires the South Florida Water Management District (SFWMD), in its role as the local sponsor, to provide reasonable assurances that existing Levels of Service for Flood Protection (LOSFP) will not be diminished by implementation of CERP projects.

Areas may become flooded during heavy rainfall events due to antecedent conditions that cause saturation and high runoff from both developed and undeveloped areas. When areas become flooded, excess water is generally removed through the C&SF canals, through the use of automated controls installed on water control structures that allow canal levels to fall, providing limited extra storage in the lakes and canals. Thus, during a heavy rainfall event, extra storage is available for the secondary canal system to drain into the larger canals.

3.1.6 Water Quality

The drainage canal network has adversely impacted the timing, quality and quantity of freshwater deliveries to the bay. In terms of timing, freshwater releases to the bay occur under two conditions: 1) flood protection discharges in response to rainfall events, and 2) daily canal and groundwater stage maintenance releases scheduled to coincide with low tide. The drainage canals affect water quality by collecting runoff from urban and agricultural activities that are sources of nutrient, heavy metal, and pesticide pollution. The operation of drainage canals in south Miami-Dade County for flood protection has resulted in a reduction in the groundwater stage and thus a reduction in the base flow of fresh groundwater to the bay. Flood protection discharges to the bay also create rapidly fluctuating salinity concentrations that are physiologically stressful to native estuarine biota such as soft corals, sponges, oysters and juvenile estuarine fishes.

The northern portion of Biscayne Bay, which lies outside of the project study area, has experienced greater water quality impairment and ecosystem stress than the central and southern portions of the Bay. For instance, in northern Biscayne Bay, an increase in dissolved nutrient concentrations is believed to have shifted this system from a benthic productivity dominated system to a water column dominated system (Alleman, 1995). This is likely a result of the high-density urban development that characterizes the northern bay watershed. The FDEP currently classifies Biscayne Bay as Outstanding Florida Water (OFW). This designation prohibits the permitting of activities that would cause a degradation of water quality. The two predominant factors controlling the water quality of the central and southern portions of Biscayne Bay are mixing of bay waters with ocean waters and the discharge of freshwaters through the seven coastal canals. Because central Biscayne Bay is relatively open to the ocean on the eastern side, the residence time of water in this portion of the bay is short as compared to residence times for the very southern or northern portions of the bay. Due to frequent flushing, the central portion of the bay has better water quality than the northern or very southern portions of the bay. Nearshore areas, particularly in areas directly adjacent to the canal mouths, experience a greater degree of water quality and ecosystem impairment than other areas of central Biscayne Bay. The nearshore area is generally considered to be the area between the shore and roughly one half mile offshore. The 2006 FDEP Impaired Water Rule (IWR) analysis for the southeast coast of Florida did not identify any impaired water bodies within the Biscayne Bay Coastal Wetlands project area. This would indicate that water quality standards are met within the project area.

3.1.6.1 Baseline Water Quality in the Nearshore and Mid-Bay Areas

Representative baseline water quality concentrations were calculated for those portions of the bay and watershed that are within the probable impact zone of the wetland restoration project. Water quality data for central Biscayne Bay and the nearshore were analyzed for the period from 1993 to 2003 using two datasets: the Florida International University (FIU) dataset, which includes stations in Biscayne Bay, and the DERM dataset, which includes stations in Biscayne Bay and at the mouth of contributing canals. The FIU monitoring stations were classified into seven groups having similar water quality (Jones et al., 1997). Three of these groups, *Alongshore*, *Inshore* and *Main Bay*, are relevant to the south central Biscayne Bay study area. A similar exercise was conducted for the central and southern Biscayne Bay DERM stations. Likewise, three of the DERM groups were within the region of interest: canal *Mouth, Nearshore* and *Open Bay*. FIU's *Alongshore* and DERM's *Nearshore*, as well as FIU's *Main Bay* and DERM's *Open Bay* were spatially equivalent. The station groupings represent a gradient of water quality conditions starting at the mouths of the canals (bay-ward of the salinity control structures), to open bay conditions.
Table 3-1 provides a summary of the mean and median values of the parameters of interest for both the FIU and DERM datasets. This table includes target concentrations for ammonia, nitrate+nitrite, and total phosphorus (TP) established by the Biscayne Bay Partnership Initiative (BBPI) for the entire bay, (Murley and Moure, 2001). The BBPI target concentrations of ammonia and TP are largely being met in nearshore, inshore and main bay areas of central Biscayne Bay. However, canal mouth, nearshore, and inshore areas of central Biscayne Bay often exceed the BBPI target nitrate+nitrite concentration of 0.020 milligrams per liter (mg/L), and some nearshore stations exceed this target more than 50 percent of the time. Stations located in the eastern portion of the bay exceed the 0.010 mg/L target less than 20 percent of the time.

The generalized spatial analysis presented above does not adequately represent pollutant "hotspots" such as Black Point, which includes the South Dade Landfill and a closed landfill. In this area, ammonia concentrations in nearshore groundwater may be up to 30 times greater than found in the overlying surface water (Meeder et al., 1997), which may be related to observed shifts in the benthic community structure in this nearshore area (Meeder and Boyer, 2001). Although the link between elevated ammonia concentrations and altered benthic community structure in this area could not be conclusively demonstrated, ammonia in combination with other pollutants may create unfavorable conditions for the seagrass *Thalassia testudinum* (Meeder and Boyer, 2001). Nearshore groundwater seepage in the area between Black Point and Mowry Canal contained higher levels of other nutrients such as phosphorus, total nitrogen, and organic carbon (Mir-Gonzalez, 2003), which may also result from landfill leachate (Meeder and Boyer, 2001).

TABLE 3-1: SUMMARY OF FLORIDA INTERNATIONAL UNIVERSITY AND DERM MEDIAN VALUES FOR WATER QUALITY PARAMETERS ASSESSED

Parameter	Units	Pooled Mean Concentrations	MEDIAN CONCENTRATIONS			BBPI Target Conc.
			Nearshore / Alongshore	Inshore	Main Bay	
Ammonia[1] FIU DERM	mg/L	0.014 0.071	0.016 0.05	0.013 *	0.009 0.06	0.02[1] 0.05[1]
Cadmium DERM	ug/L	0.08**	0.1**			
Chl-A FIU ('01-'02)	mg/L	0.33	0.30	0.20	0.20	
Copper DERM	ug/L	1.044	0.44**			
Dissolved Oxygen FIU	mg/L	6.6	7.3	6.7	6.4	
Lead DERM	ug/L	0.610	.17**			
Nitrate+Nitrite FIU	mg/L	0.03	0.042	0.014	0.005	
Salinity FIU	psu	32.9	27.5	31.3	35.2	
Total Coliform DERM	cfu/100 ml	144	<10	*	<10	
Total Kjehldahl Nitrogen FIU	mg/L	0.22	0.36	0.26	0.16	
Total Nitrogen FIU ('01-'02)	mg/L	0.27	0.38	0.26	0.18	
TOC FIU ('01-'02)	mg/L	3.0	3.9	3.9	2.8	
Total Phosphorus FIU	mg/L	0.006	0.006	0.005	0.005	
Turbidity FIU	NTU	0.8	0.5	0.5	0.8	
Zinc DERM	ug/L	3.0**	12.2**			

* Not evaluated

** Below Detection Limit (BDL)

3.1.6.2 Salinity Conditions in South Central Biscayne Bay

The salinity regime of the nearshore areas of southwestern Biscayne Bay has been modified significantly due to manmade changes in local hydrology. Today, higher salinities along the shoreline, especially during the dry season, have led to the decline in oyster reefs that once thrived at creek mouths, reduced the suitability of the area for American crocodiles (*Crocodylus acutus*), and have resulted in a shift of fish and macro invertebrate fauna to that more characteristic of marine conditions than estuarine conditions. ***FIGURE 3-12*** and
FIGURE 3-13 show the average salinity conditions for May and November 2008, respectively. While these two figures only represent a single year, they represent typical conditions for the dry season with no areas with salinity less than 20 psu and wet season conditions with salinity as low as 5 psu in the area offshore of the C-1, C-102, and C-103 canals.

Restoring the salinity in the nearshore habitat to mesohaline conditions (5 to 20 psu) throughout the year would provide the optimal salinity regime for the flora and fauna that historically inhabited this area, such as widgeon grass (*Ruppia maritima*), shoal grass (*Halodule wrightii*), eastern oysters (*Crassostrea virginica*), American crocodiles, red drum (*Sciaenops ocellatus*), and other fish and invertebrates. In Florida, for example, oyster spat have an optimal salinity range of 20-23 psu, whereas juveniles prefer salinities between 10-20 psu and adults have an optimum range of 10-20 psu (Woodward-Clyde, 1998). Target salinity for estuarine fishes is 5-15 psu from June through October, with higher salinities during the remainder of the year. Ideal salinity for juvenile crocodiles is 0-20 psu in the mangrove wetlands and coastal creeks during the wet season and several months into the dry season (approximately June through January; Mazzotti and Cherkiss, 2003). The salinity target for this performance measure is set at 20 psu, which is at the mid to upper end of the preferred range for most of the above species. Without freshwater discharges the salinity would exceed the 20 psu target. Alternatives that provide the most uniform freshwater discharge in terms of timing and spatial extent are scored the highest for this performance measure.

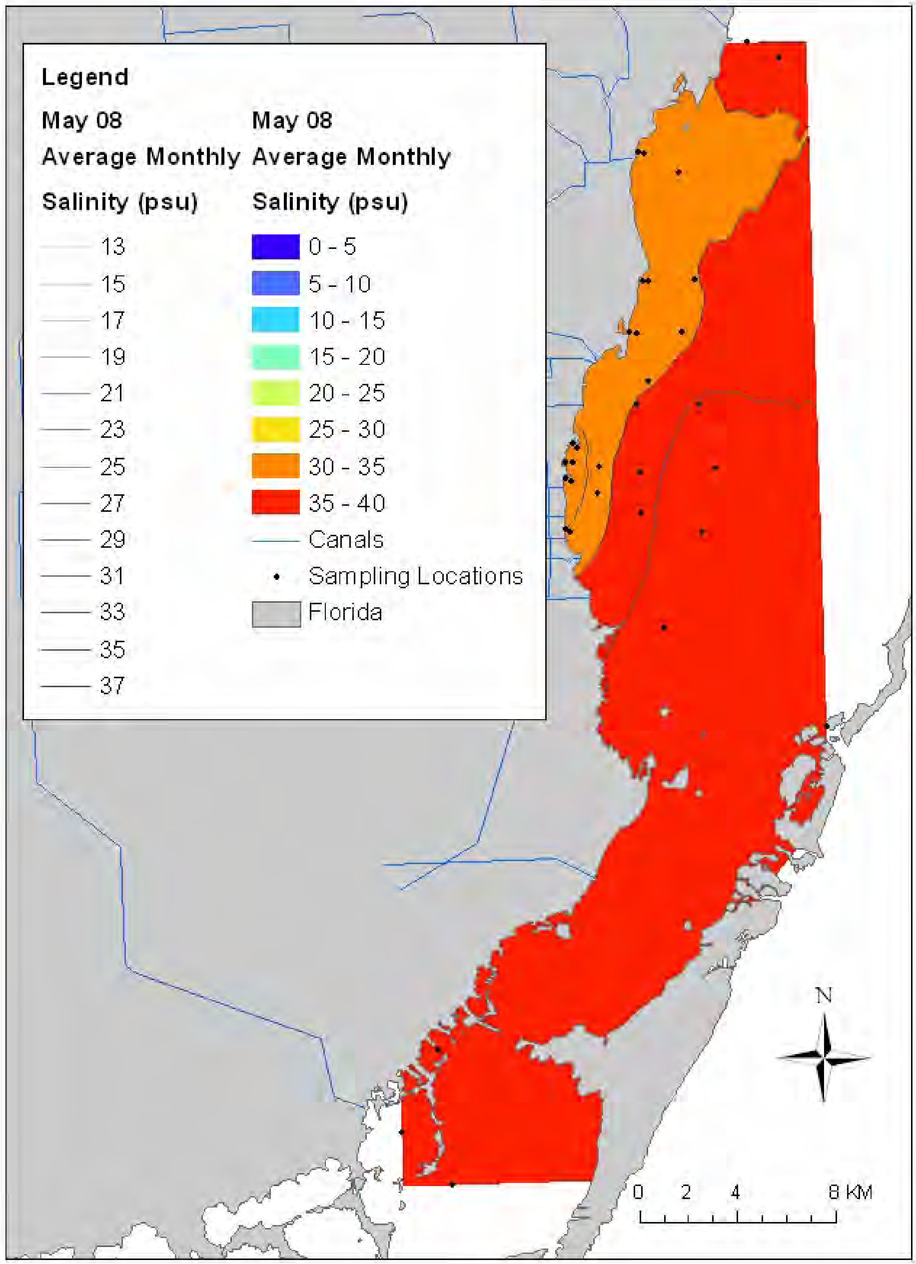


FIGURE 3-12: AVERAGE MEASURED SALINITY FOR MAY 2008 IN SOUTH CENTRAL BISCAYNE BAY

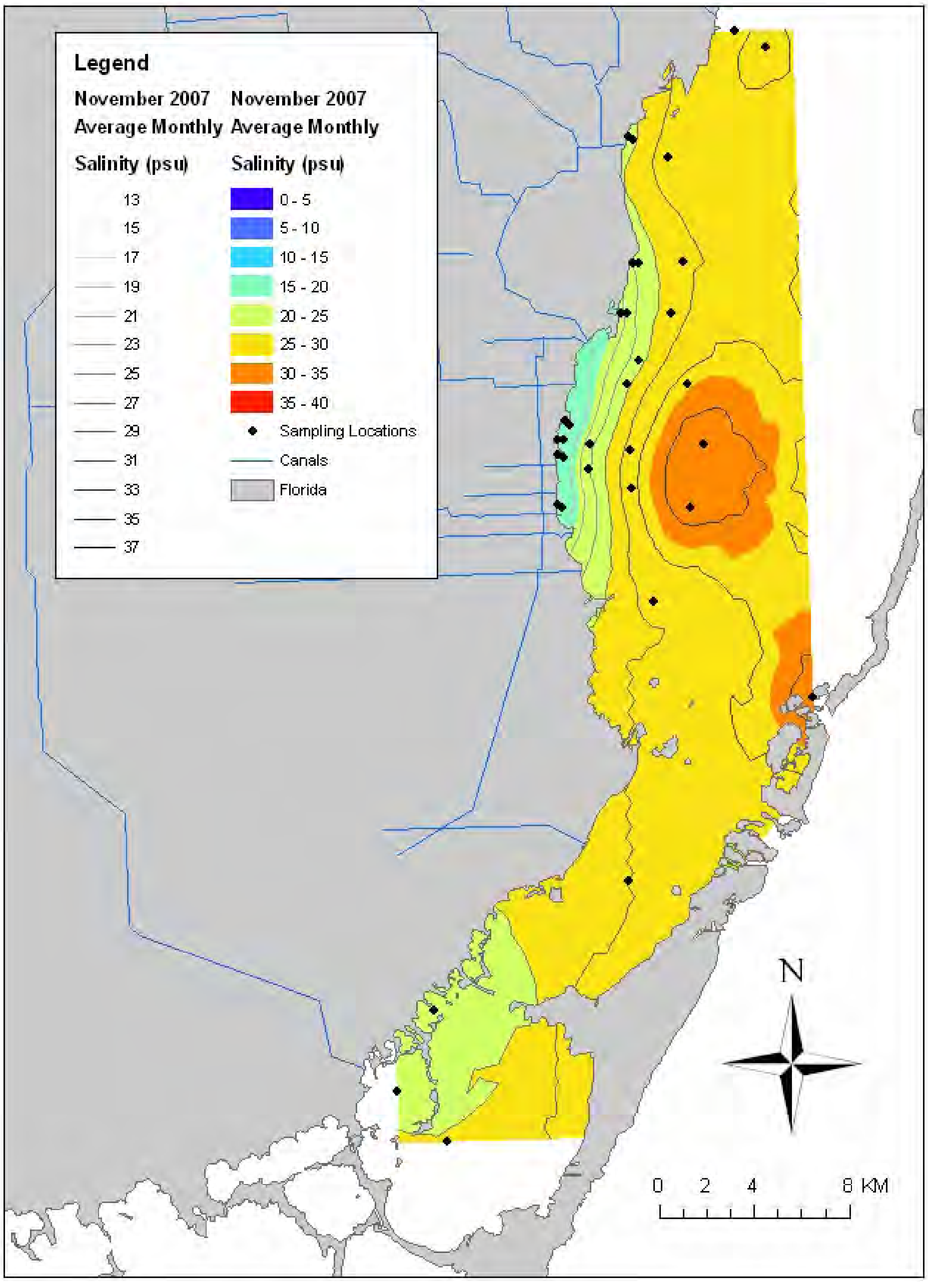


FIGURE 3-13: AVERAGE MEASURED SALINITY FOR NOVEMBER 2008 IN SOUTH CENTRAL BISCAYNE BAY

3.1.6.3 Baseline Water Quality Conditions in South Miami-Dade Coastal Canals

Water quality in South Miami-Dade canals is strongly influenced by the predominant land-use which in the north is urban and in the south is agriculture. In ***Table 3-2***, average pollutant concentrations were calculated using DERM data from one sampling location (for each canal) located upstream of the tidal control structure. Black Creek and Goulds Canal have elevated ammonia and total phosphorus concentrations and low dissolved oxygen levels relative to the other South Miami-Dade canals. This is likely due to the proximity of these canals to leachate from the South Miami-Dade landfills. Mowry and Princeton canals contain elevated levels of nitrate+nitrite that enter these canals from nearby agricultural areas.

Estimated daily loads of phosphorus and inorganic nitrogen are presented in ***Table 3-3*** to show the relative impact of nutrient loads from each canal on bay water quality. These data indicate that Black Creek and Goulds Canal contribute the vast majority of ammonia to the bay. Phosphorus loading estimates for the five canals are within the same order of magnitude. Mowry and Princeton canals contribute the bulk of nitrate+nitrite load due to the high percentage of agricultural land use. By comparison, only the Apalachicola River and the C-43 Canal (Caloosahatchee River) contribute larger loads of inorganic nitrogen to a Florida estuary.

TABLE 3-2: SOUTH MIAMI-DADE CANAL AVERAGE WATER QUALITY AT SELECTED MIAMI-DADE COUNTY DEPARTMENT OF ENVIRONMENTAL RESOURCES MANAGEMENT SAMPLING LOCATIONS

(Upstream of salinity control structures—1997–2000 data)

Water Quality Parameter	Cutler Drain	Black Creek	Goulds Canal	Military Canal	Mowry Canal	Princeton Canal
	CD02	**BL02**	**GL02**	**MI02**	**MW04**	**PR03**
FIELD PARAMETERS						
Dissolved Oxygen	6.3 mg/L	4.8 mg/L	3 mg/L	5.6 mg/L	5.9 mg/L	5.6 mg/L
TDS	306 mg/L				463 mg/L	390 mg/L
Total Suspended Solids	4 mg/L			4 mg/L	4 mg/L	4 mg/L
Turbidity	0.5 NTU	1.5 NTU	3.6 NTU	0.8 NTU	0.7 NTU	0.6 NTU
NUTRIENTS						
Ammonia Nitrogen	0.01 mg/L	0.18 mg/L	3 mg/L	0.035 mg/L	0.01 mg/L	0.02 mg/L
Total Phosphorus	0.004 mg/L	0.011 mg/L	0.016 mg/L	0.009 mg/L	0.004 mg/L	0.003 mg/L
Nitrate + Nitrite Nitrogen	0.09 mg/L	0.11 mg/L	0.1 mg/L	0.44 mg/L	2.3 mg/L	4.2 mg/L
Total Kjehldahl Nitrogen	0.3 mg/L			0.2 mg/L	0.2 mg/L	0.2 mg/L
METALS						
Copper, dissolved	2 ug/L			2 ug/L	2 ug/L	2 ug/L
Zinc	3 ug/L			5.2 ug/L	3 ug/L	3 ug/L

TABLE 3-3: ESTIMATED NUTRIENT LOADS DELIVERED TO BISCAYNE BAY FROM FIVE SOUTH MIAMI-DADE CANALS

TOTAL PHOSPHORUS (TP) LOAD ESTIMATES	**Cutler**	**Black Creek**	**Military**	**Mowry**	**Princeton**
	Drain	**Canal**	**Canal**	**Canal**	**Canal**
	S-123	**S-21**	**S-20G**	**S-20F**	**S-21A**
Average Daily Flow during period (M^3/day)	135000	580000	63000	539000	337000
Median TP Concentration, 1997-2002 (mg/L)	0.004	0.011	0.004	0.004	0.003
Average Daily TP load, Using Medians (kilograms per day [Kg/day])	0.5	4.6	0.6	4.2	2.6
Average Daily TP Load, Using U.S. Geological Survey (USGS) Equations (Kg/day)	2.4	3.8	1.2	4.3	6.7
NITROGEN LOADING ESTIMATES	Cutler	Black Creek	Military	Mowry	Princeton
	Drain	Canal	Canal	Canal	Canal
	S-123	S-21	S-20G	S-20F	S-21A
Average Daily Total Nitrogen load, Using USGS Equations (Kg/day)	46	484	122	430	1789
Median Ammonia Concentration, DERM 1997-2002 (mg/L)	0.01	0.18	0.035	0.01	0.02
Average Daily Ammonia Load, using Median Conc (Kg/day)	1.4	104.4	2.2	5.4	6.7
Median Nitrate+Nitrite, Concentration 1997-2002 (mg/L)	0.09	0.1	0.44	2.3	4.2
Average Daily N+N Load, using Median Conc (Kg/day)	12.2	58.0	27.8	1240	1415

3.1.6.4 Baseline Sediment Quality in South/Central Biscayne Bay

Central Biscayne Bay sediments are characterized by medium to coarse sands. Flocculent organic sediments, as found in other Florida estuaries such as Indian River Lagoon (IRL), do not present a significant cause of water quality degradation or ecosystem stress in central Biscayne Bay. Sediment cores collected in Barnes Sound at the southern end of Biscayne Bay revealed a thin surface mud layer that is indicative of a relatively low degree of ocean exchange (Ishman, 1997). The geologic composition of sediment cores taken in the central bay area off of Black Point, Pelican Bank and Featherbed Bank were characteristic of areas that experience frequent tidal flushing.

Concentrations of several heavy metals (e.g. copper, lead, zinc and mercury) are found in Biscayne Bay sediments at levels not typically found in marine sediments (Lidz, 2002). Heavy metal concentrations were highest at nearshore locations and lowest at the center of the bay. There was a north-south gradient, with concentrations generally highest in the northern bay associated with densely urbanized downtown Miami, and lowest at the less developed southern end of the bay.

In a microfaunal survey of benthic forams, Lidz (2002) found the highest percentage of deformed foram shells off of Black Point, which is adjacent to the South Dade Landfill and nearby Old Dade Landfill. Opportunistic forams, which are indicators of ecosystem stress, were found at a higher percentage of the total population for nearshore areas as compared to the central bay. Additionally, Lidz found a lower percentage of desirable forams at all locations when compared to a previous study conducted in the mid 1990s. Based on this last finding Lidz postulates that general water quality in the bay may be declining.

3.1.7 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 affected by development, altered hydrology, nutrient input and spread of non-native species that have resulted directly or indirectly from a century of water management.

Generally, five habitat types dominate the project area. They 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, *Casaurina spp*. or Brazilian pepper, *Schinus terebinthifolius*). Of these, mangrove forests cover the majority of the project area north of Turkey Point and east of the L-31E Canal, whereas non-native dominated forested wetlands dominate the area west of the L-31E Canal. Herbaceous flats occupy the majority of the project area south of Turkey Point in the area known as the Model Land basin, except for the coastal fringe, which is dominated by mangroves. A brief description of these five habitat types, and their associated wildlife value, are provided below. It should be noted that other habitat types exist in the project area, such as tree islands and *Melaleuca* dominated wetlands, but they occupy a small fraction of the project area, and will not be described. ***FIGURE 3-14*** displays the major vegetative types within the Biscayne Bay Coastal Wetlands project area.

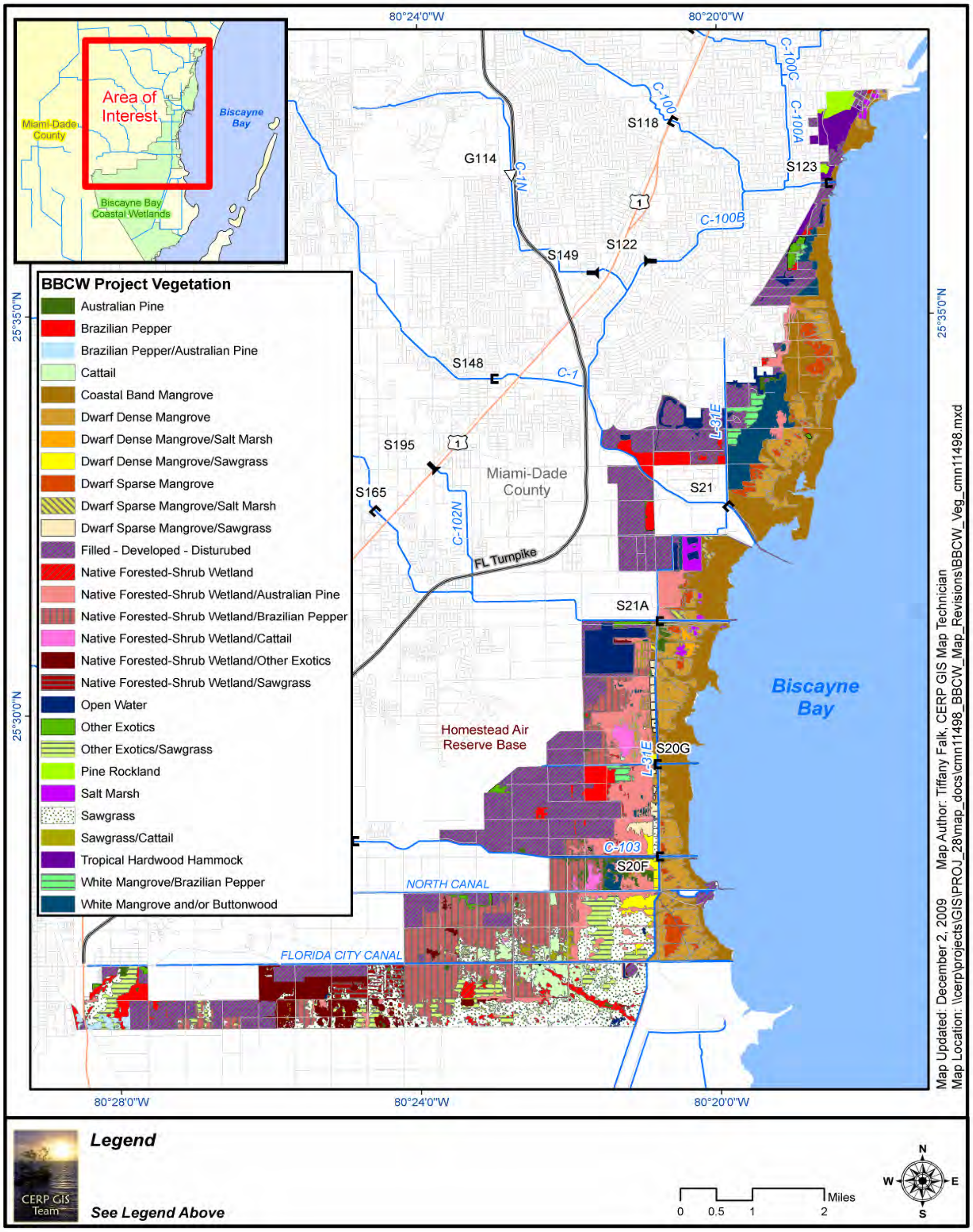


FIGURE 3-14: VEGETATION COVERAGE OF THE BISCAYNE BAY COASTAL WETLANDS PROJECT AREA BETWEEN SHOAL AND TURKEY POINTS

3.1.7.1 Seagrasses

Seagrass beds and mangrove communities dominate the flora of Biscayne Bay. The major seagrasses found in Biscayne Bay are *Thalassia testudinum* (turtle grass), *Halodule wrightii* (Cuban shoal grass), *Syringodium filiforme* (manatee grass), and *Ruppia maritima* (widgeon grass). *H. wrightii* tends to grow closer to the western shoreline and in northern Biscayne Bay. *T. testudinum* dominates most of Biscayne Bay where salinity and light penetration is highest. Seagrasses in the northern part of the Bay may be the most stressed due to variable conditions and lower light penetration. There are tens of thousands of acres of seagrass beds and hard bottom communities in the bay that are at risk from degraded water quality. Degraded water quality is thought to be a major factory that caused a massive seagrass die-off in Florida Bay beginning in the late 1980s (Koch et al., 2007).

Ecosystem functions of the bay are supported by seagrass, algal beds, and mixed hardbottom species of plants and animals (sponges, corals and algae). These highly productive seagrass beds are important not only in terms of the plant biomass produced to supply the Bay food web, but also as a physically stable refuge and nursery ground for fish, shrimp, crabs and their predators (Zieman, 1982; Thayer et al., 1984; Kenworthy et al., 1988). Species diversity and densities of organisms are typically very high in seagrass beds. The majority of commercial and recreational fish species spends at least some portion of their life history using seagrass beds or relies on their products (Laney, 1997). Other commercial fishery species, such as stone crab (*Menippe mercenaria*), shrimp and lobster species depend on seagrass for both nursery and adult habitat. Seagrass meadows provide important habitat for other species, including wading birds, waterfowl and manatee.

3.1.7.2 Mangrove Forests

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 six feet in stature.

In south Florida, the mangrove community is vital in the support of bay fisheries, including shrimp, tarpon (*Megalops atlanticus*), and gray snapper (*Lutjanus griseus*) (Odum and Heald, 1972), and invertebrate-wading bird food webs (Heald et al., 1984). In Biscayne Bay, sport and commercial fisheries rely on mangrove community function to support 11 important species of fish, such as red grouper (*Epinephelus morio*), gray snapper, and common snook (*Centropomis undecimalis*), and shellfish such as the spiny lobster (*Panulirus argus*), blue crab (*Callinectes sapidus*), and stone crab. Red mangroves prop roots also provide physical support for an extremely diverse invertebrate community.

Mangroves provide habitat for numerous species. For example, bald eagles and ospreys are top carnivores that utilize mangrove forest (Heald et al., 1984). Wading birds such as great blue herons, little blue herons, tricolor herons, and roseatte spoonbills feed on small forage fish that occupy the tidal creeks and open areas of mangrove forests. The presence of mangroves may also have a strong positive influence on coral reef fish community structure and biomass (Mumby et al., 2004).

Significant areas within the project boundary can be characterized as a low-productivity dwarf mangrove forest, known as the “white zone” because it appears as a distinct reflective white band on remotely sensed images. The white zone is a region of low vegetation cover and canopy height comprised primarily of dwarf red mangrove and sparse graminoids that occurs between more densely vegetated coastal/interior/transitional mangrove forests and more interior freshwater wetlands. The white zone has been present in the wetlands near Card Sound, Barnes Sound, and northern Florida Bay since at least the time when described by Egler (1952). Recent studies in this area indicate that the inner boundary of the white zone has moved inland by an average of one and a half kilometers (0.9 miles) since 1940, and the zone is expanding (Ross et al., 2000). The most significant changes to the white zone boundary and width occur in areas cut off from freshwater sources by canals or roads. Ross et al. (2002) suggest that the low productivity of the white zone may be primarily the result of wide seasonal fluctuations in salinity and moisture content and the absence of freshwater input from upstream sources, among other factors.

3.1.7.3 Saline Emergent Wetlands

This habitat type lies above mean sea level, but below the mean high water level, and so is continuously flooded only during the annual water level peak that occurs in the fall. The vegetation is generally dominated by herbaceous, halophytic species such as seaside tansy (*Borrichia frutescens*), cordgrass (*Spartina spp.*), saltgrass (*Distichlis spicata*), common rush (*Juncus spp.*) and sometimes spike rush (*Eleocharis spp.*). There is often a mixture of succulent herbaceous species such as saltwort (*Batis maritime)* and glasswort (*Salicornia virginica*) with scattered black mangrove (Lewis et al., 1985). Saline emergent wetlands are a prominent feature in the Model Land Basin. Historically, this habitat type was widespread in the project area north of Turkey Point, but is poorly represented in this area today.

Because these wetlands are intermittently flooded, productivity occurs in pulses, which is important to certain species, such as the mummichog killifish (*Fundulus heteroclitus)* (Weisberg and Lotrich, 1982). This pulse productivity is important to various other fishes and wading birds, and may play a crucial role in determining wading bird nesting success. Many species of larval or juvenile vertebrate and invertebrate species utilize the available habitat, including fishes (some of which depend on the marsh for at least some phase of their life cycle), decapod crustaceans, and birds. Gilmore (1987) documented 84 species of fish, 29 species of decapod crustaceans, and 38 species of birds utilizing subtropical coastal herbaceous flats associated with the IRL.

These periodically flooded marshes serve as important habitat for various species of fiddler crab, considered by some to be a keystone species in this habitat type. Fiddler crabs are extremely important to the coastal ecosystem, as a major prey item, recycler of nutrients and an agent in oxygenating the soils. As many as six species of the genus *Uca* may exist in the coastal marsh of the project area. Small fishes feed on the larval forms, whereas wading birds, particularly the night herons, prefer adult fiddler crabs as a food source. Snakes, various predator crab species, clapper rails, and raccoons have been documented feeding on *Uca* (MacIntosh, 1980).

3.1.7.4 Freshwater Wetlands

Freshwater wetlands in the project area can be comprised of various freshwater wetlands vegetation types, including sawgrass (*Cladium jamaicense*), cattail (*Typha spp.*), and coastal plain willow (*Salix caroliniana*). This habitat type is found mostly south of the Mowry Canal (C-103), and includes extensive areas of the Model Land Basin. These vegetation types may be found as monocultures, but more often occur as mixed species. A variety of other freshwater wetland plant species, including numerous periphyton species, also occur in freshwater wetlands.

These wetland types provide a variety of habitats for fish, amphibians, reptiles, birds and mammals. Under the appropriate conditions they can support a relatively large biomass of freshwater fish species, such as mosquito fish (*Gambusia affinis*) and sailfin molly (*Poecilia latipinna*), which in turn provide prey for the large variety of wading birds utilizing these wetlands. Freshwater wetlands are a preferred habitat for the American alligator (*Alligator mississippiensis*). For additional information on the wildlife value of these wetland types refer to Schomer and Drew (1982).

3.1.7.5 Non-native Dominated Wetlands

Two types of non-native dominated wetlands are prevalent within the project area: Australian pine-dominated wetlands and Brazilian pepper-dominated wetlands. The type of non-native species that dominates a given area is generally related to the topography of the wetland. The majority of the Australian pine dominated wetlands occur in artificially elevated mangrove areas. Often the pines occur as linear features along berms created by the digging of drainage and mosquito ditches. Scattered Australian pine mixed with shrubs (usually mangrove) and/or sawgrass occurs in much of the project area north of Turkey Point and on both sides of the L-31E Canal. Brazilian pepper dominated wetlands are generally intermediate in elevation, hydroperiod, and function between the native wetland and upland types in the project area (EPA, 1994). Brazilian pepper can occur as dense mono-specific stands that are difficult to penetrate or as stands mixed with willow, buttonwood and/or other mangrove species.

The wildlife value for the Australian pine dominated areas is primarily provided by the food and habitat contributions of the associated native plant species occurring as co-dominants in the canopy and the understory. These associated species are generally a combination of mangrove species, which provide significant food and habitat value as discussed above in the mangrove section. The pines themselves have been noted to provide shade for ground dwelling animals, and habitat for a variety of insects and spiders (EPA, 1994). Australian pine provide some roosting and nesting habitat for birds, such as the great blue heron (*Ardea herodias*), brown pelican (*Pelecanus occidentalis*), and double-crested cormorants (*Phalacrocorax auritus*). Pileated woodpeckers (*Dryocopus pileatus*) have been observed nesting in the trunks of dead Australian pines in the project area (EPA, 1994).

The limited habitat value provided by Australian pines is offset by negative impacts that include the loss of higher value native habitat, the loss of primary productivity of the native species, and change in elevation due to build-up of organic matter (EPA, 1994). Fallen leaves accumulate as a "duff" layer several inches thick, which suppresses understory development. It is unclear if the duff physically smothers native seedlings or if some sort of allelopathic chemical is leached from the leaves, retarding seedling germination. The duff build-up may also slightly increase the local elevation, which results in more favorable habitat for the pines and may help the species increase its spatial expansion.

Little information on the wildlife habitat value of Brazilian pepper dominated wetlands is available. A survey of herptofauna found in Brazilian pepper habitat in ENP revealed a total of 21 species of reptiles and amphibians, out of a total of 37 species occurring over all habitat types in the area (Dalrymple, 1988). By comparison, 30 species of herptofauna were found in nearby freshwater prairie, which was the highest number of species found in any one-habitat type. Curnutt (1989) compared breeding bird usage of this habitat type with pinelands in ENP. Curnutt's results indicate that 35 percent fewer breeding pairs were utilizing the Brazilian pepper habitat compared with the pinelands habitat. Also, only six bird species were found to breed in the Brazilian pepper habitat compared to 28 species in the pinelands.

The species does produce an edible fruit that is consumed by a variety of wildlife, particularly avifauna and raccoons. However, the berry has relatively low food value as evidenced by the large numbers of intact berries observed in raccoon scat. Most of the food value of this habitat type is derived from the native plant species, such as willow, that sometimes co-occur with the Brazilian pepper.

3.1.7.6 Other Non-Native Vegetation

A variety of other non-native flora can be found scattered throughout the project area. Shoebutton ardisia (*Ardisia elliptica*) is often found associated with the extensive stands of Brazilian pepper. Small isolated stands of Bishopwood (*Bischofia javanica*) occur along the western edge of the project area, usually adjacent to urban development. Other exotic species known to exist in the project area include napier grass (*Pennisetum purpureum*), seaside mahoe (*Thespesia populnea*), paperbark tree (*Melaleuca leucadendron*), wild taro (*Colocasia esculenta*), and primrose willow (*Ludwigia peruviana*).

3.1.8 Fish and Wildlife Resources

The distribution, life cycles, community structures, and population densities of the fauna of south Florida are intricately linked to regional hydrology. The current status of fish and wildlife has been strongly influenced by the cumulative effects of drainage activities early this century, the C&SF project, and the ensuing agricultural and urban development made possible by those activities. A major emphasis of the CERP is to remedy many of the hydrologic aspects of the flood control project that in hindsight have been deleterious to fish and wildlife. Likewise the major emphasis in this section is on those faunal groups that appear to have declined as a result of hydrologic changes caused by the C&SF project and that are expected to benefit from implementation of the CERP (USACE & SFWMD, 1999). The major linkages between hydrologic alterations and fauna that are addressed by the CERP and emphasized here include the collapse of aquatic food webs and populations of higher level consumers that depend upon them, shifts in habitats to those less favorable to faunal communities, and the reduction in the spatial extent of the undeveloped greater Everglades wetland system.

A critical link in the aquatic food webs, and one that appears to have been broken by hydrologic alterations, is the intermediate trophic level of the small aquatic fauna. Small marsh fishes, macro-invertebrates, and herptofauna 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. Small aquatic animal populations are currently diminished due to two factors related to water management. Reduction in the spatial extent of Everglades wetlands by half has resulted in a proportional reduction in habitat of aquatic organisms, and changes in the hydrology in remaining wetlands east of the protective levees has further reduced their populations.

A minimum of 268 fish species, 16 amphibian species, 57 reptilian species, 294 avian species, and 35 mammalian species have been observed in or near the Biscayne Bay Coastal Wetlands project area (USFWS, 2004). An additional nine fish species, one amphibian species, seven reptilians, ten bird species, and eleven mammalian species may exist in the area. The following sub-sections describe in greater detail the occurrence and habitat utilization in the project area of the five major classes of vertebrates.

3.1.8.1 Mammals

Mammals constitute a relatively small number of the vertebrate wildlife associated with the Biscayne Bay Coastal Wetlands project area. Species diversity is relatively low, with only 35 species having been observed in or near the project area (USFWS, 2004). Of those species, there are several that would not be of concern to the project. Namely, the whales appearing on the list were likely observed in the open ocean environment of BNP (they appear only on BNP's species list). Another 11 species may exist in the area according to the supporting literature (see references cited in USFWS, 2004).

A total of 12 mammalian species utilizing the area are federally or state listed threatened or endangered species. Some of the most notable species include the Florida panther (*Felis concolor coryi*) and West Indian manatee (*Trichechus manatus*). Others, such as the Lower Keys marsh rabbit and Key Largo cotton mouse (*Peromyscus gossypinus allapaticola*), are unlikely to be found in the project area. However, both of these species can be found on Elliot Key across the bay.

The most common large mammals observed in the project area are the West Indian manatee and the bottlenose dolphin (*Tursiops truncates*). Both species are protected by the Marine Mammal Protection Act of 1972, making it illegal to take, injure, molest or kill any marine mammal. The bottlenose dolphin is common to inshore Florida waters, and normally forages in the open waters of the bay, feeding on mullet and other available fishes (Odell, 1976). Biscayne Bay is considered important habitat for this species. White-tailed deer are likely found predominately in the Model Land basin portion of the project area. Suitable habitat exists in the Model Land basin for the Florida panther, and although no panthers had been observed in the area since the late 1980s, two panther road kills have occurred within the past two years.

Most of the mammalian species occurring in the project area are small to medium-sized. The most common medium-sized mammal is the raccoon (*Procyon lotor*). They are often observed foraging throughout the wetland and upland areas. Another species often spotted in the project area is the river otter (*Lutra canadensis*), which utilizes the extensive and complex network of canals, drainage ditches and mosquito ditches found in the project area for hunting fish and other prey. Some of the more common small mammals include the cotton rat (*Sigmondon hispidus*) and gray squirrel (*Sciurus carolinensis*).

3.1.8.2 Birds

Avifauna is particularly well documented in and around the Biscayne Bay Coastal Wetlands project area, and they represent the most diverse group of vertebrates utilizing the area. At least 294 bird species have been observed in or near the project area, and ten additional species may exist (USFWS, 2004). The species list includes a wide variety of bird groups including gulls, wading birds, water birds, raptors, warblers, woodpeckers and thrushes. Many of the species are migratory birds and winter residents, which commonly swell the avian populations during the late fall to early spring months.

The most commonly observed birds are water and wading birds, such as the Great Blue Heron, Great Egret (*Casmerodius albus*), Brown Pelican, Double-crested Cormorant and Osprey (*Pandion haliaetus*). Common Grackles (*Quiscalus quiscula*) and Boat-tailed Grackles (*Quiscalus major*) are also highly visible birds in this area. Less noticeable, but relatively common, are the Mockingbird (*Mimus polyglottos*), Northern Cardinal (*Cardinalis cardinalis*) and various warbler species during spring and fall migration periods.

The USFWS (2004) describes 16 exotic avian species existing or potentially existing in the project area. These are comprised mostly of a variety of tropical species such as parrots and parakeets. For example, the Monk Parakeet (*Myiopsitta monachus*) is particularly common in south Florida. Other common non-native avian species include the Eurasian Collared Dove (*Streptopelia dacaocto*) and the European Starling (*Sturnus vulgaris*).

There are four species of federally listed endangered birds and four species of federally listed threatened birds expected to occur in the project area. ***Section 4.2.6.1*** provides greater detail regarding the federally and state listed threatened and endangered species.

3.1.8.3 Reptiles

A total of 57 reptile species have been observed in or near the project area (USFWS, 2004), and another seven reptile species are anticipated to occur in the area. These numbers represent a relatively high fraction of the total number of reptile species present in the State of Florida, which probably is a reflection of the diversity of habitat types found in the project area. At least seven non-native reptile species may occur in the project area (USFWS, 2004). The brown anole (*Anolis sagrei*) and spectacled caiman (*Caiman crocodiles*) are likely the most abundant and problematic of these non-native reptiles in the project area. The American alligator (*Alligator mississippiensis*) and endangered American crocodile (*Crocodylus acutus*) assume the dominant ecological position in the project area. Alligators, in particular, are important to the ecosystem because they create small ponds or “gator holes” that are particularly important in the dry season as they provide habitat for aquatic organisms and serve as staging areas for re-colonization of the marshlands when the rainy season returns.

Two additional high-profile reptile species that occur in the nearshore Biscayne Bay area are the green sea turtle (*Chelonia mydas*) and loggerhead sea turtle (*Caretta caretta*). These two species are the most common of the sea turtles inhabiting south Florida. The seagrasses and algae that are abundant along the shoreline of the project area represent suitable foraging habitat for the green sea turtle. The diet of loggerhead sea turtles consists primarily of benthic invertebrates such as gastropod and pelecypod molluscs and decapod crustaceans, which occur in the nearshore waters of the project area. A third species of sea turtle, the hawksbill sea turtle (*Eretmochelys imbricata*), may also utilize the nearshore waters of the project area, as it has been documented to inhabit mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Carr, 1952).

3.1.8.4 Amphibians

The extensive, yet degraded wetlands within the project area support a relatively large variety and number of amphibians. Sixteen species have been observed and one additional species is anticipated to occur in the project area (USFWS, 2004). Of the observed species, three are non-native, including the Cuban tree frog (*Osteopilus septentrionalis*), greenhouse frog (*Eleutherodactylus planirostris*), and giant toad (*Bufo marinus*).

Amphibians associated with deeper marsh systems observed in the project area include the pig frog (*Rana grylio*), Florida’s second largest frog, and the green tree frog (*Hyla cinerea*), one of the smallest amphibians in south Florida. Other amphibians, such as the little grass frog (*Limnaoedus ocularis*) and eastern narrow-mouthed frog (*Gastrophryne carolinensis*) prefer the slightly drier shallow marsh and wet prairie systems.

Although the USFWS (2004) indicates that generally the amphibians were observed in the Barnes Sound wetlands area or outside the project boundary, this finding is likely to reflect a lack of data for suitable habitat types within other parts of the project area rather than a lack of these species in those areas.

3.1.8.5 Fishes

The USFWS (2004) reports that 268 species of fish have been observed in or near the project area and another nine species may exist there. Three of these fish species are listed by the State of Florida as Species of Special Concern, including the common snook, mangrove rivulus (*Rivulus marmoratus*), and Key blenny (*Starksia starcki*). Ten species are non-natives (e.g. various cichlids, Tilapia species and goldfish [*Carassius auratus*]) that primarily inhabit relatively deep freshwater habitats provided by conveyance canals.

It is important to note two qualifiers when discussing information concerning fish species appearing in the project area. First, a relatively large number of the fish species appearing in recorded species lists are primarily associated with coral reef habitats. Although hard-grounds, a type of submerged habitat that is usually comprised of a few scattered coral species, exists within the project area, the main reef tract is located well offshore of the barrier islands that separates the bay from the open ocean. These reefs are likely outside the influence of the project. Secondly, some lists may omit a number of fish species that likely exist in the project area. De Sylva (1976) documented at least 512 species of fish occurring in Biscayne Bay. Both temperate and tropical species are represented, and somewhat seasonal fluctuations occur with tropical species more prevalent in the summer and temperate species partially replacing them in winter (Alleman et al., 1995).

Recent studies have shown that estuarine fishes and shellfishes have precipitously declined in abundance within the project area due to loss of estuarine habitat along the bay's southwestern shore (Serafy et al., 2001). Abrupt salinity fluctuations due to canal discharges have negatively affected fish populations (Serafy et. al., 1997). Redfish and other species of sciaenids that rely upon estuarine areas were "abundant at all seasons" during the late 19th Century in some areas of Biscayne Bay (Smith, 1896), but are conspicuously absent today in southern Biscayne Bay. Spanish mackerel, spotted seatrout and Crevalle jack were abundant in the past (Gregg, 1902). Attempts to restore redfish to the bay failed due in large part to the stocking of juveniles to areas that no longer contained suitable (consistently brackish) estuarine environments (Serafy et al., 1996). In southern Biscayne Bay, the salinity of marine waters (30-35 practical salinity units [psu]) downstream of flood canal locks frequently drops by 20 psu within 60 minutes and returns almost as rapidly (Wang et al., 1988). As currently operated, these dramatic salinity fluctuations can occur several times per day during the wet season (May–October).

Still, seagrass beds and intertidal mangrove forests in the area support a variety of fish species, including recreationally or commercially important ones such as spotted seatrout (*Cynoscion nebulosus*), common snook, permit (*Trachinotus falcatus*), and various members of the grunt, snapper, mullet and grouper families.

Small, minnow-sized fish species dominate most of the freshwater wetlands in the project area. This dominance is most likely due to the water level fluctuations and periodic dry downs that occur in this area. Many of the small native fish are adapted for survival in shallow, warm stagnant water that is typically low in oxygen, especially during the summer months. A good example is the mangrove rivulus (*Rivulus marmoratus*), which exists in mangrove habitats and spends most of its life in land crab burrows. This fish is listed as a Species of Special Concern by the State of Florida.

3.1.8.6 Threatened, Endangered and State-Listed Species

TABLE 3-4 lists 15 federally listed threatened and endangered animal species as either known to exist or potentially exist within the project area and, subsequently, may be affected by the proposed action (USFWS, 2005). Federally listed animal species include the American crocodile (*Crocodylus acutus*), West Indian manatee (*Trichechus manatus*), Florida panther (*Puma concolor coryi*), wood stork (*Mycteria Americana*), Eastern Indigo snake (*Drymarchon corais couperi*), and the Schaus swallowtail butterfly (*Heraclides areistodemus ponceanus*). Other Federally threatened or endangered animal species that are known to exist or potentially exist in Miami-Dade County, but which would 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, Everglades snail kite (*Rostrhamus sociablis plumbeus*), Cape Sable seaside sparrow (CSSS) (*Ammodramus maritimus*), and roseate tern (*Sterna dougallii dougalii*). Five Federally listed sea turtles species exist or potentially exist in the project area, including the 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*). Federally listed plant species that may occur in the project area include the crenulated lead plant (*Amorpha herbacea* var. *crenulata*), Garber's spurge (*Chamaesyce garberii*), tiny polygala (*Polygala smallii*, deltoid spurge (*Chamaesyce* [=*Euphorbia*] *deltoidea* ssp. *deltoidea*), Small's milkpea (*Galactia smallii*), beach jacquemontia (*Jacquemontia reclinata*), and Johnson's seagrass (*Halophila johnsonii*). Most of these plant species are associated with pine rocklands, which only occur at the northern extreme of the project area and are highly unlikely to be affected by the project. A number of candidate plant species are known to exist or potentially exist in the project area, most of which are also associated with pine rocklands (USFWS, 2004).

The project area includes designated critical habitats for both the American crocodile and the West Indian manatee. The crocodile's critical habitat starts at the easternmost tip of Turkey Point and continues southeast and southwest across the southern part of the Biscayne Bay Coastal Wetlands project area. The Model Land basin, including the wedge area between U.S. Highway 1 and Card Sound Road, lies within critical habitat for this species. The West Indian 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. Card and Barnes sounds are in the southern part of the project area. The northern part of the project area lies close to another segment of designated critical habitat for the West Indian manatee. This component 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." (Code of Federal Regulations [CFR] 50 Parts 1 to 199).

The project area provides habitat for several state-listed species (***TABLE 3-4***). State listed endangered species include the arctic peregrine falcon (*Falco peregrinus tundrius*) and Florida mastiff bat (*Eumops glaucinus floridanus*). Threatened species include the White-crowned Pigeon (*Columba leucocephalus*), Least Tern (*Sterna antillarum*), Piping Plover (*Charadrius melodus*), Miami Black-headed Snake (*Tantilla olitica*), and the Everglades Mink (*Mustela vison evergladensis*). State-listed species of special concern include the Roseate Spoonbill (*Ajaia ajaia*), Limpkin (*Aramus guarauna*), Little Blue Heron (*Egretta caerulea*), Reddish Egret (*E. rufescens*), Snowy Egret (*E. thula*), Tricolored Heron (*E. tricolor*), White Ibis (*Eudocimus albus*), Brown Pelican (*Pelecanus occidentalis*), Black Skimmer (*Rynchops niger*), Mangrove Rivulus (*Rivulus marmoratus*), Gopher Tortoise (*Gopherus polyphemus*), American Alligator (*Alligator mississippiensis*), and the Florida Tree Snail (*Liguus fasciatus*).

TABLE 3-4: THREATENED, ENDANGERED AND SPECIES OF SPECIAL CONCERN; PLANTS AND ANIMALS LIKELY TO BE AFFECTED BY THE BISCAYNE BAY COASTAL WETLANDS PROJECT

Common Name	Scientific Name	Listing Status	Listing Agency
Mammals			
Florida mastiff bat	*Eumops glaucinus floridanus*	Endangered	State
Everglades mink	*Mustela vison evergladensis*	Threatened	State
Florida panther	*Puma concolor coryi*	Endangered	Federal
West Indian manatee*	*Trichechus manatus*	Endangered	Federal
Birds			
Arctic peregrine falcon	*Falco peregrinus tundrius*	Endangered	State
Black skimmer	*Rynchops niger*	Special Concern	State
Brown pelican	*Pelecanus occidentalis*	Special Concern	State
Cape Sable seaside sparrow*	*Amodramus maritimus mirabilis*	Endangered	Federal
Everglade snail kite	*Rostrhamus sociabilis plumbeus*	Endangered	Federal
Least tern	*Sterna antillarum*	Threatened	State
Limpkin	*Aramus guarauna*	Special Concern	State
Little blue heron	*Egretta caerulea*	Special Concern	State
Piping plover	*Charadrius melodus*	Threatened	State
Reddish egret	*Egretta rufescens*	Special Concern	State
Roseate spoonbill	*Ajaja ajaja*	Special Concern	State
Roseate tern	*Sterna dougallii dougallii*	Threatened	Federal
Snowy egret	*Egretta thula*	Special Concern	State
Tricolored heron	*Egretta tricolor*	Special Concern	State
White-crowned pigeon	*Columba leucocephalus*	Threatened	State
White ibis	*Eudocimus albus*	Special Concern	State
Wood stork	*Mycteria americana*	Endangered	Federal
Reptiles			
American alligator	*Alligator mississippiensis*	Threatened/SA	Federal
American crocodile*	*Crocodylus acutus*	Threatened	Federal
Eastern indigo snake	*Drymarchon corais couperi*	Threatened	Federal
Gopher tortoise	*Gopherus polyphemus*	Special Concern	State

Common Name	Scientific Name	Listing Status	Listing Agency
Green sea turtle	*Chelonia mydas*	Endangered	Federal
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered	Federal
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered	Federal
Leatherback sea turtle	*Dermochelys coriacea*	Endangered	Federal
Loggerhead sea turtle	*Caretta caretta*	Threatened	Federal
Miami black-headed snake	*Tantilla oolitica*	Threatened	State
Fish			
Mangrove rivulus	*Rivulus marmoratus*	Special Concern	State
Smalltooth sawfish	*Pristia pectinata*	Endangered	Federal
Invertebrates			
Elkhorn coral	*Acropora palmata*	Endangered	Federal
Florida tree snail	*Liguus fasciatus*	Special Concern	State
Schaus swallowtail butterfly	*Heraclides aristodemus ponceanus*	Endangered	Federal
Staghorn coral	*Acropora cervicornis*	Endangered	Federal
Plants			
Beach jacquemontia	*Jacquemontia reclinata*	Endangered	Federal
Crenulate lead plant	*Amorpha crenulata*	Endangered	Federal
Deltoid spurge	*Chamaesyce deltoidea deltoidea*	Endangered	Federal
Garber's spurge	*Chamaesycegarberi*	Threatened	Federal
Johnson's seagrass	*Halophila johnsonii*	Endangered	Federal
Small's milkpea	*Galactia smallii*	Endangered	Federal
Tiny polygala	*Polygala smallii*	Endangered	Federal

* Critical habitat designated for this species
SA: Similarity of Appearance species

Detailed accounts of the Federally listed species, including description of their distribution, habitat, critical habitat, reproduction, foraging, movements, status and trends, and respective recovery plan objectives, are contained within the South Florida Multi-Species Recovery Plan (USFWS, 1999); or the USFWS endangered species website at http://www.fws.gov/endangered/. The USFWS (2004) provides additional information regarding these species in relation to the project area. Some of this information appears in the following sub-sections.

West Indian Manatee

Manatees occur throughout Biscayne Bay on a year-round basis, but are most consistently observed in tributaries (i.e. conveyance canals) and nearshore seagrass beds, which are used as foraging areas. The extensive acreages of seagrass beds in the bay provide important feeding areas for manatees. Manatees depend upon canals as a source of freshwater and resting sites. It is highly likely that manatees 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.

Manatees have been observed in virtually all conveyance canals lying within the project boundary according to data collected by the Florida Fish and Wildlife Conservation Commission (FWC) and Miami-Dade County DERM. These include (from north to south), the C-100, C-1 (Black Creek Canal), C-102 (Princeton Canal), Military Canal, C-103 (Mowry Canal), Florida City Canal, North Canal, FPL Canal, Card Sound Road Canal, and C-111 (Aerojet Canal). Manatee sightings are especially high in Black Creek Canal, Mowry Canal, North Canal, FPL Canal, Card Sound Road Canal, and Aerojet Canal. Unfortunately, the water control structures associated with the canals are directly responsible for a significant percentage of reported manatee deaths (boating-related mortality is the other leading cause of manatee deaths). The FWC and Miami-Dade County DERM data also include mortality information. Manatee mortality appears to be particularly high in Black Creek Canal and Mowry Canal (FWC, 2004: www.floridamarine.org). It is unclear from the data if the cause of death in the canal is due to the water control structures or collisions with boats utilizing the canals.

Florida Panther

According to FWC telemetry data, Panther #21 utilized a large portion of the Model Land Basin between the FPL's Turkey Point Power Plant cooling canals and Card Sound Road in 1988. Unfortunately, this panther was a victim of a motor vehicle collision and perished the same year. In the past couple of years, there have been two additional panther road kills on Card Sound Road in the Model Land basin. This underscores the fact that these portions of the project area remain suitable panther habitat.

Wood Stork

Wood Storks are commonly observed in the project area, and appear on virtually all references of wildlife sightings in or near the project area (USFWS, 2004). The Biscayne Bay Coastal Wetlands project lies well outside all known wood stork colonies, as well as the colonies' primary and secondary zones. However, the Biscayne Bay Coastal Wetlands project area lies within the Core Foraging Area (CFA) of two active Wood Stork colonies (USFWS, 2001 data). The CFA is defined as a 30-kilometer diameter (18.6 miles) zone surrounding the colony boundary. The two colonies affected by the Biscayne Bay Coastal Wetlands project are located approximately 16 miles and 18 miles northwest of the Deering Estate, so the CFAs overlap the Deering Estate and parts of the Cutler and Black Creek wetlands in the northern part of the project area.

<u>Bald Eagle</u>
On July 9, 2007, the USFWS 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.

Until recently, the nearest bald eagle site was located on West Arseniker Key, which is southeast of Turkey Point and approximately 3.4 miles from the project boundary (T. Obenaur, BNP, personal communication, 2003). However, a nest has recently been recorded in the Black Creek wetlands within the project area. Due to the confirmation of this nest it can be surmised that habitat is conducive for bald eagle nesting and foraging within the project area. Another known nest is located 13 miles northeast of the Deering Estate Flow Way subcomponent.

<u>American Crocodile</u>
Crocodiles are known to exist throughout the project area at densities ranging up to three crocodiles per 0.6 mile (Mazzotti and Cherkiss, 1998). Although no nests are known to occur within the project boundaries, the cooling canals of FPL's Turkey Point Power Plant, which are in close proximity to project boundary, support the most successful crocodile nesting population in south Florida (Mazzotti et al., 2002). Individuals from this population disperse northward and southward into the Biscayne Bay Coastal Wetlands project area. These cooling canals offer premium nesting habitat because they satisfy the crocodile's two primary nesting requirements: suitable substrate that lays 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).

Watershed flow through conveyance canals has robbed these wetlands of vital freshwater for the last several decades, creating an unnaturally high salinity environment, a loss of graminoid marshes and a landward migration of mangrove wetlands. Juvenile crocodiles require low salinity for growth and survival, presumably because they have limited physiological capability to osmoregulate. The ideal salinity range for crocodiles is 0–20 psu (Mazzotti et al., 2002). As salinity levels increase above 20 psu, habitat suitability decreases.

An extensive mosquito and drainage ditch system that interferes with historic flow patterns exists in much of the project area between Shoal Point and Turkey Point. This ditch system forms a grid of relatively shallow (less than one meter deep), closely spaced, north-south oriented mosquito ditches crossed by larger, deeper (up to two meters deep), and more widely spaced (every 400 meter) east-west oriented drainage ditches. Because the mosquito ditches are relatively shallow, they offer little, if any, crocodile refuge. It is anticipated that these ditches would naturally fill in if their connection to the larger east-west ditches is severed. Restoring a more natural flow across these ditches should enhance restoration of the mangrove wetlands by providing a more stable mesohaline condition, which would enhance overall crocodile habitat. The larger east-west drainage ditches are more suitable as crocodile refuge areas, and backfilling these ditches could eliminate potential deep water crocodile refuge.

Eastern Indigo Snake

Eastern Indigo snakes are known to occur in the project area, and are regularly sighted along some of the levees, particularly the L-31E Levee (Dr. J.F. Meeder, FIU, personal communication. 2003). Eastern Indigo snakes utilize a wide variety of habitats, many of which are found in the Biscayne Bay Coastal Wetlands project area. However, at least one research scientist believes that the Eastern Indigo snakes occurring in the project area comprise an artificial population due to manmade effects on topography (e.g. levees and other artificial high ground; G.H. Dalrymple, The Everglades Group, personal communication, February 26, 2003). This project area is at the southern extreme of the Eastern Indigo snake's range, and the snakes in this area survive in suboptimal environments.

Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act, 16 USC 1801 et seq. PL 104-208 reflects the Secretary of Commerce and Fishery Management Council authority and responsibilities for the protection of Essential Fish Habitat (EFH). Federal agencies that fund, permit or carry out activities that may adversely impact EFH are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH. In conformance with the 1996 amendment to the Act, the information provided in this PIR/EIS will comprise the required EFH assessment and will be coordinated with NOAA Fisheries.

This project falls within the jurisdiction of both the South Atlantic Fishery Management Council (SAFMC) and the Gulf of Mexico Fishery Management Council (GOMFMC). They are located in areas designated as EFH for coral,

coral reef and live bottom habitat, red drum (*Sciaenops ocellatus*), shrimp, spiny lobster (*Panulirus argus*), other coastal migratory pelagic species, and the snapper-grouper complex. Specifically, EFH in Biscayne Bay is comprised of seagrasses, estuarine mangroves, intertidal flats, estuarine water column, live/hard bottoms, and coral reefs. Seagrasses occur in a broad band near the western and eastern shores of Biscayne Bay and surround a relatively large area of hard bottom. Seagrass areas have been designated as an EFH area of particular concern for post larval and juvenile shrimp, red drum, and juvenile gray snapper. Intertidal flats occur in a narrow band shoreward of the seagrasses, and estuarine mangroves occur as a shoreline fringe, particularly along the western edge of the Biscayne Bay. Isolated coral patches occur on the hard bottom areas of the Biscayne Bay, but coral reefs occur only seaward of the fringing keys on the eastern boundary of the Biscayne Bay.

3.1.9 Air Quality

The existing air quality within south Florida is considered good, and the region attains all National Ambient Air Quality Standards.
Figure 3-15 shows the quantity of six major air pollutants monitored by the EPA as a percentage to the maximum allowed (before it is considered a serious health risk) by the EPA (source: USGS, Synergos Technologies Inc., and EPA-Air Quality Trends, 2001). In the majority of cases ozone is the major pollutant facing most cities.

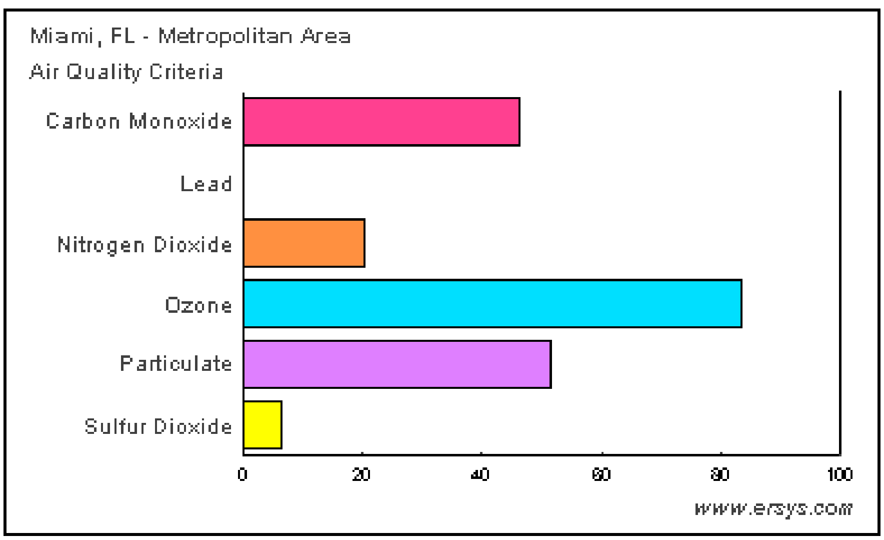


Figure 3-15: ALLOWABLE PERCENTAGE OF POLLUTANTS

An air quality concern that is not addressed by National Ambient Air Quality Standards is the atmospheric deposition of mercury. For additional specific and detailed information on air quality and the atmospheric deposition of mercury within the study area, refer to *Appendix I* of the *Central and Southern Florida Project Comprehensive Review Study Final Integrated Feasibility Report and Programmatic Environmental Impact Statement* dated April 1999.

3.1.10 Hazardous, Toxic, and Radioactive Waste

The USACE HTRW policy (ER 1165-2-132) directs that Construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable. During the plan formulation phase of the study, the project delivery team developed and/or modified project alternatives in an effort to minimize and avoid lands that contain HTRW materials . However, none of the planning alternatives evaluated is likely to be completely free of HTRW materials because every alternative included former agricultural land that likely have of residual agricultural chemicals present in the cultivated soils. The development of an alternative that does not include former agricultural lands was not possible within this study area. As part of the HTRW due diligence efforts, human health risks were evaluated on prospective project lands by comparing chemical concentrations in all media (e.g., soil, groundwater, surface water, sediment) to human health-based cleanup target levels (SCTLs) promulgated by FDEP in Chapter 62-777, F.A.C. Ecological risks were also evaluated by comparing chemical concentrations to the Sediment Quality Assessment Guidelines (SQAGs) developed by FDEP for inland waters and the copper ecological restoration target established by the USFWS. In addition to these evaluations, lands within the project boundary were also investigated in accordance with the jointly developed (FDEP, USFWS, and SFWMD) protocol, entitled "Protocol for Assessment, Remediation and Post-remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects" (SFWMD, 2008), which focuses on assessments of agricultural lands proposed for use in projects that will be inundated with water. This protocol is commonly referred to as the Ecological Risk Assessment (ERA) Protocol. A copy of the ERA Protocol is provided in **Appendix C.4.**

As a first step towards satisfying the requirements of ER 1165-2-132, Phase I Environmental Site Assessments (ESAs) were performed on each parcel owned by the South Florida Water Management District (SFWMD), the non-Federal sponsor. Site assessments were also conducted on parcels which lie within the project footprint but have not yet been acquired by the SFWMD. The Phase I ESAs conducted on SFWMD owned lands are consistent with the Reconnaissance Phase requirements outlined in Section 7 of the USACE ER 1165-2-132 – Hazardous Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects, dated June 26, 1992. The assessments conducted on parcels that have not yet been acquired by the SFWMD are similar to Phase I ESAs with the exception of site visits or personal interviews.

Phase II ESAs and further studies were also performed on parcels where the initial Phase I ESA indicated a potential for human health or ecological concerns. The data collected during the Phase II ESA were initially compared to the human health SCTLs and the ecological risk SQAG thresholds referenced above. Where the results exceeded the SQAG screening criteria, a Screening Level Ecological Risk Assessment (SLERA) was performed as part of a Phase II ESA. The purpose of the SLERA is to evaluate potential risks to benthic invertebrates and higher trophic species, particularly USFWS trust species, associated with exposure to constituents present in soils which will be inundated as a result of project implementation. In general, the results of the ESAs indicate that some low level residual agricultural pesticides are present on some of the project lands, however, limited corrective action is anticipated to be required for implementation of the recommended plan (Alternative O Phase 1). A summary of HTRW conditions found to date on the proposed project lands is included in Section 7.9.3. Details regarding the investigation results and specific recommendations for each parcel are provided in **Appendix C.3**. Additional investigations have been recommended for several parcels. It is possible that conditions will be encountered on these parcels will require further study; however, it is not likely that corrective actions will be required. A comparison of known and expected site conditions associated with each alternative can be found in **Section 6.1.10.** Compliance with the requirements of EC 1165-2-132 for the project planning phase is demonstrated in this report. The USACE and SFWMD will continue to document HTRW conditions on the project lands to ensure full compliance with ER 1165-2-132 and other applicable HTRW policy prior to construction of project features.

3.1.11 Cultural Resources

USACE is reviewing information regarding historical properties that might be affected by the Biscayne Bay Coastal Wetlands project, in compliance with Section 106 of the National Historic Preservation Act of 1966 (PL 89-665), as amended in 2000; its implementing regulations (36 CFR Part 800) and the Archaeological and Historic Preservation Act of 1974 (PL 93-291), as amended.

Human occupation and usage within the Biscayne Bay Coastal Wetlands area has occurred over the past 12,000 years. As the character of the landscape changed from upland prairie to the current wetlands, the ways in which people have used the land has changed. A review of the Florida Master Site Files indicated several known archaeological sites and historic structures within the Biscayne Bay Coastal Wetlands project area. One of the oldest prehistoric sites in the state is found at the Deering Estate; other sites include an early 20th Century historic site listed on the National Register of Historic Places, and the "Old Cutler Road" designated as a State Historic Highway. Due to the existence of known historical properties, tree islands, and the high probability of unrecorded sites within the general vicinity that have the potential to be impacted by construction, a professional archaeological survey will be required.

3.1.12 Socio-Economic Conditions

The Biscayne Bay Coastal Wetlands project site does not coincide exactly with the census tracts. The census tract provides a convenient area for which data is available, and is closer to the relatively small sub-county component site footprint. This census tract data provides a blueprint for the surrounding area, not exact characteristics of the project site. The Biscayne Bay Coastal Wetlands site has few permanent residents or existing businesses, and most of the owners of the land do not occupy the property. In many instances, the land owners reside outside of the region. The most current information regarding the detailed demographics of the Biscayne Bay Coastal Wetlands census tracts was published in Year 2000.

Describing the demographic characteristics for the project site's census tract, Miami-Dade County, and the State of Florida, helps to provide a basis for understanding the existing socio-economic context in which plan implementation would take place. Some of these characteristics are outlined below while ***Table 3-5*** and

Table 3-6 describes additional socio-economic information.

TABLE 3-5: COMPARISON OF FLORIDA AND MIAMI-DADE COUNTY SOCIO-ECONOMIC INFORMATION

Florida		
	Population 2000	15,982,378
	Change in population, 1990-2000	23.5%
	Below poverty level, 1999 estimate	12.5%
	White, 2000	78.0%
	Black, 2000	14.6%
	Hispanic, 2000	16.8%
	Other, 2000	7.4%
Miami-Dade County		
	Population 2000	2,253,362
	Change in population, 1990-2000	16.3%
	Below poverty level, 1999 estimate	18%
	White, 2000	69.7%
	Black, 2000	20.3%
	Hispanic, 2000	57.3%
	Other, 2000	10%

TABLE 3-6: BISCAYNE BAY COASTAL WETLANDS 2000 CENSUS TRACT

Census Tract	106.02	107.04	114.01	Total
Population	2,915	7,914	4,330	15,159
Percent below poverty level	43%	24%	9%	23%
White	16%	53%	77%	53%
Black	79%	32%	11.8%	35%
Hispanic	20.1%	48.8%	31%	38%
Some other Race	5%	15%	11.2	12%

Population in Miami-Dade County increased from 1,937,540 to 2,253,362 (16.3 percent) during the period from 1990 to 2000. The population of Florida and the United States increased 23.5 and 13.1 percent respectively over the same period. Population in Miami-Dade County is expected to increase nearly 70 percent from 2000 to 2050, while the projected growth of the entire south Florida nine-county area is projected to grow 78 percent during the same period.

Additional characteristics of the study area include a strong service sector, fishing, tourism and recreation. Florida's economy is generally characterized by strong wholesale and retail trade, government and service sectors. Florida's warm weather and extensive coastline attract vacationers and other visitors and helps to make the state a significant retirement destination for people from all over the country. Easily developed land, accessible water supply, abundant natural resources, and the aesthetic beauty of the region are the fundamental building blocks of the local economy. Relative to the national economy, the manufacturing sector has played less of a role in Florida, including the study area. However, high technology manufacturing has begun to emerge as a significant sector in the state over the last decade.

3.1.13 Land Use

Existing land use within the study boundaries varies widely from agriculture to high-density multi-family and industrial urban uses. Urban development is generally concentrated along the lower east coast of Miami-Dade County, which is beginning to overlap with the project area at the northern portion located within the Miami-Dade County 2015 Urban Development Boundary (UDB), as shown in ***FIGURE 3-16***. The project area contained only 675 acres of urban land in 2005, which is about 0.5% of the 125,300 total acres of urban land uses within the Miami-Dade UDB.

Rapid population growth and land development practices have resulted in notable western urban sprawl; the predominant land use is single-family residential. The once significant rural population in the western areas of Miami-Dade County is rapidly evolving into an urbanized population. Although there remains substantial agricultural land in southwestern Miami-Dade County (67,050 acres county-wide in 2007), the total acreage of agricultural lands has fallen in recent years from 90,373 acres in 2002. The project area contained 2,970 acres of agricultural land in 2004, about 4% of the total agricultural lands in Miami-Dade County, see ***FIGURE 3-16***.

The Turkey Point Nuclear Power Plant is located on the shoreline near the project area. Some water used in the reactor is piped in from the Miami-Dade municipal water supply. A separate supply of water that cools the turbine steam supply for reuse comes from a unique, closed system of 36 interconnected canals totaling over 168 miles on length. The existing use of the land that is being considered for the project primarily consists of mixed open land with agriculture, degraded wetlands and fallow fields. Homestead Air Reserve Base borders a portion of the study area on the west, and BNP borders the study area on the east. Inside the study area boundary there is a landfill toward the northern end of the study area as well as a water treatment facility. The majority of the agricultural land use is ornamental trees, with a mix of row crops and nursery crops.

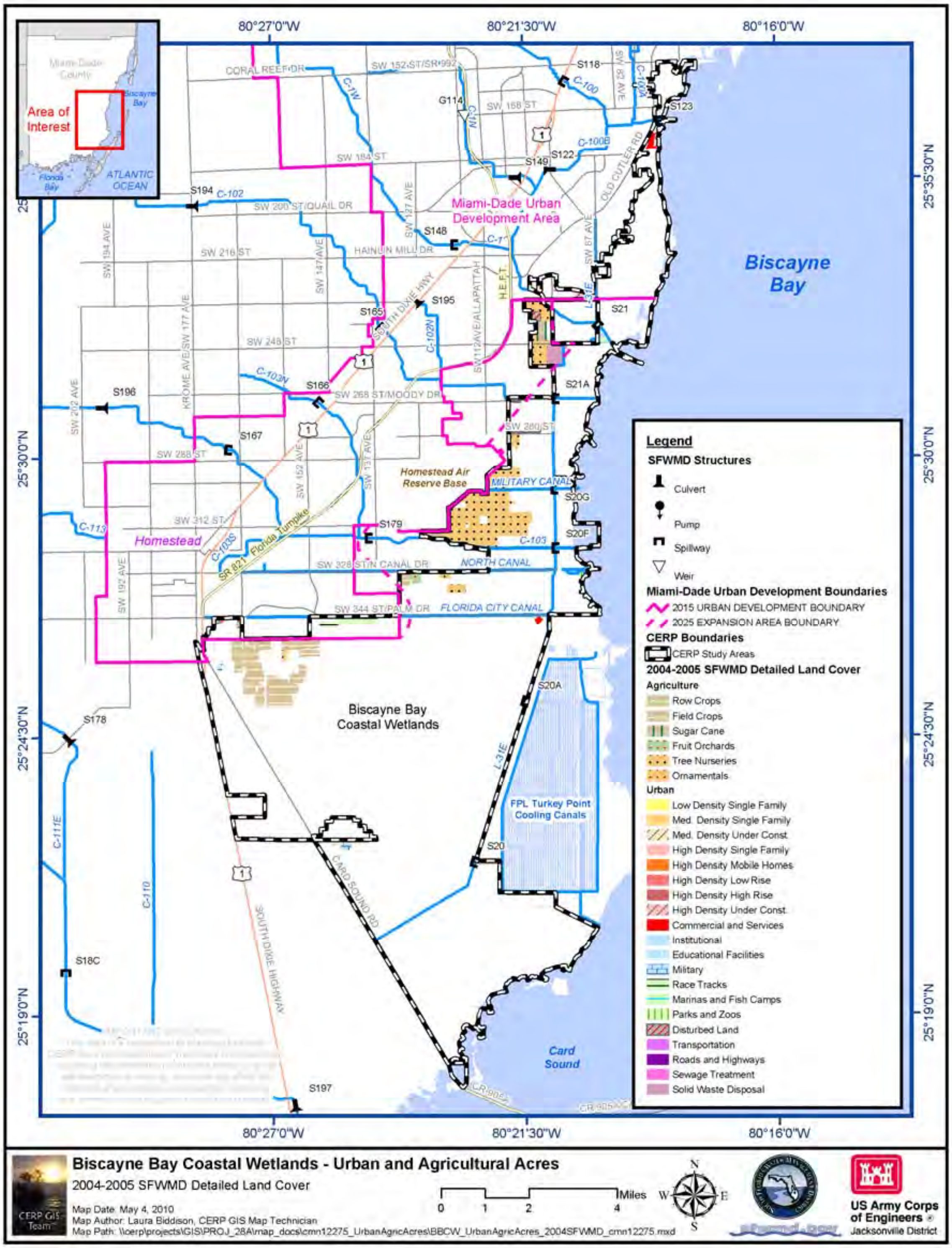


FIGURE 3-16: PROJECT AREA DETAILED LAND USE MAP

3.1.14 Noise

Within the major natural areas of south Florida, external sources of noise are limited and have low occurrence. Rural areas have typical noise levels in the range of 34-70 decibels, and urban areas may attain 90 decibels or greater. Noise is not considered to be an issue in the development of the Biscayne Bay Coastal Wetlands project components.

3.1.15 Recreational Resources

BNP is comprised of about 180,000 acres in Miami-Dade County, Florida, just south of Miami and 21 miles east of ENP. It was established as a national monument in 1968, and subsequently enlarged and designated as a national park in 1980. BNP is about 22 miles long, with its northern boundary near Key Biscayne and its southern boundary near Key Largo. The only overland access to BNP is at the Convoy Point Visitor Center via Southwest 328th Street (North Canal Drive).

BNP provides abundant opportunities for recreation, including boating, snorkeling, diving, fishing, bird watching and nature study. Multiple self-guided nature trails are located in the park offering views of tropical hardwood hammock of rare vines, flowers, and trees. There are over 500,000 visitors to BNP every year. Eighty percent of United States visitors to BNP were from Florida. Nine percent of all visitors were international, with the most coming from Canada. A majority of the visitors to BNP spend less than a day at the park. The most common activities are nature viewing, walking/hiking and fishing (BNP Visitor Study, 2001).

There are many other recreational opportunities within and adjacent to the study area. They include: ENP, Florida Keys National Marine Sanctuary, Wildlife Refuges, Fish Management Areas, Wildlife Management Areas, State of Florida Greenways, Florida Circumnavigational Paddling Trail, State of Florida Parks, Florida Community Trust Sites, Florida Artificial Reef Program Sites, and Miami-Dade County parks. Refer to ***Appendix H***; page H-5, for more detailed information.

3.1.15.1 Aesthetics

The aesthetics of the study area are characteristic of the dominant three land use categories (natural areas, agricultural lands and urban areas).

The natural areas are composed of a variety of upland and wetland based ecosystems including lakes, sloughs, ponds and vast expanses of marsh and wet prairie with varying vegetative components. Overall, the land is remarkably flat with few natural topographic rises such as hills or other geographic undulations.

In the southern end of the study area, much of the visible topographic features are man-made, including ubiquitous canals and levees. Additional man-made features of the landscape include landfills, agricultural fields, pump stations, navigation locks, secondary and primary roads, highways, electrical wires, communication towers, occasional buildings (some abandoned), borrow pits and other features which may or may not detract from the regional aesthetic. Views, from a high perspective such as atop a levee, offer perspectives on mangrove and freshwater marsh, as well as scenic views of Biscayne Bay, often with sightings of birds and other wildlife. Views of the Biscayne Bay study area are panoramic and can be stunning during sunrise and sunset.

The northern and western portion of the study area borders on medium density urban development. These areas are visually congested with immense residential areas, composed mostly of one-story or two-story buildings, well-trafficked roads, parking lots, strip malls, and industrial and commercial enterprise. It includes intensively developed residential communities and highways.

SECTION 4

FUTURE WITHOUT PROJECT CONDITIONS

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4.0 FUTURE WITHOUT PROJECT CONDITIONS

This section describes changes expected in the study area over the period of analysis assuming an ecosystem restoration project is not built as a result of this study. This description of the assumed without-project condition serves as the baseline against which alternative plans will be evaluated to determine their effectiveness and to identify effects that would result from them. Consistent with the revised final draft CERP Programmatic Regulations GM #2 (USACE, 2007), the planning period of analysis ends in 2050.

4.1 STUDY AREA

Undeveloped areas contain predominantly wetland vegetation, plus disturbed, rural upland areas with roads, levees and other man-made features. As a consequence of past and current water management practices, land development and sea-level rise, freshwater wetlands in the project area have been altered, degraded and reduced in spatial extent. Anthropogenic changes to freshwater flow patterns and volumes have reduced the occurrence of mesohaline, oligohaline, freshwater marshes, and sloughs, and have allowed the landward expansion of saltwater and mangrove wetlands.

The study area for the proposed Biscayne Bay Coastal Wetlands project is composed of a variety of privately-owned, local, state and Federal lands. Privately owned natural lands in south Florida have become scarce due to development; therefore, it is believed these lands would be developed in the near future. The ecosystem within this area is unique and fragile. Extension of current development trends (including increase in impervious surface area) would lead to increased runoff velocity and higher, more frequent freshwater discharges in the area. These increases would exacerbate the damage that already is present due to canal drainage. Increased development within this area would also lead to increased habitat fragmentation and a loss of critical wildlife corridors.

Residential development in the project area would require the dredging and filling of wetlands. The creation of stormwater ponds and drainage facilities would have an extremely detrimental effect on groundwater flow into Biscayne Bay. Freshwater groundwater flow into Biscayne Bay is necessary to maintain existing salinity regimes in the dry season and reduce hypersalinity levels that already exist. Additionally, foraging opportunities for wildlife would be reduced as native plant communities would be replaced with invasive exotic species.

Regulatory impacts were considered when compiling the future without project conditions. The future without-project land coverage used in the hydrologic modeling and benefit assessment assumed minimal loss of wetlands with new development occurring mostly on previously farmed lands. Under Section 404 of the Clean Water Act permits are required for the discharge of dredge or fill material in waters of the United States including wetlands. Unavoidable impacts to wetlands or other aquatic resources require compensatory mitigation. There are some exemptions under the Clean Water Act for agricultural activities. Digging ditches and farming uplands does not require a permit so this activity could occur in the basin without any USACE permit. Clearing and filling for development would likely require a permit. In that situation, mitigation may be done on site through enhancement and preservation of existing wetlands or offsite. In addition, through the Federal permit process the regulatory division of USACE evaluates compliance with other environmental laws such as the Endangered Species Act (ESA).

4.2 FORECASTED ECOLOGICAL DESCRIPTION/SETTING

The spatial extent of the natural areas within the project study area has the potential to decrease considerably through the Year 2050. Much of this area is not currently in public ownership or in public land acquisition plans and is therefore likely to be developed for urban and possibly agricultural uses. Urbanization is accompanied by an increase in runoff of a wide range of pollutants including herbicides, pesticides, fertilizers, aromatic compounds (hydrocarbons, oils, greases, gasoline), heavy metals and other emerging pollutants of concern (hormones, organic and inorganic compounds). In urban developments near wetlands, residents often request and obtain frequent mosquito control spraying. Agricultural development is accompanied by the use of herbicides, pesticides and fertilizers. The increased release of pollutants into the natural environment would result in the decline of macroinvertebrates (e.g., insects, snails), which in turn would adversely impact resident and migratory birds, as well as other insectivores. Observations from field visits indicate that this area has high all terrain vehicle (ATV) usage, and this is likely to increase in the future without-project condition scenario. Although there is current and near-future development planned for the area, the City of Miami would not provide solid waste disposal. This is likely to result in increases in unauthorized dumping of solid waste in natural areas and even in urban areas.

4.2.1 Climate

During the period between the present and Year 2050, South Florida should experience a full multi-decadal cycle of Atlantic hurricane activity. Currently, the area is in an active phase of this cycle that started in 1995. This active phase followed a 25-year period of low hurricane activity. This suggests that between the present and Year 2050, the area would complete this active phase, pass through another low activity period and begin another active phase.

There is now evidence of anthropogenic changes to global climate patterns that will likely have an impact on South Florida in terms of rainfall, evapotranspiration, and temperature. The Intergovernmental Panel on Climate Change (2007) estimates that by 2060 (near the end of the projected life of the project average), air temperature will increase by 2°F. Maps produced by the Intergovernmental Panel on Climate Change indicate that evapotranspiration will likely increase by an estimated 15% by 2100 relative to historic conditions (1980 to 1999). Similar maps for rainfall show a reduction of up to 20% in rainfall in South Florida by 2100 as compared to the historic conditions experienced between 1980 and 1999. The Florida Oceans Council (2009) predicts more frequent intense rainfall events will occur coupled with longer dry periods in between. This is likely to lead to higher peak canal flows and longer periods of little to no canal flow within the BBCW study area.

4.2.2 Physical Landscape: Geology, and Soils

4.2.2.1 Geology

In the future without-project scenario, the subsurface geologic conditions are not expected to significantly change from the current conditions. Groundwater is the notable exception. The average groundwater stage (elevation) may be impacted by increased development within the area as well as sea level rise and the resulting changes to the canal operating plans. Increased saltwater intrusion along the shoreline is expected to occur.

4.2.2.2 Soils

Soil conditions may be altered in the agricultural and upland areas by residential and/or industrial development. This soil may be removed, accreted or built upon. Soils within the upland and coastal wetlands are not expected to be disturbed. In rare instances, some development may occur in wetland areas with proper permitting from the local governing agencies. As a result, these wetland soils would be drained and/or displaced with fill materials to support development.

4.2.3 Hydrology

Some fundamental aspects of hydrologic conditions are expected to change in the southern Miami-Dade County watershed by the Year 2050. In the absence of any mitigation or restoration, freshwater flows to Biscayne Bay may diminish, flooding may increase, and stormwater runoff intensity from large storms would likely increase. The primary drivers for these changes are sea-level rise, expanded impervious areas due to increased development in the watershed, and increased water use demands from the aquifer as a result of population increase.

By 2050, sea level is expected to rise 0.8 to 2.0 feet from the existing condition (year 2000) level in Biscayne Bay. If the freshwater heads currently maintained under operational rules remain the same in Year 2050, the rise in sea level would effectively reduce the groundwater slope from the coastal ridge toward Biscayne Bay, thus reducing head pressure and groundwater flux toward the Bay. Under this scenario, the Biscayne Aquifer is likely to experience greater intrusion of saltwater possibly rendering some of the current urban water supply well fields unusable due to contamination. Higher groundwater stages in the project area will reduce the ability of water managers to store rainfall runoff either within wetlands or the surficial aquifer, resulting in increased intensity of stormwater discharges through the primary canals. Reduced water storage reduces the capacity of the flood control system to accommodate runoff and would likely lead to increased frequency of flooding events.

The functional population is expected to increase more than 100 percent by the Year 2050 within the primary drainage basins of the Biscayne Bay Coastal Water Preserve (BBCWP) (SFRPC et al., 2007). To accommodate the increased population within the watershed, land use would shift from open and agricultural lands to residential and commercial uses. Within the southern Miami-Dade County watershed, about 50 percent of the lands are currently built, with the balance split roughly between agricultural uses and wetlands. By Year 2050, the built environment is expected to be the dominant land use with a 180 percent increase of households (Keith and Schnars, 2004). Most of the increase in urban land uses will occur west of the project area in Homestead and Florida City. (Note that the referenced predictions of land use and population were made prior to more recent thinking regarding the impact of sea level rise on South Florida coastal communities.) The shift in land use would likely impose additional demands on the flood risk management system, especially during heavy rainfall events. The percentage of impervious surface typical of agricultural land is estimated to be less than one percent, but in residential areas it is estimated at 65 to 70 percent. Heavy rainfall may quickly overwhelm on-site stormwater retention systems of the future built environment and overflow into the primary flood risk management system that has been affected by sea-level rise.

Increased water use could effectively reduce the overall quantity of surface and groundwater flow into Biscayne Bay. Hydrologic modeling results using the South Florida Water Management Model (SFWMM) published in 2000 indicate that water withdrawals for agriculture and urban uses affect the quantity of fresh water that ultimately flows into Biscayne Bay (SFWMD, 2000). These simulation results predict that by Year 2020, well field demand in the BBCWP area would increase by 89 percent and agricultural demand by four percent, resulting in up to a 23 percent decrease of surface water discharges to Biscayne Bay through the primary canals. The Year 2020 projections assume that modified water deliveries to Everglades National Park (ENP) have been implemented and are mitigated somewhat by the assumption that Miami-Dade

Water and Sewer Department has implemented a supplemental aquifer storage and recovery system of 150 million gallons per day (mgd). Demand for water in the Year 2050 would likely be greater with a commensurate impact to freshwater flow into Biscayne Bay.

More recently, the SFWMD, FDEP, and the Miami-Dade County Sewer and Water Authority (MDCSAWA) agreed in 2008 to move forward with a moratorium on new consumptive use permits within the study area and to implement water reuse projects within the southern portion of Miami-Dade County. These actions should significantly limit increased potable water demand within the project area that result from increased populations. If municipal demand is held to no increase as agreed to by SFWMD, FDEP, and MDCSAWA, the overall increase in water demand within the basin should be around 3 percent by 2020. By 2050 agricultural demand will decrease as a result of sea level rise impacting farming operations in the vicinity of Biscayne Bay.

4.2.3.1 Sea-Level Rise

Sea-level rise would have the most impact on coastal canals and communities, with loss of flood protection and increased saltwater intrusion being the primary impacts. Additionally, coastal ecosystems and estuaries may be adversely affected and may require additional deliveries of fresh water to maintain desirable salinity patterns and healthy ecosystems.

Sea-level rise is one of the more certain consequences of climate change, and because it affects the land/ocean interface, it has the potential for environmental impacts on coastal areas. Sea-level rise is discussed in ***Section 7.14.2.3*** of ***Section 7, The Selected Plan***.

4.2.4 Water Management

Using the most likely population scenario for Service Area 3, the water demand projections for conservation-adjusted water use in Year 2050 would be 505.6 million gallons per day (mgd). Water demand for Service Area 3 is expected to comprise one-third of the total water demand of the nine-county Initial CERP Update Region. With the increase in population and infrastructure, the demand for water would increase, and the shortages and restrictions would become more prominent, leading to both economic and environmental damages. In the LEC region, groundwater is the predominant source of water for municipal and industrial (M&I) uses. This trend is expected to continue in the future though there are efforts underway to prohibit future increases in groundwater withdrawal in southern Miami-Dade County. Sea level rise combined with increased water demand is likely to result in increased salt-water intrusion along the coast line.

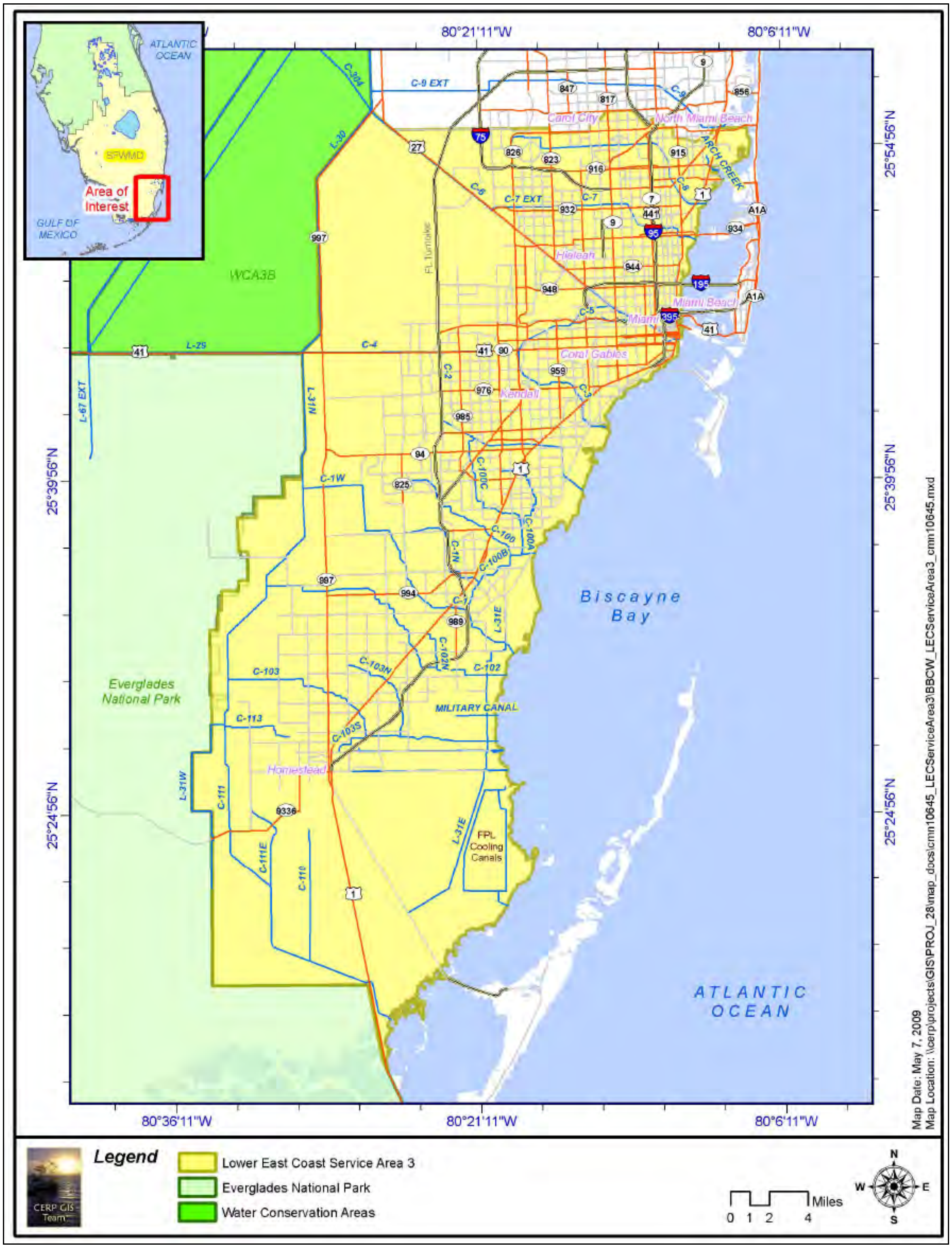

FIGURE 4-1: LOWER EAST COAST REGION SERVICE AREA 3

4.2.4.1 Flooding

Flood damage reduction needs have increased since the original C&SF flood control project was constructed and would likely continue to increase in the future. As agricultural and urban development continues, the volume, duration and frequency of floodwaters may increase, and the actual level of flood risk management service may decline in some areas. Sea level rise is likely to impact flood protection effectiveness as tailwater conditions at the coastal structures increase and limit maximum discharge rates. The negative effects associated with flooding are expected to increase significantly over current conditions by the year 2050.

4.2.5 Water Quality

Future water quality conditions in southern Biscayne Bay would be influenced by multiple factors. The changes in land use and runoff hydrographs are likely to affect the water quality of surface and ground waters within the watershed. The high nitrate loads from the C-102 and C-103 basins that result from the current agricultural land uses would be reduced by Year 2050 as agriculture gives way to urban development. However, this land use conversion would result in runoff quality in these basins becoming more like the C-1 and C-100 basins, which is characterized by elevated phosphorus, hydrocarbons and heavy metal concentrations that are typical of urban stormwater (Alleman et al., 1995). The changes in land use and runoff hydrographs are likely to affect the water quality of surface water and groundwater within the watershed. Presently, the most prolific contaminant is nitrate, which has been linked to agricultural sources. As agricultural land uses diminish in the watershed, other contaminants such as ammonia, phosphorus, trace metals and hydrocarbons more typical of urban settings are likely to become more common (Alleman et al., 1995). In addition to the reduction in nitrate loads from agricultural runoff, the nearshore bay should experience a reduction in ammonia loading from the South Dade landfill and its predecessors. Though modern stormwater controls should limit the impact of urban development, changes in runoff volume and timing may increase the amount of suspended solids which, in addition to reducing water transparency, often transport phosphorus and trace metals.

The nearshore area within a couple of kilometers of the shoreline will continue to experience hypersalinity conditions during the dry season. This will continue to limit the numbers of juvenile fish, pink shrimp, oysters and other species that prefer mesohaline (10-20 psu) conditions. During the late wet season, mesohaline salinity conditions should continue to occur. However, additional flood storage capacity necessary to accommodate new urban development may result in additional periods of high salinity within the nearshore bay as well as rapid swings in salinity due to the increase in magnitude of flood releases.

4.2.6 Vegetative Communities

It is likely that native forested/shrub wetlands and graminoid marshes east of Card Sound Road not in public ownership would cease to exist as a natural area due to urban development. This is almost certainly to be true of areas north of Turkey Point. Future development would also have numerous secondary effects. The wetlands in the northern part of the sawgrass marshes in the Model Lands could transition from a sawgrass-dominated marsh to cattail-saltbush-dominated wetlands due to poor water quality from residential runoff and decline of available fresh water.

Changes in availability and distribution of fresh water and further disruption of natural sheet flow from discontinuities in hydrology due to levees, roads and canals would further exacerbate the changes occurring in the natural freshwater graminoid marshes, forested/shrub wetlands, marl prairie, tree islands and mangrove ecotones. Disruption of natural fire cycles and extent can have several effects that would increase in the future without-project condition scenario. Control of fire intensity and extent due to potential for impacts on human infrastructure can encourage establishment of woody plant species that would normally be eliminated as well as selection against more fire tolerant species such as sawgrass and muhly grass. Reduction of water availability can cause fires to burn more intensely than otherwise, killing plant species that would normally survive a more natural "cool burning" fire as well as permitting organic soils to burn. Concurrently, unnatural flooding can inhibit fires and beneficial vegetation changes. All of these processes would be exacerbated due to increased urbanization in the future.

Sea-level rise would create the potential for further expansion of salt tolerant plant species, especially mangroves, into the freshwater marsh areas. If sea level rise is as much as 2 ft over the next 50 years, it is possible that historic wetlands west of the L-31E levee that are presently farmed will revert to wetlands as farmers abandon fields due to unmanageable flooding conditions. Overtime these re-converted wetlands will transition to salt tolerant species beginning first with areas just west of the L-31E levee and progressing westward. Of course, the speed at which these lands re-convert first to freshwater wetlands then to salt tolerant wetlands will depend upon the water management practices put in place to deal with increased sea level conditions.

Urbanization and associated habitat changes and anthropogenic effects (e.g., pets, exotic species releases, wildlife mortality) would negatively affect native vegetative and wildlife species number and occurrence. These negative effects are expected to intensify from current conditions.

Tree islands, an important component of the Everglades habitat for a variety of native plant species not adapted to growing directly in flooded marshes, are being variously impacted by changes in water management and invasion of exotic plant species.

The impacts resulting from unauthorized ATV usage in the natural areas include killing the vegetation and changing the microtopography of the area. This has implications for the hydrology and vegetation, which are very sensitive to slight (in terms of inches) changes in topography. ATV usage and its associated detrimental effects to the environment would likely increase with the anticipated increase in population in or near the project area.

4.2.7 Fish and Wildlife Resources

The region supports a variety of wetland dependent wildlife, including several Federal and state-listed endangered and threatened wildlife species. A reduction of the wetland function and value of coastal and inland habitats within and adjacent to the Biscayne Bay Coastal Wetlands project area associated with the spread of development and land conversion, would result in an overall loss of fish and wildlife resources within the project area in the future. Disruption of the natural hydrology has resulted in aquatic vegetation community changes and a resultant disruption of aquatic productivity and function that has had repercussions throughout the food chain, including effects on wading birds, raptors, larger predatory fishes, reptiles (crocodiles and alligators), and mammals. These effects would undoubtedly worsen given demands associated with environmental changes for the next 50 years.

Productivity of native fish species, many important as prey species for wading birds, has been and would continue to be depressed due to water management practices (Ogden, 1994; Loftus and Eklund, 1994) and other factors previously discussed.

Introduction and spread of a wide range of exotic fish species has increasingly been problematic in the project study area. The causative factors for this exotic fish problem include illegal introductions, unnatural habitat due to construction of canals and impoundments, and the establishment of vectors for travel and refugia (linear canals and deeper water) unlike the natural Everglades environment. Evaluation of the effects on occurrence and productivity of native fish species is controversial at best, but some studies report that the effect is negative and would be exacerbated in the next 50 years (Turner et al., 1999; Trexler et al., 2000; Kline et al., 2003).

Maintenance of the popular sport fishery for non-native species such as the butterfly peacock (*Cichla ocellaris*), and native largemouth bass (*Micropterus salmoides*) should remain largely unaffected in the future without the Biscayne Bay Coastal Wetlands project.

4.2.7.1 Threatened, Endangered and State-Listed Species

Direct loss of habitat, as well as fragmentation of habitat in surrounding areas caused by the conversion of agricultural lands to urban and agricultural uses, is likely to result in a continued decline in threatened, endangered, and state listed species. Section 9 of ESA prohibits the unauthorized "take" of listed species on public and private lands, as a result of Federal and non-Federal actions. Future Federal actions unrelated to the proposed action, but located in the study area, will require separate consultation pursuant to Section 7 of the ESA. In addition, future non-Federal actions will be coordinated with FWS through Section 10 of the ESA.

Over the next 50 years, continued increase in urbanization, water management practices, direct habitat loss, and other land requirements, as well as the degradation of existing habitat function, are likely to result in the continuance of negative population trends of threatened, endangered and state-listed species of special concern. A discussion of species of particular concern follows.

West Indian Manatee

The major threats faced by the West Indian manatee today and continuing into the future are from two primary anthropogenic causes: collisions with watercraft and entrapment in water control structures. The future without the Biscayne Bay Coastal Wetlands project would likely witness an increase in boat-related manatee mortality due to increased human resident population and a corresponding increase in boating. Direct manatee mortality rates from water control structures would likely be similar to current figures.

The future of the current system of warm-water refuges for manatees is uncertain as deregulation of the power industry in Florida occurs. The lack of establishing minimum flows and levels for Biscayne Bay may compromise the natural springs on which many manatees depend for drinking sources, as well as warm water refugia. There are threats to habitat caused by coastal development throughout much of the manatee's Florida range. Florida's human population is growing significantly in conjunction with intensive coastal development with the greater part occurring in the 35 coastal counties. An increase in boating traffic associated with this human population increase would potentially cause an increase in manatee collisions with watercraft and associated manatee deaths. Natural wintering sites in South Florida have been and continue to be altered by activities such as rip-rapping and bulkheading shorelines, diverting or capping sources of warmer water, and elimination of foraging and resting areas. Demands for water for residential, industrial and agricultural purposes from the aquifer have and would continue to diminish spring flows as would paving and water diversion projects in spring recharge areas. Nutrient loading from residential and agricultural sources is promoting the growth of algae and clouded water columns, reducing available forage in seagrass beds and refuges.

There are threats from natural events such as red tide and cold events. Survival of manatees would depend ultimately on maintaining the integrity of natural ecosystems and habitat sufficient to support a viable manatee population.

Florida Panther
Florida panther (*Puma concolor coryi*) habitat in the Biscayne Bay Coastal Wetlands project area includes habitat designated as a primary/dispersal zone in the Landscape Conservation Strategy for the Florida panther in South Florida. This habitat (primary/dispersal zone) is considered to be the most important area needed to support a self-sustaining panther population.

The Florida panthers' existence is threatened by extinction processes. Population viability analysis projections indicate that under existing demographic and genetic conditions the panther could be extinct in 24 to 63 years (Seal et al., 1992). Environmental factors affecting the panther include: habitat loss and fragmentation, contaminants, prey availability, human-related disturbance and mortality, disease and genetic erosion (Dunbar, 1993). Present and probable future human population growth, urban expansion and agricultural expansion in South Florida, including the project area, are compromising the ability of natural habitats to support a self-sustaining panther population. The recovery of the South Florida panther and the Landscape Conservation Strategy will be in jeopardy if development and anthropogenic expansion trends continue over the next 50 years.

Wood Stork
The prognosis of the United States wood stork (*Mycteria americana*) population over the next 50 years is partially dependent on the success of the CERP. Almost all of the freshwater marsh and estuarine areas in the project study area can be considered suitable wood stork foraging habitat. In the future without-project condition, wood stork habitat would be eliminated by development or would continue to be degraded as foraging habitats in much of the remaining wetlands. As noted earlier, the CFAs of two wood stork colonies overlap the northern part of the project area, including the Deering Estate and parts of the Cutler and Black Creek wetlands. Continued urban development in this part of the project area under the future without-project condition scenario would certainly reduce or even eliminate this important foraging area for wood storks.

Bald Eagle
Although the bald eagle was removed from the Federal list of endangered and threatened wildlife in August 2007, it remains protected under the Migratory Bird Treaty Act and the Bald Eagle Protection Act.

Suitable nesting and foraging habitat exists throughout the project area. Preferred habitat for bald eagles consists of large, open-water bodies for foraging and suitable perch and nesting sites nearby. The future without-project scenario in the Biscayne Bay Coastal Wetlands project area would offer no habitat enhancements to expand eagle populations in the project area and new electrical lines associated with urbanization could present an increased electrocution hazard for eagles.

Wading Birds

Although there are fluctuations of nesting success for wading birds that are driven by climatic as well as water control related issues, in general, nest numbers and success of wading birds have decreased dramatically across South Florida over the past 100 years. These results are especially evident in data collected for wood storks and white ibis (*Eudocimus albus*). Although data is less complete and suggests regional and short-term population increases for species such as the little blue heron (*Egretta caerulea*), evidence suggests that the degree to which these species populations have increased system-wide, and over longer periods of time, is less convincing.

A long-term scenario that does not include habitat restoration components of the CERP currently being evaluated would undoubtedly result in a continued overall decline in wading bird species populations due to continued encroachment into habitat and anthropogenic influences on water supply.

Historically, the area northeast of Florida Bay was one of the most productive sub-regions of the bay for roseate spoonbill (*Ajaja ajaja*) (Lorenz et al., 2002). Over the last 60 years, this area has been heavily impacted by anthropogenic water control practices, which have led to negative impacts to spoonbill nesting success (Lorenz, 2000). Nesting success in other active sub-regions compared to the northeastern sub-region gives increased credibility to the conclusion that the observed decline is anthropogenic in nature. Other sub-regions in roseate spoonbill nesting habitat, such as western Florida Bay, are buffered by distance from water management practices. The future without the Biscayne Bay Coastal Wetlands project would likely witness a further degradation of spoonbill habitat due to continued conveyance of fresh water through existing canals that disrupts natural patterns of spoonbill prey base production and concentration. Unless major changes are implemented to water management practices that affect roseate spoonbill habitat and Florida Bay in general, these areas would continue to decline in ecologic health with resultant further detrimental effects on roseate spoonbill.

Continually decreasing hydroperiods in presently over-drained marl is likely to worsen. Wading birds will be directly affected by the decreased foraging opportunities provided by shorter and less-frequent hydroperiods in shallow ‘grass-sea’ areas. The pattern of marsh degradation, hydroperiod decrease and habitat loss for wading birds is expected to continue in the future without-project scenario.

American Crocodile

Compared to historical estimates of 1,000 to 2,000 animals, populations declined to a low that apparently occurred sometime during the 1960s or 1970s with an estimated 100 to 400 non-hatchlings (Ogden, 1978). The American crocodile population in south Florida increased substantially over the last 25 years and is estimated at approximately 1,400 to 2,000 individuals, not including hatchlings (72 FR 13027-13041). Habitat protection has accounted for much of this increase but would be unlikely to produce a much greater population increase given potential future human encroachment, development, and land use changes.

Habitat loss due to development and water management practices along coastal areas has been and continues to be the primary factors endangering the American crocodile in Florida. Field and laboratory data suggest that low nest success combined with high hatchling mortality are the primary factors affecting survival. The disruption of water flowing to the bay across a broad front has severely reduced the spatial extent of suitable crocodile habitat based on salinity requirements of juvenile crocodiles. The future without-project condition scenario would likely result in no improvement of habitat for juvenile crocodiles, and may result in further degradation.

Collisions with automobiles continue to be the major documented cause of mortality of crocodiles in Florida, with most of these occurring on U.S. Highway 1 or Card Sound Road. Both of these roads lie within the Biscayne Bay Coastal Wetlands project area. Continued human expansion threatens *Crocodylus actus* populations by way of incidental death from traffic, and decreased frequency of natural prey. The future without-project scenario presents all of these anthropogenic threats along with the continuance of habitat degradation. This could potentially cause niche overlap and subsequently competition between *C. actus* and *Alligator mississippiensis*, the effects of which cannot be estimated without further study.

American Alligator

The American alligator (*Alligator mississippiensis*) is a keystone species of the South Florida ecosystem. The American alligator's role as a top predator and its effect on the structuring of plant communities and associated aquatic animals (Mazzotti and Brandt, 1994) make it an ideal indicator of ecosystem health. Population growth and survival depends directly on the hydrologic functioning of South Florida watersheds. Each of these watersheds has experienced, and continues to experience, substantial degradation. Current water management practices have, and should continue to result in, a high and unpredictable rate of nest flooding. Historically, maximum summer water levels were positively correlated with water levels during alligator nest construction. This natural predictability has been lost. Historically, alligators were abundant in prairie habitats of the eastern floodplain and along the edge habitats of deeper sloughs. Pre-drainage occupancy of the deep water central sloughs was relatively low. Given the shortened hydroperiod and lowered water tables in the Everglades caused by drainage (Fennema et al., 1994; Van Lent et al., 1993; VanZee, 1999), the alligator has mostly abandoned the southern marl prairies, and today and for the foreseeable future without-project condition scenario, the distribution of the alligator in the southern Everglades is shifted to sloughs, canals and some deeper areas (Craighead, 1968; Mazzotti and Brandt, 1994).

Eastern Indigo Snake

In South Florida, the Eastern indigo snake (*Drymarchon corais couperi*) is widely distributed but is not commonly found in great numbers in the wetland complexes of the Everglades. They can however be found in pine rocklands, tropical hardwood hammocks, tree islands, coastal prairies, mangroves, freshwater marshes, abandoned agricultural land and human-altered habitat such as levee banks. Because of its relatively large home range, this snake is especially vulnerable to habitat loss, degradation and fragmentation caused by residential and commercial construction and agriculture (Lawler, 1977; Moler, 1985). Habitat destruction and alteration for the present and foreseeable future would be most substantial along the coasts, in the Florida Keys, and along the high ridges of south-central Florida, where human population growth would continue to accelerate. Urban and agricultural developmental interests continue to destroy large expanses of suitable habitat throughout the project area. Even with continued habitat destruction and alterations, this species would probably persist in most areas if large, unfragmented pieces of suitable habitat persist (USFWS, 1999). However, continued habitat fragmentation would result in increasingly isolated small groups of Eastern indigo snakes that cannot ensure the continuation of viable populations.

4.2.7.2 Essential Fish Habitat

Continued point source discharges of canal water into Biscayne Bay would reduce the ability of affected organisms to sustain productivity levels in a manner generally consistent with natural marine communities. The absence of freshwater overland flow into the coastal areas of Biscayne Bay would promote hyper-saline conditions in the near-shore and estuarine biological communities, thus reducing the survivorship of juvenile shrimps and fishes resulting in a reduction of the functional capacity and overall spatial extent of those systems. The future without-project condition scenario is likely to result in an overall decrease in the abundance and diversity of species within those habitats. Sea level rise over the next 50 years will exacerbate some of these impacts and moderate others. For instance, the frequency, duration, and magnitude of hyper and hypo salinity events may decrease as the average depth of the nearshore portions of the bay increases as sea level comes up. Changes to hyper and hypo salinity events in the nearshore will also depend upon how water management practices such as structure operating rules are changed in response to increased sea level. Translocation of juvenile fish habitat westward further into the mangrove zone is likely to occur as a result of sea level rise though it is difficult to predict whether this will be an improvement over existing conditions.

4.2.7.3 Non-Native Wildlife

An increase is anticipated in the Year 2050 future without-project condition in the spatial coverage of invasive non-native (exotic) plant species, such as Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina* spp.), and melaleuca (*Melaleuca quinquenervia*), due to land disturbance and projected lower water levels. With the lack of project monitoring and maintenance, there would be an increase in other exotic plants including shoebutton ardisia (*Ardisia elliptica*) and Old World climbing fern (*Lygodium microphyllum*). The spread of all these invasive non-native plant species has resulted in the conversion of large acreages with a variety of native vegetative species to less diverse and in some cases monospecific vegetative cover with reduced value as wildlife habitat. Detrimental affects to wildlife habitat value caused by non-native vegetation invasion was described in detail in the previous section.

4.2.8 Air Quality

Air quality between the present and Year 2050 is not expected to change significantly from existing conditions. Atmospheric contribution of mercury to the area would continue to decrease as existing controls on major mercury sources are fully implemented. Future, more restrictive regulations on mercury emissions from coal-fired power plants would likely continue the trend for reduced atmospheric contributions of mercury to the Biscayne Bay Coastal Wetlands area.

4.2.9 Hazardous, Toxic and Radioactive Waste

Site contamination issues 50 years into the future are likely to be improved over today's status, whether or not this and other CERP projects are implemented. This statement is made in reference to historically contaminated superfund-type sites. Several decades and billions of dollars have been spent to correct past practices, and added vigilance and increasingly strict regulations should prevent recurrence of this type of site in the future. Major events such as supertanker spills or refinery explosions are accidents that may happen but would be difficult to predict. If such accidents were to occur, they would be addressed immediately, which is critical to minimizing long-term impacts.

4.2.10 Cultural Resources

Under future without-project conditions, there may be some degradation and loss of existing cultural resources within the study area due to the continuation of current development trends, assuming that existing regulatory processes are not completely effective in preventing such losses.

4.2.11 Socio-Economic Conditions

4.2.11.1 Population

Current statistics demonstrate that countywide, Miami-Dade County is characterized by a slower population growth rate than the rest of the state, but a larger population growth than the nation as a whole. However, for lands within and adjacent to Miami-Dade County's Urban Development Boundary (UDB) in the Biscayne Bay Coastal Wetlands study area, growth rates are projected to be much higher.

Miami-Dade County had a Year 2000 census population of 2,253,362 persons. The population of this county experienced a relatively modest increase of 16.3 percent from 1990 to 2000. It is important to note that Hurricane Andrew, in 1992, significantly impacted population growth during this time period because it caused so many people to relocate out of the county. During the same period, the population of the State of Florida and the United States increased 23.5 percent and 13.1 percent, respectively. The State of Florida added over three million persons from 1990 to 2000, ranking third in the nation in numerical change.

Population in Miami-Dade County is expected to increase by almost one and a half million people from 2000 to 2050. Due to this anticipated population growth, the county is expected to remain the most populated county in Florida. The dense urban area of the LEC of Florida has contributed to development pressure and population increases in Miami-Dade County. Miami-Dade County is expected to grow faster than the national trends until at least Year 2050. Conversion of agricultural and other unimproved lands in southern Miami-Dade County including large areas within the Biscayne Bay Coastal Wetlands study area would continue to be fueled in significant part by this population growth.

Table 4-1 summarizes existing and projected population in Miami-Dade County; the Year 2000 figures are from the U.S. Census. The future estimates to Year 2030 were based on the University of Florida Bureau of Economic and Business Research (BEBR) projections in *Projections of Florida Population by County, 2001-2030*, dated February 2002. The Miami-Dade County Department of Planning and Zoning developed the long-term projections from 2030 to 2050. These population projections were calculated for, and accepted by, the Initial

CERP Update. ***Table 4-2*** displays the population rates of growth for each decade from 2000 to 2050. As shown in ***Table 4-3***, the population growth rate of the study area is expected to be lower than that of the state from 2000 to 2050.

TABLE 4-1: POPULATION ESTIMATES, 2000-2050

Population (1,000s)						
	Year					
	2000	2010	2020	2030	2040	2050
Miami-Dade	2,253	2,554	2,862	3,148	3,499	3,811
Share of Florida Total	14.10%	13.54%	13.13%	12.83%	12.90%	12.83%
Florida Total	15,982.40	18,866.70	21,792.60	24,528.60	27,118.70	29,714.50

TABLE 4-2: STUDY AREA POPULATION RATES OF GROWTH 2000-2050

	Average (% Per Year) Population Growth				
	2000-2010	2010-2020	2020-2030	2030-2040	2040-2050
Miami-Dade	1.3%	1.2%	1%	1.10%	0.90%
Florida Total	1.8%	1.55%	1.26%	1.06%	0.96%

TABLE 4-3: STUDY AREA POPULATION GROWTH 2000-2050

	% Change 2000-2050*
Miami-Dade	70.0%
Florida	85.9%

* Note: Florida population projections are only published through 2050

4.2.11.2 Water Demand

The South Florida LEC Region Municipal and Industrial (M&I) water demand forecast is shown in ***Table 4-4.*** Figures are derived from the University of Florida BEBR population and employment projections, and were collected for the 2000 Initial CERP Update. The section of the Initial CERP Update that applies to the Biscayne Bay study area is Service Area 3, which encompasses Miami-Dade and Monroe counties. Water demand projections estimate the Service Area 3 most likely population scenario, conservation-adjusted water use in Year

2050 at 505.6 mgd. Service Area 3 is expected to be using one-third of the total water demanded in the nine-county Initial CERP Update Region.

The SFWMD requires the development of water conservation plans as a prerequisite for water utilities to obtain a water use permit. With the implementation of conservation plans, water demand should change. Most conservation plans incorporate passive water conservation measures that include increasing block rate structures, the required use of ultra-low flow water fixtures on new or renovated construction, restrictions on lawn watering, required use of rain sensors on automatic sprinkler systems, a leak detection program, and public education concerning water conservation measures.

With the increase in population and infrastructure, the demand for water would increase and the shortages and restrictions would become more prominent, leading to both economic and environmental damages. In the LEC region, groundwater is the predominant source of water for M&I uses. This trend is expected to continue in the future though the SFWMD has recent place a moratorium on new consumptive use permits within the south Miami-Dade County. With more persons potentially drawing water and less water available for recharge, migration of the underlying salt wedge leading to increased saltwater intrusion and shortages to wells and well fields would become more prevalent.

TABLE 4-4: ESTIMATED 2050 SERVICE AREA 3 CONSERVATION ADJUSTED, MOST LIKELY POPULATION DEMAND SCENARIO (MGD)

End Use	2000 Demand	2050 Demand
Service Area 3	373.2	586.6

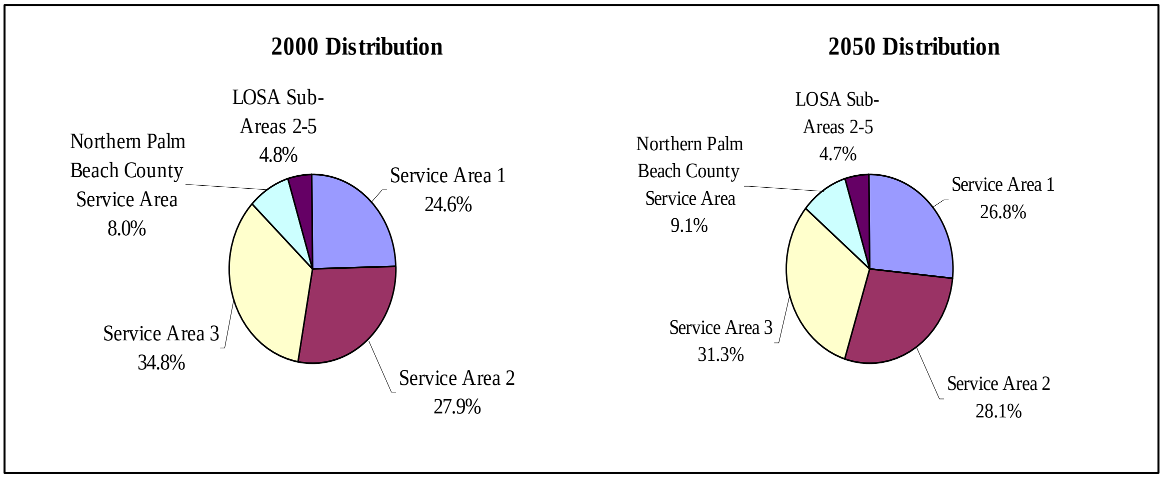

FIGURE 4-2: DISTRIBUTION OF TOTAL CONSERVATION ADJUSTED MUNICIPAL AND INDUSTRIAL WATER USE, BY SERVICE AREA, 2000 AND 2050, MOST-LIKELY POPULATION SCENARIO

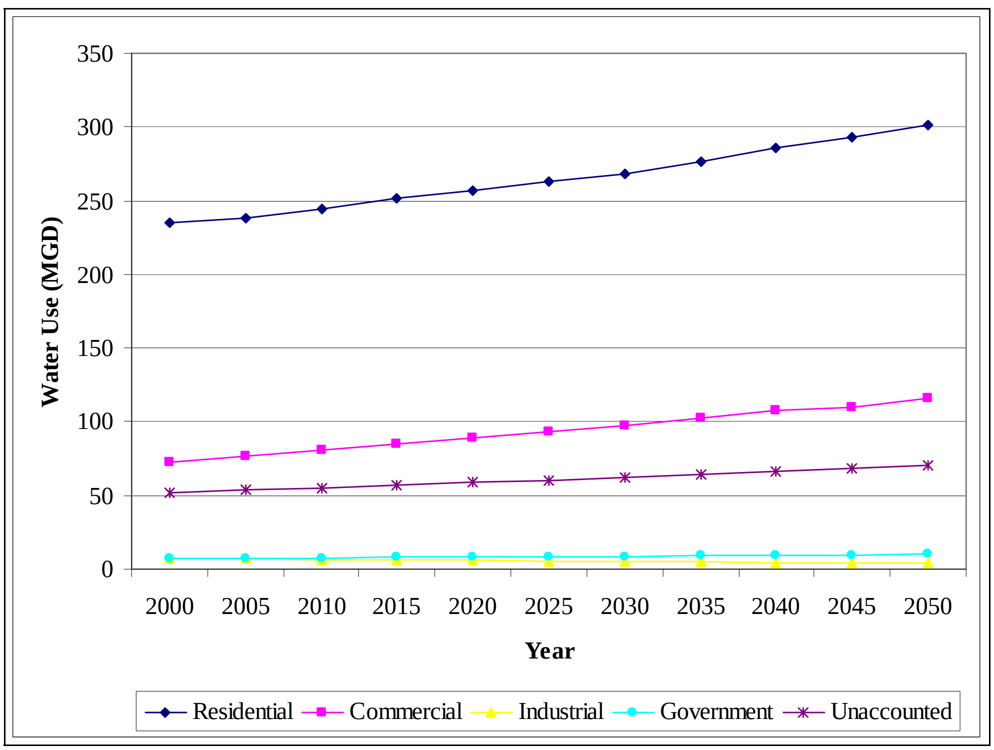

FIGURE 4-3: SERVICE AREA 3, MOST-LIKELY POPULATION SCENARIO MUNICIPAL AND INDUSTRIAL CONSERVATION-ADJUSTED FORECAST, BY WATER USE SECTOR

4.2.12 Land Use

After reviewing historical growth trends, and future land use and population projections, changes in urban, commercial, and residential land use acreages were estimated for the year 2050. Additionally, GIS current land-use data and future projections were referenced within the study area; specifically within the adopted Urban Development Boundary (UDB) for 2015 and 2025, as defined by the Miami-Dade county comprehensive plan, see ***Figure 4-4.***

As of 2006, the entire Miami-Dade UDB had 125,300 acres of urban land use according to the American Forests report *American Forests. Urban Ecosystem Analysis: Miami-Dade County UDB and the City of Miami, Florida*, published May, 2008. In 2004-2005 the SFWMD reported that there were 675 acres of land within the study area dedicated to urban, commercial, and residential purposes. Based on historical land use data and future population predictions, the future without-project condition assumes that 1,220 acres of land will be devoted to residential and urban uses in 2050, an 80.7% net increase overall, as shown in ***Table 4-5***. This level of future urban land use was estimated by the SFWMD. These lands will be mostly converted open space into "estate" or "low density residential" land uses, which range in density from two and a half to six dwellings per acre.

Additionally, a majority of land currently designated for agricultural use and lying outside of the UDB, but within the Urban Expansion Area (UEA), is projected to be developed with similar uses once the UDB is expanded. Based on increasing residential demand in this area, it is highly probable that this section of the UDB would be expanded within the next ten years.

After many decades of increasing agricultural lands in Miami-Dade County, the 2007 USDA Census of Agriculture reported a sharp decrease in the total area of agricultural lands, falling from a 20-year peak of 90,373 acres in 2002 to a low of 67,050 acres in 2007. The severe reduction of agricultural lands from 2002 to 2007 is expected to reverse by 2050 and agricultural lands in the project area should experience some growth.

The 2004-2005 level of agricultural land use in the study area was 2,970 acres, according to the SFWMD. Based on the recent sharp decline and historical positive growth rates, 5,401 acres of agricultural lands are estimated to exist within the project area by 2050, an 81.9% increase overall, as shown in ***Table 4-5***. This level of future agricultural land use was also estimated by the SFWMD.

In areas east and south of the UDB, but landward of the coastal areas, at least some continued conversion of undeveloped lands designated in the county land use map as "Open Lands" to rock mines and some undeveloped lands designated as "Agriculture" to construction/demolition debris landfills is possible. In addition, pressure to remove conservation easements on wetland mitigation areas within the UDB to allow development is already occurring. In cases where existing (and/or future) wetland mitigation areas are developed, additional mitigation areas would be needed to offset the loss of wetland functional values. However, based on development pressures, land costs and the proximity of the FPL mitigation bank; it is likely that the additional mitigation would be in the form of wetland enhancement, resulting in a further net loss of the spatial extent of wetlands and other open lands within the study area.

Portions of the coastal areas adjacent to BNP that are currently designated in the county land use map as "Environmental Protection" and "Environmentally Protected Parks" within the Biscayne Bay Coastal Wetlands study area are anticipated to remain in this use. However, the remaining undeveloped coastal areas landward of the environmental protection designation within the current UDB are expected to be developed within the next ten to 15 years. With a few exceptions such as the expansion of Turkey Point Power Plant, the remaining coastal wetland areas adjacent to BNP and outside the UDB are likely to remain largely unfilled and undeveloped with the exception of governmental facilities such as fire stations.

TABLE 4-5: CURRENT AND ESTIMATED STUDY AREA LAND USE

Land Use by Type (acres)		
Year	2005	2050
Urban	675	1220
Agriculture	2970	5401

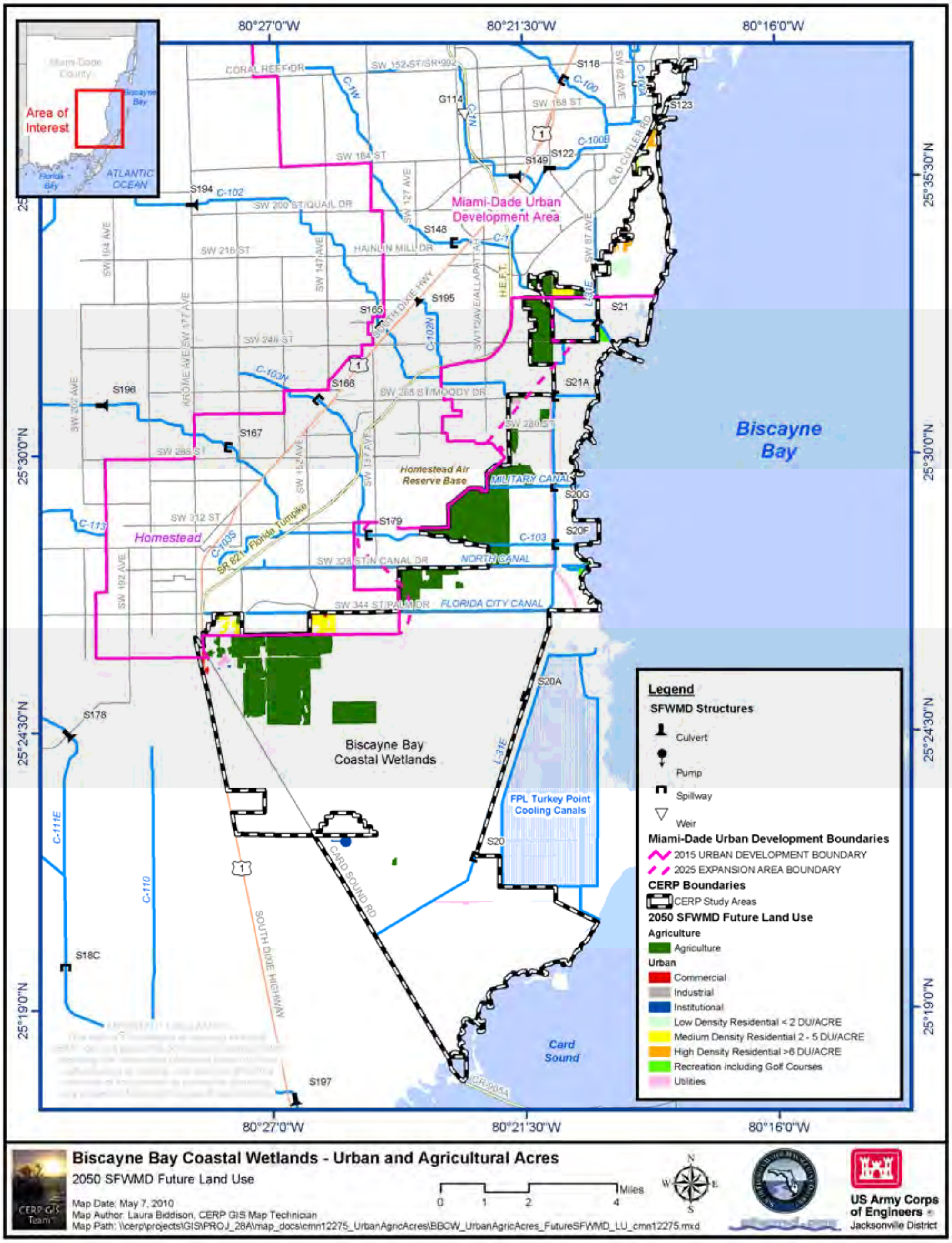

FIGURE 4-4: MIAMI-DADE COUNTY URBAN DEVELOPMENT BOUNDARY AND PROJECT AREA FUTURE LAND USE ESTIMATE

4.2.13 Noise

As additional areas are developed within designated growth boundaries around cities, noise from general traffic, construction, and other vehicles would be expected to increase modestly between the present and Year 2050.

4.2.14 Recreational Resources

The State Comprehensive Outdoor Recreation Plan (SCORP) is the best source of information on recreation demand and supply at the state and regional scales. It divides the state into 11 planning regions, each with clusters of counties. As indicated in ***Table 4-6***, Region 11 is the planning region that encompasses the study area.

TABLE 4-6: COUNTIES WITHIN SCORP PLANNING REGIONS POTENTIALY AFFECTED BY ALTERNATIVE RESTORATION PLANS

Region	Counties
Region 11	Broward
	Miami-Dade
	Monroe

Source: Florida Department of Environmental Protection, 2000

The SCORP organizes outdoor recreation in Florida into 47 categories that encompass a variety of recreation activities including team sports (e.g., basketball and baseball), individual sports (e.g., golf and tennis), hunting, fishing, swimming and boating. ***Table 4-7*** presents descriptive information on the recreation facilities in SCORP Region 11 for study area specific recreation categories. These resource-based categories were selected as those that could potentially be affected by the hydrologic changes or ecological changes associated with the alternative restoration plans. This table includes percentages of the statewide totals for the recreation categories.

TABLE 4-7: REGIONAL OUTDOOR RECREATION FACILITIES REGION 11, 1998

Resource / Facility	Region 11	% of State Total	State Total
Outdoor Recreation Areas	2,080	16%	13,097
Outdoor Recreation Acres	3,038,475	28%	10,850,904
Land Acres	1,831,363	20%	9,077,004
Water Acres	1,207,112	68%	1,773,900
Hunting Acres	871,151	14%	6,168,716
Land Acres	869,573	14%	6,046,955
Water Acres	1,578	1%	121,761
Camping			
RV / Trailer Camp Sites	10,603	8%	138,576
Tent Camp Sites	1,081	11%	10,214
Trails			
Hiking Trails (miles)	277	7%	3,904
Horseback Riding Trails (miles)	91	6%	1,443
Nature Trails (miles)	107	10%	1,043
Freshwater Catwalks	40	5%	748
Boating			
Canoe Trails (miles)	296	11%	2,587
Freshwater Boat Ramp Lanes	235	12%	1,973
Freshwater Marinas	6	1%	511
Freshwater Slips / Moorings	303	3%	11,758
Saltwater Marinas	366	33%	1123
Saltwater Marina Slips	14,470	32%	45,839

Source: Florida Department of Environmental Protection, 2000.

4.2.14.1 Recreation Demand

Profiles of existing and future recreation demand in the study area can be developed by drawing on a variety of information at the national, state, regional and local levels. In general, the variety of recreational interests in the United States appears to be increasing along with recreational participation rates. As future recreation needs and interests develop, it is important to recognize that participation in specific types of recreational activities is often linked to demographic factors such as age and income. For example, participation in activities requiring vigorous exercise is considerably higher for young people than for senior citizens. However, the elderly population is increasing recreation participation because of the growing awareness of the importance of physical fitness. Participation in most activities is low for those with family incomes below $25,000 per year. Interestingly, participation is low for those with family incomes greater than $100,000 per year. Most outdoor recreational activities appear to be enjoyed largely by the middle class, those with family incomes between $25,000 and $75,000 per year.

4.2.14.2 State Recreation Trends

Recreation demands were developed for the SCORP through surveys of residents and tourists. The survey being discussed was completed by the State of Florida for purposes other than CERP. This study was able to take advantage of the survey results but did not conduct a separate survey. The Division of Recreation and Parks conducts periodic surveys of resident and tourist participation in recreation activities to estimate outdoor recreation in Florida. The recreation participation information was derived from the 2000 surveys conducted by the University of Florida, Department of Recreation, Parks and Tourism. Participation in outdoor recreation activities is expressed in terms of user-occasions, which occur each time an individual participates in a single outdoor recreation activity. The number of user-occasions was calculated for each planning region as well as the entire state by type of activity. Demand was estimated for 1997, 2000, 2005 and 2010 by applying the per capita participation rates to population projections.

Table 4-8 presents Year 1997 and projected Year 2010 demands for the selected recreation activities in SCORP Planning Region 11. This table includes user-occasions as well as facility/resource needs. As part of the without-project conditions, all of the regions are expected to have significant increases in demands for the selected recreation activities with a commensurate need to increase development of the regions' recreation resources and facilities.

TABLE 4-8: DEMAND AND FACILITY NEEDS (1997 AND 2010) SELECTED RECREATION ACTIVITIES (SCORP REGION 11)

Activity	Units	Demand (user-occasions)		Resources / Facility Needs	
		1997	2010	1997	2010
Hunting	Acres	663,841	772,849	79,348	235,427
RV/Trailer Camping	Camp Sites	2,203,445	2,779,565	0	0
Tent Camping	Camp Sites	888,761	1,136,981	10	317
Hiking	Miles	1,282,041	1,672,767	252	413
Horseback Riding	Miles	1,780,575	2,189,849	0	0
Nature Study	Miles	1,456,739	1,988,143	0	0
Canoeing	N/A.	108,405	142,253	N/A.	N/A.

Source: Florida Department of Environmental Protection, 2000.

In summary, the Biscayne Bay ecosystems support a significant amount of outdoor recreation in the LEC of south Florida. A significant portion of the expenditures comes from tourists.

4.2.14.2.1 Local Parks and Recreation

Miami-Dade County owns or operates several parks within the study area. They include the Deering Estate, Black Point Park and Marina, and Homestead Bayfront Park that provide direct access to the Bay both visually and by water. In addition, Lakes by the Bay Park is under development and will provide both active recreation areas and nature trails and preserves. Homestead Air Force Base Park, also under development, is a SFWMD park that will provide facilities for active recreation.

As development continues in the southern tier of the county, particularly in the area just inside the eastern boundary of the UDB, there will be continuing pressure to acquire additional park land in order to meet the county's level of service for local park and recreation acres.

4.2.14.3 Aesthetics

With an anticipated increase in urbanization, changes in the project area are expected to reflect population growth. Aesthetically, there would be more high rises, roads and infrastructure associated with development and less open land.

4.3 SUMMARY OF EXISTING AND FUTURE WITHOUT PROJECT CONDITIONS

The following table summarizes the existing and future without project conditions for each of the project resources.

TABLE 4-9: EXISTING VERSUS FUTURE WITHOUT PROJECT CONDITIONS ON PROJECT LANDS

Resources	Existing condition	Future without condition
Landscape	Soils in and adjacent to the project area consist of several types including peat, Everglades peat, Lake Flint Marl, and weathered Miami Oolite, marl, marly peat, red mangrove peat, black mangrove peat, sandy mud, and skeletal sand gravel.	BBCW project lands would be disposed and developed consistent with surrounding land use patterns.
Climate	The subtropical climate of south Florida, with distinct wet and dry seasons, high rates of evapotranspiration, and climatic extremes of floods, droughts and hurricanes	Climate change is expected to result in a 20% decrease in rainfall by the year 2100. Assuming a linear response, a 10% decrease in rainfall is expected over the 50 year life of the project. Evapotranspiration as well as average temperature will increase as a result of climate change.
Hydrology	Presently, freshwater runoff from the watershed is discharged to the bay through a system of conveyance canals.	Some fundamental aspects of hydrologic conditions are expected to change in the southern Miami-Dade County watershed by the year 2050. In the absence of any mitigation or restoration, freshwater flux to Biscayne Bay will diminish, flooding may increase, stormwater runoff intensity from large storms will likely increase, and the character of water quality will change. The primary drivers for these changes are an increased sea level, greatly expanded impervious areas to accommodate expected development in the watershed, and increased water use demands from the aquifer.
Water Management	The Biscayne Aquifer provides water for municipal and industrial (M&I) water supply and agricultural irrigation along the southeast coast. Well fields, which are the source of municipal water supplies, are significantly recharged by Water Conservation Area water. Water stored in the Water Conservation Areas can be used to maintain groundwater levels in the coastal area for public water supply, to irrigate the vast agricultural areas interspersed within the project area, and to maintain a freshwater head along the lower east coast for prevention of saltwater intrusion.	Water demand projections estimate the Service Area 3 most likely population scenario, conservation–adjusted water use in 2050 at 505.6 MGD. Service Area 3 is expected to be using 1/3 of the total water demand in the nine-county Initial CERP Update Region. With more people drawing water and less water available for recharge, migration of the underlying salt wedge could lead to increased salt-water intrusion and shortages to wells and well fields would become more prevalent.

Resources	Existing condition	Future without condition
Flooding	Areas may become flooded during heavy rainfall events due to antecedent conditions that cause saturation and high runoff from both developed and undeveloped areas.	Flood damage reduction needs have increased since the original flood control project was constructed and will likely continue to increase in the future. As agricultural and urban development continues, the volume, duration, and frequency of floodwaters may increase, and the actual level of flood damage reduction may decline in some areas.
Water Quality	Drainage canals have adversely impacted the timing, quality and quantity of freshwater to the bay. The flood protection discharges from the canals transport nutrients, heavy metals and pesticide pollution from urban and agricultural activities and create rapidly fluctuating salinity concentrations within the bay.	Water quality will continue to be impacted by changes in land use. As agricultural lands are converted to urban development changes in the chemical constituents of the pollution will change but is still likely to have an adverse affect on the ecosystem. Additional flood storage capacity necessary to accommodate new urban development would result in additional periods of high salinity within the nearshore bay as well as rapid swings in salinity due to the increase in magnitude of flood releases.
Vegetative Communities	Generally, five habitat types dominate the project area. They 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*]).	Continued urbanization will lead to the exacerbation of hyper-saline conditions, reduced water quality, reduced natural fire control, and increased ATV usage. Over the next 50 years this will continue to alter the historical vegetative composition of the coastal and freshwater wetlands, thus reducing the special extent and functional value of those habitats
Fish & Wildlife Resources	A minimum of 268 fish species, 16 amphibian species, 57 reptilian species, 294 avian species, and 35 mammalian species has been observed in or near the project area.	A reduction of the wetland function and value to coastal habitats within and adjacent to Biscayne Bay, along with increased development and land conversion, is likely to result in an overall loss of fish and wildlife resources within the project area.
Threatened & Endangered Species	Federally listed endangered and threatened animal species known to exist or potentially exist within the project area include fifteen endangered vertebrate and invertebrate species and ten threatened vertebrate species. In addition, six endangered and one threatened plant species are known to exist or potentially exist within the project area.	Without the environmental benefits of the BBCW project, direct loss of habitat, as well as degradation of existing habitat function will likely result in a continued decline in threatened, endangered, and state listed species within the next 50 years.

Resources	Existing condition	Future without condition
Non-Native Wildlife	In many cases, non-native animals have adapted to the sub-tropical environment of south Florida and have established themselves as breeding residents. Whereas some species pose little or no known threat to natives, others are particularly invasive, presenting a predatory threat or competing with indigenous species for food, territory, nest sites, or other resources.	An increased coverage of exotic vegetation associated with continued land disturbance is anticipated in a 50-year future-without project scenario.
Essential Fish Habitat	The project is located in areas designated as EFH for coral, coral reef, and live bottom habitat, red drum (*Sciaenops ocellatus*), shrimp, spiny lobster (*Panulirus argus*), other coastal migratory pelagic species, and the snapper-grouper complex. Specifically, EFH in Biscayne Bay is comprised of seagrasses, estuarine mangroves, intertidal flats, estuarine water column, live/hard bottoms, and coral reefs.	A lack of freshwater sheet flows into the coastal areas of Biscayne Bay will continue to increase salinity levels in the nearshore and estuarine biological communities, thus reducing the spatial extent of those systems. A future without-project is likely to result in an overall decrease in the diversity of species within those habitats.
Land Use	The existing use of land within the study boundaries varies widely from agriculture to high-density multi-family and industrial urban uses. A large portion of south Florida remains natural, although much of it is disturbed land.	Much of the future development within the study area will occur on lands that are currently in agricultural use.
Recreational Resources	The urbanized east coast includes good quality marine based recreation activities such as underwater diving, salt water and estuary fishing, boating, surfing, and, of course, the beach. County and state parks, scenic rivers, state reserves and forests, and Federal refuges provide wildlife viewing, nature interpretation, hiking, and canoeing opportunities.	Based on the adverse effects related to environmentally damaging releases of waters into the Bay's ecosystem, it can be concluded that improving the environmental quality of the Biscayne Bay ecosystem will substantially support and sustain local recreation-based businesses.
Aesthetics	The natural areas are composed of a variety of upland and wetland based ecosystems, including lakes, sloughs, ponds, and vast expanses of marsh and wet prairie with varying vegetative components. Overall, the land is remarkably flat with few natural topographic rises, such as hills or other geographic undulations.	With an anticipated increase in urbanization, changes in the project area are expected to reflect population growth. Aesthetically, there will be more high rises and less open land.
Socio-Economic Conditions	The 2000 census tract for Miami-Dade County indicates a population of 2,253,362. The BBCW site, however, has few permanent residents or existing businesses. The three most significant employment sectors in the Miami-Dade economy are retail trade, administrative support, and guest services (accommodation and foodservice).	Population in Miami-Dade is expected to increase by almost 1.5 million people from 2000 to 2050. Conversion of agricultural and other unimproved lands in southern Miami-Dade County, including large areas within the BBCW study area, will continue to be fueled in significant part by this population growth.

Resources	Existing condition	Future without condition
Hazardous, Toxic & Radioactive Waste	Numerous hazardous waste sites (e.g., Superfund and Resource Conservation and Recovery Act (RCRA) sites) have been identified in the area underlain by the Biscayne Aquifer. Remedial action to clean up existing contamination is underway at many of these sites. All sites will be fully investigated and remedial action will be taken as necessary. Waste management practices are generally monitored to prevent further contamination.	The conditions that exist today relative to hazardous, toxic, and radioactive waste within the study area are expected to be improved over today's status, whether or not CERP projects are implemented.
Cultural Resources	A review of the Florida Master Site Files has indicated several known archaeological sites within the BBCW project area.	The future, without a protection plan, offers little or no protection without further investigation, while a future with a conservation plan provides some level of protection to cultural resources.
Air Quality	Existing air quality within south Florida is considered good, and the BBCW region attains all National Ambient Air Quality Standards.	In the future, air quality is not expected to change significantly.
Noise	Within the major natural areas of south Florida, external sources of noise are limited and have low occurrence.	A moderate increase in noise is to be expected as additional areas are developed within designated growth boundaries around cities, noise from general traffic, construction and other vehicles.

SECTION 5

FORMULATION OF ALTERNATIVE PLANS

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5.0 PLAN FORMULATION

Plan formulation is the process of building alternative plans that meet planning objectives and avoid planning constraints. The USACE uses a six step planning process that provides a structured approach for problem solving, through a rational framework that leads to sound decision making. The six steps are:

- Identification of problems and opportunities;
- Inventory of existing and forecasting of future conditions;
- Formulation of alternative plans;
- Evaluation of alternative plans;
- Comparison of alternative plans; and
- Selection of a recommended plan.

This process was followed to ensure the recommended plan adequately addresses the problems identified and is cost effective. USACE guidance relating to the planning process and the preparation of a Project Implementation Report (PIR) is found in “Principles and Guidelines”, ER 1105-2-100, and CERP Guidance Memoranda (CGM’s) 1 & 2.

Documentation of the plan formulation process was prepared and incorporated into an integrated PIR and Environmental Assessment (EA) according to USACE policy and regulations and NEPA regulations.

This section of the report covers the formulation, evaluation, and comparison of alternative plans, and finally, the identification of the Selected Plan. The problems and opportunities section and the existing and future without project conditions sections can be found in Sections 2, 3 and 4 respectively.

5.1 FORMULATION OF ALTERNATIVE PLANS

The plan formulation and evaluation process involves identifying, organizing, and combining management measures to create the different alternative plans for the project that will solve the problems and realize the opportunities. The formulation completed and described in the Restudy serves as the foundation for the formulation of alternatives for this project. The BBCW Project Delivery Team used the Restudy (Yellow Book) alternative as a starting point for the basis of developing alternatives.

Alternative plans are developed from a combination of structural and/or non-structural measures that address the planning objectives. In addition to the alternative plans developed by the team, a “future without project” plan is included. This “future without project” plan is equivalent to the “no action” plan required by NEPA. Plans are then evaluated and compared using multiple criteria, followed by selection of a recommended plan. The plan that reasonably maximizes the production of benefits, best solves the problems and realizes the opportunities while avoiding constraints, and is cost effective, was identified as the National Ecosystem Restoration (NER) plan. This is the Selected Plan.

5.2 PRIOR FORMULATION

Restoration in the project area was investigated in the early 1980s in Miami-Dade County's Biscayne Bay Management Plan (Metropolitan Dade County Board of County Commissioners 1986) and SFWMD's Biscayne Bay SWIM Plan (Alleman et al. 1995) further considered restoration opportunities. A conceptual restoration plan for the area was included as two elements of the authorized and approved Comprehensive Everglades Restoration Plan (CERP) or "Yellow Book" (YB) selected alternative - Alternative D13R: (1) BBCW (designated an Other Project Element (OPE)) and (2) Biscayne Bay Coastal Canals (component FFF of CERP). This conceptual plan includes pump stations, spreader swales, STAs, flowways, levees, culverts and backfilling canals located in southeast Miami-Dade County and covers 13,600 acres from the Deering Estate area at C-100C, south to the FPL Turkey Point power plant, generally along L-31E. ***Figure 5-1*** is a conceptual rendering from the CERP and illustrates the basics of the project (CERP Alternative D13-R).

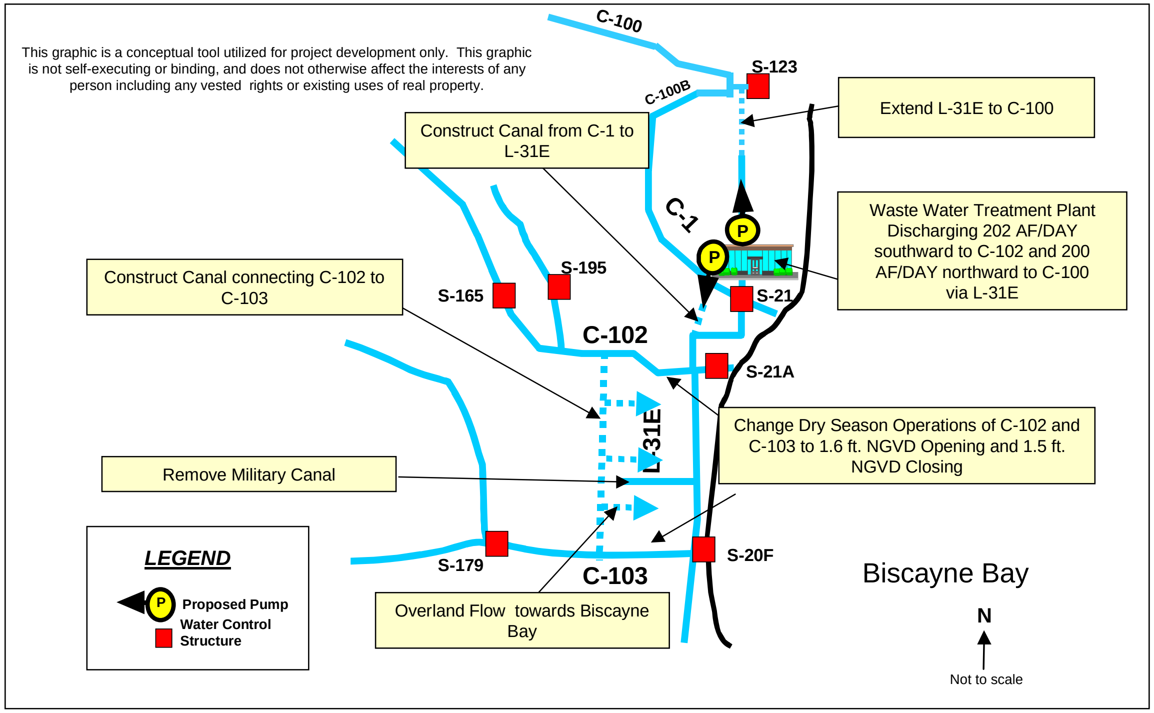

FIGURE 5-1: ALTERNATIVE D13R (YELLOW BOOK) – SOUTH BISCAYNE BAY AND COASTAL WETLANDS ENHANCEMENT COMPONENT

Source: Restudy Appendix A4–Description of Alternative D-13R (Page A4-47)

5.3 PROJECT FORMULATION METHODS

5.3.1 Formulation Method

The study area is composed of four sub-basins defined by major drainage canals. Each sub-basin was assigned a component area and management measures were formulated. ***Figure 5-2*** illustrates the location of each component area. Descriptions of each are provided below.

Deering Estate Flowway: This component area is bounded by Biscayne Bay to the east, with C-100A running in a north/south direction to the west, and C-100B running in an easterly direction to the south. Proximity to the canals provides opportunities for access to available water for wetland rehydration. Several ditches dissect the property, as well as Cutler Drain which is a major tributary to Biscayne Bay. Canal C-2 runs north of the property in an easterly direction.

Cutler Wetlands: Major infrastructure in the component area includes - to the north, C-100B as it exits to the Bay; C-100A to the west; and Biscayne Bay to the east. The area runs south along Biscayne Bay, mostly east of L-31 E and ends where C-1 meets the Bay. A small golf club shaped area reaching toward the turnpike extends west of the L-31E Levee, resting on the lower portion of C-1. Like the other component areas, it too includes a number of ditches to the Bay.

L-31E Flowway: This component area runs in a southerly direction and is completely dissected in a north/south direction by L-31E levee and canal. It is bounded to the south by Florida Canal running in an easterly direction and is further dissected in an easterly direction by North Canal, C-103, Military Canal, and partially by C-102. Like the other component areas, it too includes a number of ditches to the Bay. L-31E provides unique opportunities for the development of an extensive spreader canal. Homestead Air Reserve Base is located to the west of this component area.

Model lands/Barnes Sound: This area is bounded to the north by the easterly running Florida City Canal; to the east by L-31E and the FPL complex, disconnecting the area from Biscayne Bay to the east; bounded by U.S. 1 and Card Sound Road to the west; and lower Biscayne Bay.

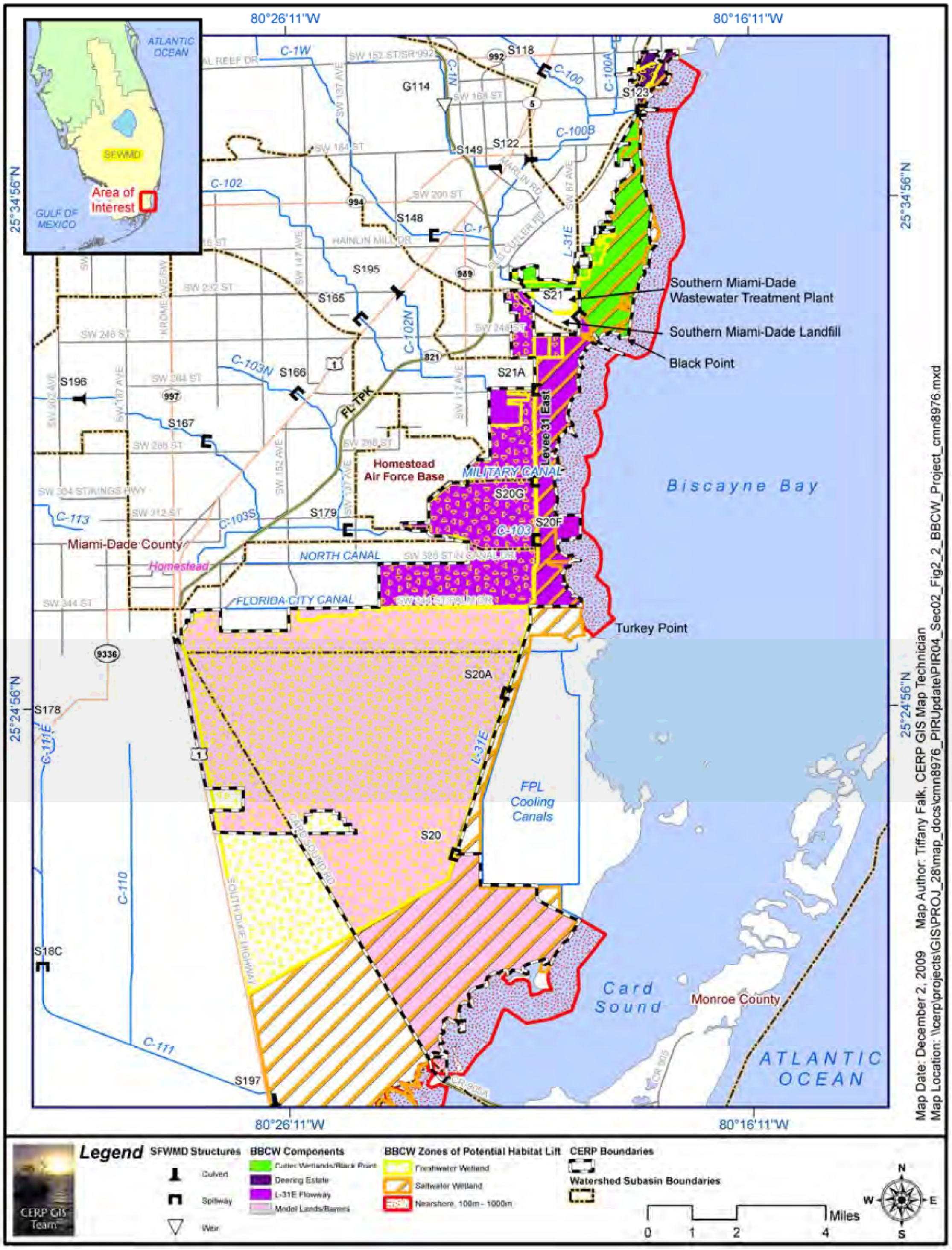

FIGURE 5-2: BISCAYNE BAY COASTAL WETLANDS COMPONENT AREA MAP WITH ECOLOGICAL ZONES

The team further defined three ecological zones within the study area: freshwater wetlands, saltwater wetlands, and nearshore Biscayne Bay (defined as one kilometer seaward of the shoreline) for determining and weighing the ecological benefits of the alternatives.

An understanding of the ecological zones in relationship to the component areas and the study area as a whole will provide insight into the selection of measures for each alternative. ***Figure 5-3*** below illustrates the ecological zones, desired salinity levels, species at risk, component areas and basic infrastructure in the study area.

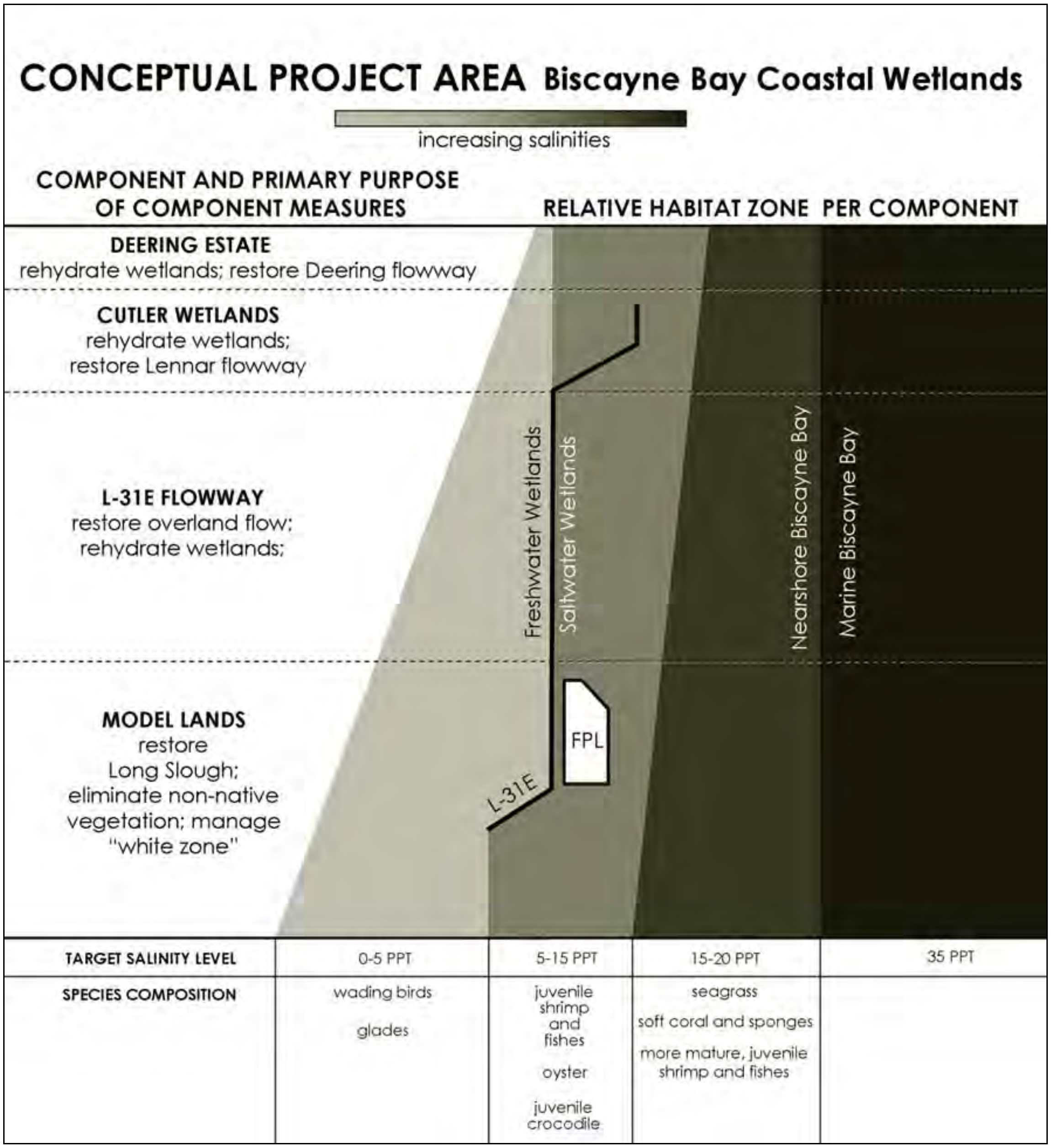

FIGURE 5-3: BISCAYNE BAY COASTAL WETLANDS CONCEPTUAL PROJECT AREA

5.3.2 Management Measures

Management measures are defined as features or activities that can be implemented at a specific location to address one or more planning objectives: they can be either structural or non-structural. Management measures form the building blocks of alternative plans. Measures are used to meet one or more of the planning objectives by:

- redistributing point source discharges through a mix of measures such as spreader canals, spreader swales, canal and ditch backfill, land acquisition, road removal, levee removal, and/or culverts;
- improving flexibility in the delivery of water with a mix of pump stations, weirs, conveyance or connector canals, flowways, stormwater treatment areas (STAs) and/or reservoirs;
- eliminating harmful point source discharges with canal backfill, plugs and/or weirs;
- improving water quality with STAs and/or detention ponds;
- encouraging the growth of native vegetation by removing invasive growth and rehydrating wetlands.

To assemble a suite of management measures for the BBCW project, the team used the YB alternative as a starting point. The team verified the continued need for each measure and added additional features or activities as necessary. The following is a list of management measures considered and/or used in the development alternatives:

1. Spreader Canals – Spreader canals would divert water that is currently being discharged directly into Biscayne Bay as point discharges. Increased overland flow to target freshwater and saltwater wetlands would increase spatial extent of wetland habitats, restore existing wetland habitats, improve water quality and restore historic salinity levels in the Bay.
2. Stormwater Treatment Areas – These areas would be utilized for storing and treating water before it is discharged to freshwater wetlands and Biscayne Bay. Due to the extremely porous substrate in this area of Florida, the STAs would likely be constructed above-ground with a liner. The primary benefit of these types of impoundments would be improved water quality, with some measure of water supply and habitat value.
3. Reservoirs – Reservoirs were considered and added as a measure that would provide needed water for restoration during periods of low flows (i.e., the dry season). The reservoirs would be filled during peak storm events and would be utilized for wetland rehydration during low flow periods in the major canals. Reservoirs constructed above-ground would need to be lined in order to retain water in the porous South Florida geology, adding cost.
4. Pump Stations – Pump stations would be required to divert flow from major conveyance canals into reservoirs, STAs, and spreaders. They would also aid the control of water when needed for restoration purposes during low flow events and also maintain authorized flood damage reduction levels for urban or agricultural areas.
5. Removal of existing levees – The major levee that obstructs overland flow is the L-31E Levee.

6. Culverts – Culverts provide gravity water flow underneath levees or roadways where the distribution of additional water is proposed. Culverts would be necessary in order to render some of the existing obstacles to flow (levees) as transparent as possible.
7. Construction of new levees – New levees may need to be constructed in order to provide for flood damage reductions where wetland restoration is proposed in close proximity to any municipalities. Levees may be used in combination with other measures to achieve project objectives.
8. Flowways – The creation of new flowways provide a means to convey water from major conveyance canals to spreader features or directly to wetlands.
9. Stormwater Treatment Plant – This measure could be used to add water into the project area, by routing water from urban areas through the plant for treatment.
10. Desalinization Plant – This measure could be used to add water into the project area, by converting saltwater from the Bay into freshwater for use in other part of the project area.
11. Removal of minor drainage and structural features – This would include the plugging or backfilling of ditches and removal of minor roads that negatively affect the movement of water.
12. Operations – This measure is non-structural in nature. The existing study area is complex in terms of C&SF water management features. Efficient operations of such a complex system would reduce infrastructure needs (i.e., more pumps, culverts, canals) and therefore reduce the cost of alternative plans.

5.3.3 Initial Array of Alternative Plans

Since the CERP Yellow Book (YB) serves as the origin for development of all BBCW alternatives (by feature, cost and intended benefits), the YB plan as envisioned is discussed in detail to understand the nature of feature development in component areas. To ensure consistency with the YB plan, while considering the intent to ensure uniform freshwater flows to all of Biscayne Bay, management measures for each of the four component areas are included for all alternatives in the initial array. All alternatives are discussed in comparison to the YB Plan to reduce redundancy.

Based on the above management measures, the team created the following conceptual alternative plans. A brief description of the alternatives is provided below. Detailed descriptions can be found in Appendix F of this report.

5.3.3.1 No Action Alternative – Alternative A

The first alternative considered is always the No-Action or “do nothing” alternative. It includes the changes expected in the study area over the period of analysis ending in 2050 assuming that no ecosystem restoration project is built as a result of this study. It includes the continuation of the degraded ecological state currently exhibited in the study area. For this study, this alternative is labeled No Action Alternative. A narrative description and table comparison of existing and future conditions can be found in Sections 3 and 4.

5.3.3.2 Alternative YB (Yellow Book)

Because the YB plan was conceptual, a sub-team was created to develop a detailed description of what it believed the YB plan intent was. The team crafted additional alternatives all drawing on the perceived attributes and drawbacks of this YB alternative. ***Table 5-1*** synopsizes this initial array of alternatives, including main summary differences between the YB alternative and the alternative being crafted and/or a major feature that is distinctive. Detailed narratives have been prepared and included with this package as Appendix F.

Deering Estate Flowway – Alternative YB
Involves pumping water from the SW 160th Street ditch (a tributary to C- 100C) through property adjacent to the Deering Estate and ultimately into Cutler Drain, which runs through Deering Estate. The design involves adding a pump station at the end of SW 160th Street Canal, filling in mosquito ditches in coastal mangroves, and constructing weirs to delay water passage in old Cutler Drain.

These combined measures would rehydrate both freshwater and saltwater wetlands, restore some overland flow to Biscayne Bay, improve water quality, and eliminate or slow the release of freshwater through point sources, all ultimately benefiting the nearshore areas of Biscayne Bay. Rehydrating freshwater wetlands will also improve groundwater flows to Biscayne Bay. These measures contribute to multiple planning objectives, potentially improving habitat in all three ecological zones.

Cutler Wetlands – Alternative YB
This alternative involves routing water south from C-100A to the Cutler Wetlands area via a shallow distribution swale to C-100B, pumping water from C-100B to a spreader swale, and pumping water from C-100A south into a spreader swale to allow sheetflow to Biscayne Bay. For water quality, flows are routed through an STA. Construction includes a spreader swale from C-100A south to C-100B with a levee west of the spreader swale, and a pump along the north end of the spreader swale at C-100A; a pump adjacent to the STA and C-100B; and a levee seepage canal along the northern and southern end of the STA.

These combined measures would rehydrate mostly saltwater wetlands, and some freshwater wetlands in the component area, improve overland flow across a large spatial extent, and improve water quality. As a result, both the saltwater wetlands ecological zone and salinity levels in the nearshore ecological zone stand to benefit significantly from the proposed improvements.

L-31E Flowway – Alternative YB

This alternative includes a flow redistribution system west of L-31E and existing wetlands restoration in the area between L-31E and the western boundary of the redistribution system. A distribution swale with a western levee will be constructed along this boundary. The wetland area west of L-31E should be used for short-term, shallow ponding of water to maintain wetlands and help drive freshwater flow to the nearshore Bay out of the east bank of L-31E. For water quality purposes, flows are routed through STAs. Construction involves installation of culverts and risers under L-31E; construction of a spreader swale east of L-31E; backfilling Military Canal; a plug in C-100B; a new a canal west of the landfill to intersect with the L-31E borrow canal; and filling in mosquito ditches. A seepage collection ditch may be required on the western side of the STA(s), as well as pumps to the STA.

The combined measures would rehydrate both freshwater and saltwater wetlands, restore some overland flow to Biscayne Bay, improve water quality, and eliminate or slow the release of freshwater through point sources, all ultimately benefiting the nearshore areas of Biscayne Bay. Rehydrating freshwater wetlands will also improve groundwater flows to Biscayne Bay.

In the North Canal Flowway area, the features involve pumping available water from C-103 and the Florida City Canal to re-establish sheetflow across freshwater and saltwater wetlands to Biscayne Bay with flows routed through an STA. Construction involves a pump on C-103; a pump on Florida City Canal; installation of culverts and risers under L-31E; a delivery canal from C-103 south to North Canal; a spreader swale east of L-31E; backfilling the North Canal east of SW 112 Avenue; and a flowway south of the Florida City Canal from SW 127th Avenue to SW 107th Avenue. Additional construction includes an STA on the western edge of the coastal wetlands in between the C-103 and the Florida City Canal, an STA associated with the flowway south of the Florida City Canal, and construction of seepage management facilities around the STAs.

These combined measures would rehydrate both freshwater and saltwater wetlands, restore some overland flow to Biscayne Bay, improve water quality, and eliminate or slow the release of freshwater through point sources, all ultimately benefiting the nearshore areas of Biscayne Bay. Rehydrating freshwater wetlands will also improve groundwater flows to Biscayne Bay.

Model Lands/Barnes Sound – Alternative YB

Operation of this component involves pumping available water from the Florida City Canal to a shallow east-west spreader canal with flows routed through an STA. Design involves construction of a pump at the Florida City Canal; a new canal south from Florida City Canal to a shallow spreader swale along the edge of the saltwater wetlands with an STA and seepage management facility.

There are some general problems and considerations that apply to the entire area. These include existing ditches, which are extensive, the presence of exotic plants and animals, potential water quality problems, and land ownership constraints. The areas under review for restored sheet flow were extensively ditched early in the 1900s. This cross ditching interferes with providing restored historic flow patterns. For these reasons, the ditches may need to be filled. In addition, the area would require an extensive and possibly ongoing invasive exotic plant removal program.

5.3.3.3 Alternative C

This alternative is similar to Alternative YB in purpose, including features in each of the four component areas, but seeks to recreate historic slough patterns using gravity conveyance instead of pumps. This plan removes the L-31E Levee and backfills all major canals.

5.3.3.4 Alternative D

This alternative is identical to C but adds minor features including:

1. Backfill of all north-south mosquito ditches in all sub-regions (if it can be achieved without destroying desirable vegetation);
2. Removal of Tallahassee Road in the Model Lands area;
3. Removal of SW 360th Street and the adjacent ditch in the Model Lands.

5.3.3.5 Alternative E

This alternative has the same management measures as Alternatives C and D with the exception of reservoirs to provide water to the project area during dry periods. It uses plugs instead of backfilling major canals. This alternative prioritizes rehydrating and restoring the wetlands and embayments associated with Black Point and Fender Point. The morphology of the coastline in these two areas includes embayments that are likely to provide the most likely areas for restoring estuarine conditions year round. This alternative was also designed to provide flexibility for inter-basin transfer of freshwater across the project.

5.3.3.6 Alternative F

This alternative is designed to improve on Alternative YB by adding reservoir storage. This resulted in smaller STA acreage however it was assumed that the spatial extent/treatment capacity of the STAs for this alternative would be sufficient to adequately treat water. This alternative was crafted to adjust the specific boundaries of the STAs as necessary based on available lands. The intent was to save costs on real estate acquisitions to the extent practicable.

5.3.3.7 Alternative G

This alternative is a low cost, primarily non-structural approach greatly relying on water management operational changes; uses limited construction of features such as smaller pumps and spreader canals and has less acreage dedicated to STAs relative to the YB.

5.3.3.8 Alternative H

Like Alternative G, this alternative minimizes construction. However it is smaller in scale than Alternative G; for example, it uses small polishing ponds instead of STAs to cleanse water.

5.3.3.9 Alternative I

This alternative is similar to Alternative YB, but extends the connector canal northward and proposes a desalinization plant for water supply.

5.3.3.10 Alternative J

Uses a combination of reservoirs and STAs to capture and treat water. Existing canals are not backfilled and although the alternative does not attempt to recreate historic sloughs, it does degrade the L-31E Levee in an attempt to restore the saltwater to freshwater ecotone transition. The L-31E Levee would be rebuilt further west.

5.3.3.11 Alternative K

Similar to Alternative YB, but uses package water treatment plants instead of STAs to significantly reduce land acquisition costs.

5.3.3.12 Alternative L

This alternative is a modification of Alternative YB with heavy emphasis on the use of reservoirs to rehydrate the wetland areas. The reservoirs would be located adjacent to primary canals (C-1, C-102 and C-103) upstream of STAs and be fed by pumps. Water conveyed out of the reservoirs into the STAs would be controlled.

5.3.3.13 Alternative M

This alternative is a minimal approach that reduces both the number of project features and the project footprint. It relies on trenches and small detention areas to capture and store water and focuses the restoration effort on saltwater wetlands and nearshore areas of the Bay. It includes pump stations, culverts, spreader canals and plugging of mosquito ditches.

5.3.3.14 Alternative N

This is an unrestrained alternative designed for ecological lift with little concern for costs. It includes an upstream impoundment and a full array of construction features wherever needed, as well as water treatment plants. L-31E Levee is completely removed south of the Florida City Canal.

5.3.4 Initial Screening of Alternative Plans

After initial review of the above alternatives, the team concluded that some alternatives were extremely similar and some features should be combined, therefore eliminating some alternatives. The rationale for the combination of certain alternatives was that the features and operations of these alternatives were too similar in cost and expected benefits and there would be no discernible differences when comparing plans. Further consideration led to the decision to eliminate some alternatives based on anticipated significant construction or operating costs, environmental impacts, or expected benefits. In other words, if the same array and level of benefits could be achieved at a lesser cost, the more expensive of the alternatives was eliminated. ***Table 5-1*** lists each alternative that was eliminated as well as the reason for elimination. In summary:

- Alternative C, D and E features were substantially the same and would likely achieve similar benefits. Net features from Alt C and D were added to Alternative E and Alternatives C and D were eliminated.
- Alternatives F and L were both built from the basics in the Yellow Book Plan but also incorporated a combination of STAs and reservoirs to capture, store and release flows. Due to their similarity to Alternative J which also uses a combination of reservoirs and STAs, net features from both Alternatives were added to Alternative J and Alternatives F and L were eliminated.
- Alternatives G and H were both minimal approaches similar to Alternative M; therefore, Alternatives G and H were eliminated and net features from both alternatives were added to Alternative M.

- Alternative I, which included a desalinization plant, was eliminated due to high operational costs and environmental degradation due to the creation of undesirable brine by-product.
- Alternative K, which included package treatment plants instead of STAs, was eliminated due to high operational cost and environmental degradation due to the creation of undesirable effluent by-product.
- Alternative N, an "unrestricted" approach to restoration was deemed too costly and was eliminated from further consideration.

TABLE 5-1: INITIAL ARRAY OF ALTERNATIVES

INITIAL ARRAY OF ALTERNATIVES			
Alternative	**Description**	**Carried Forward ?**	**Reason for Elimination**
A	Future Without Project Condition	Yes	
YB	Yellow Book (Restudy) alternative; includes extensive use of STAs, some canal and ditch backfilling, pumps, and connector canals from C-102 to C-103, and from C-1 to the L-31E borrow canal. Uses culverts and risers under L-31E Levee to remove obstacle to flow.	Yes	
C	Similar to YB, but uses some gravity flow instead of pumps. Removes the L-31E Levee to remove obstacle to flow and backfills all major drainage canals to recreate historic sloughs.	No	Similarity to Alternative E; net features carried over to E
D	Identical to C but adds minor features including road removal and more ditch backfilling.	No	Similarity to Alternative E; net features carried over to E
E	Deviates from YB and C by adding reservoirs to provide water to the project areas during the dry season; unlike C does not remove L-31E Levee.	Yes, with net features from C & D	
F	Largely resembles YB but attempts to improve the ecological lift by adding reservoirs and reducing STA sizes.	No	Benefits are similar to YB but at a higher cost; also similar to J& L; net features added to J
G	Minimizes construction for a less expensive approach: for examples, smaller pumps and spreader canals, less STA acreage, and greater reliance on	No	Similarity to M; net features added to M

	water management operational changes to achieve objectives.		
H	Resembles G but in lieu of STAs, uses polishing ponds and lateral ditches to provide water treatment.	No	Similarities to M; net features added to M
I	Resembles YB but extends the C-102/103 connector canal northward and proposes a desalinization plant for water supply.	No	High operational costs and environmental degradation due to desalinization plant byproducts
J	Maximizes redirection of flow to natural flowways; includes a combination of reservoirs and STAs to capture flows from canals; does not attempt to recreate historic sloughs.	Yes, with net features from F & L	
K	Resembles YB but uses package treatment plants in lieu of STAs to significantly reduce land acquisition costs.	No	High operational costs and environmental degradation due to water treatment plant byproducts
L	Resembles YB but uses a combination of reservoirs and STAs instead of STAs alone to cleanse and store water; improves water availability and reduces cost in comparison to YB.	No	Similarity to F & J; net features added to J
M	Strives to meet project objectives with the smallest footprint and smallest number of constructed features possible.	Yes, with net features from G & H	
N	A "no holds barred" approach with limited concern with costs; provides for construction features wherever needed seeking maximum ecological lift.	No	Projected cost more than twice the inflated YB cost

As a result of the initial screening, Alternatives A, YB, E, J, and M were carried forward. Three more alternatives were developed to ensure a full array of project measures was considered. These are:

- Alternative P: Designed to maximize ecological benefits while disregarding costs or other potential constraints. It includes features such as culverted roadways and a complete removal of the L-31E Levee. This would allow target salinity levels in Biscayne Bay to be met, benefitting the nearshore area and saltwater wetlands.

- Alternative Q: Crafted to provide an alternative that was more aligned with the possible location of the proposed C-111 Spreader Canal. The team attempted to design this alternative to avoid the more costly real estate and also to utilize more passive water flow to reduce costs rather than using pumps. Alternative Q does not include reservoirs. This alternative is intended to reduce proposed infrastructure to the minimum needed for the redistribution of canal discharges. It also maintains existing infrastructure to the extent possible to reduce construction costs, including the L-31E Levee, but allows eastward surface water flow through this levee. The intent of this alternative is to provide maximum passive storage of water particularly in the Model Lands area and the areas just west of the L-31E Levee.
- Alternative S: Added as a non-structural alternative that proposed operational changes to hold water higher in the existing canals. Benefits would be achieved by increasing the groundwater flow to the Bay. Concerns for this alternative include purchase of lands that may become flooded and effects on the level of service of flood protection.

The addition of the three plans resulted in the following secondary array of alternative plans.

5.3.5 Secondary Array of Alternative Plans

The secondary array of alternatives included:

- No Action Alternative
- Alternative YB
- Alternative E
- Alternative J
- Alternative M
- Alternative P
- Alternative Q
- Alternative S

5.3.5.1 Secondary Array of Alternatives Screening

Costs were not considered in the creation of alternatives from management measures, but costs are an important factor in plan selection and were therefore used to screen the intermediate plans. Alternatives E, P and J were deemed far too costly and unacceptable alternatives for recommendation. While Alternative Q was also was very costly, it was less expensive than E, P or J and was retained to further refine the construction costs and provide a more complete and comprehensive alternative “bookend scenario” that was feasible to construct.

Alternative S was eliminated because it would reduce the ability to control water levels west of the L-31E Levee and therefore not meet the flood protection constraint.

The YB alternative was carried through to the final array solely as a point of comparison to the Restudy, although the YB plan as originally envisioned was determined to be non-implementable due to land use changes since the Restudy was published. ***Table 5-1*** lists each alternative that was eliminated during the second round of screening as well as the reason for elimination.

TABLE 5-2: SECONDARY ARRAY OF ALTERNATIVES

Alternative	Carried Forward?	Reason for Elimination
A	Yes	
YB	Yes, as a point of comparison	
E	No	Excessive Cost
J	No	Excessive Cost
M	Yes	
P	No	Excessive Costs and Similar to E
Q	Yes, maintained to refine construction costs	
S	No	Would cause groundwater to rise within communities west of project area; would likely cause flooding at Homestead Air Reserve Base, impacting Homeland Security

As a result, the remaining alternatives included No Action Alternative, YB, M and Q. General descriptions of these intermediate alternatives are provided below, and specific details are included in Appendix F (Plan Formulation).

***No Action Alternative*:** Future without-project condition (FWO) or no action plan. This alternative reflects the most probable future scenario without a project being constructed; no costs were included for this plan. The study area is most influenced by the land use projections for 2050, which project a decrease in agricultural and natural land uses and an increase in urban land uses. Potential effects of this change include: decreasing groundwater recharge, decreasing dry season canal flows, increasing stormwater flows, and decreasing agricultural nutrient outflows. Secondary impacts on the environment may include: increasing exotic vegetation, decreasing native vegetation, decreasing freshwater wetland habitat, and decreasing fish and wildlife. A full description of this alternative is included in Section 4 (Future Without Project Condition).

***Alternative YB*:** This is the Yellow Book plan as further developed by the BBCW team. The plan includes pump stations, spreader swales, STAs, flowways, levees, culverts and backfilling canals. The plan covers 13,600 acres from the Deering Estate at C-100C, south to the FPL Turkey Point power plant, generally along L-31E. The costs from the 1999 Restudy for this alternative were escalated to 2005 price levels for comparison with the other alternatives. Real estate costs were recalculated based on current land use and development.

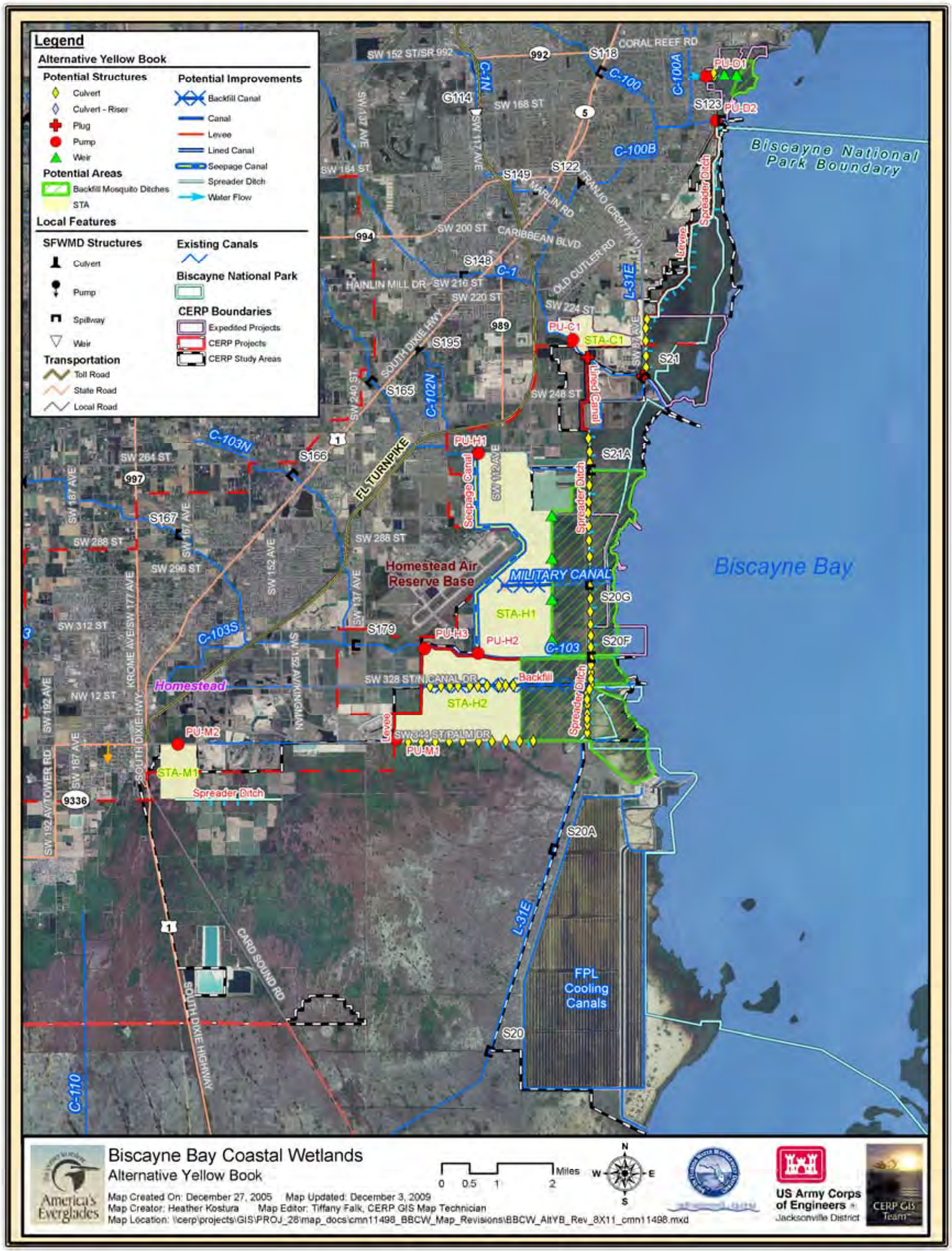

FIGURE 5-4: ALTERNATIVE YELLOW BOOK

TABLE 5-3: SUMMARY OF MEASURES – ALTERNATIVE YB

Sub-component / Management Measure	Deering	Cutler	L-31E Flow/ North Canal Flowway	Barnes Sound Wetlands
Reservoir (ac.)	N/A	N/A	N/A	N/A
STA in acre-ft (ac@depth)	N/A	(1)STA-C1 400 ac @ 3’ = 1,200 ac-ft	(1)2250ac@3’= 6,750ac-ft (1)1650x3’= 4950 ac-ft	(1)STA-M1 350@3’=1050 ac-ft
Pump(s)/sizes (cfs)	(1) PU-D1 50 cfs	(1) PU-C1- 200 cfs (1) PU-C2- 200 cfs	(1) – 200 cfs C-1 (1) – 300 cfs C-1 (2) 200 cfs C-102 / C-103 into STA (1)PU-NC1- 200cfs (1)PU-NC1- 200cfs	(1)PU-M1-50 cfs
Levees (ft./cyd)	N/A	(1)L-C1-west of spreader (4+ miles)	N/A	N/A
Canals (ft./cyd)	(1)C-D1600 ft (160th Street Ditch)	N/A	(1)- new linking canal (1) lined canal west of landfill – connect C-1 at diversion plug (1)3,800’	(1)C-M1 Southward into Model Lands
Spreader canals	N/A	1 size TBD Approx 4+ miles	(1) spreader swale east of L-31E (1)SC-NC1 East of L-31E	(1)SC-M1

Plugs vs. backfilling canals	Fill mosquito ditches in wetlands – 20 plugs, 3ft deep x 8ft wide	1-Plug	(1)plug-Backfill Military canal (1)plug-Backfill North Canal (1)plug-C-1 canal Backfill North Canal east to S.W. 112th Ave	N/A
Culverts weirs & pipes	(2)CC-D1-1 42”- Culverts (1)S-D1-100ft long set 2.5 ft NGVD weirs	(4)CC-C –Culverts	(43)CC-H-flap-gated Culverts 36” (7)CC-NC	CC-M1 Southern end of L-31E
Unique measures	N/A	N/A	N/A	N/A

Alternative M: This is the minimal alternative that uses the smallest number of constructed features and the smallest footprint possible to make use of mutual water management features to attain the objectives of the project. This alternative also attempts to reduce costs by eliminating some features in addition to using trenches and detention areas instead of reservoirs and STAs. Detention areas were sized based on capturing 80 percent of current flows in the canals. As detention areas cannot pond water as high as reservoirs, a greater amount of land was used for the detention areas. Revisions to Alternative M reduced the scope by limiting restoration to only those wetlands east of L-31E and using the L-31E Canal to convey water and act as a spreader canal.

TABLE 5-4: SUMMARY OF MEASURES – ALTERNATIVE M

Sub-component / Management Measure	Deering	Cutler	L-31E Flow/ North Canal Flowway	Barnes Sound Wetlands
Reservoir (ac.)	N/A	N/A	N/A	N/A
Detention Areas in acre-ft (ac@depth)	N/A	(1)DA-C1 100ac@3.75'= 375ac-ft	STA-C1 – 100 ac@ 3.75' deep	N/A
Pump(s)/sizes (cfs)	(1)PU-D1 20cfs	(1) PU-C2-20 cfs	(1)PU-C1 620cfs	N/A
Levees (ft./cyd)	N/A	(1)L-C1	N/A N/A	N/A
Canals (ft./cyd)	(1)C-D1 600'	N/A	(1)- new linking lined canal west of landfill – connect C-1 at diversion plug	N/A
Spreader canals	N/A	(1)SC-C1-spreader	(1)SC-NC1 East of L-31E	(1)SC-M1
Plugs vs. backfilling canals	N/A	(1)PG-C1	N/A	N/A
Culverts weirs & pipes	(1)CC-D2-70' (1)S-D1 40' weir	(1)CC-C1 Subterranean pipe 3500'	(20)CC-H1-36"	N/A
Unique measures	N/A	WWR 50cfs	WWR 150 cfs	N/A

Alternative Q: The intent of Alternative Q is to provide maximum passive storage of water particularly in the Model Lands area and the areas just west of L-31E Levee, and to be aligned with the possible location of the proposed C-111 Spreader Canal. This alternative minimizes costly real estate and utilizes passive water flow rather than pumps to reduce cost. Alternative Q does not include reservoirs. This alternative is intended to reduce proposed infrastructure to the minimum needed for the redistribution of canal discharges and water volumes associated with anticipated reuse water, while maintaining existing levels of flood risk management in developed areas. It relies on existing infrastructure to the extent possible to reduce construction costs including L-31E Levee but allows eastward surface water flow through this levee. The alternative relies on canal plugs instead of canal filling in specific locations where canals are no longer needed, to reduce costs. Alternative Q assumes wastewater reuse is available to hydrate lands in presently abandoned and/or underutilized farming areas as polishing wetlands instead of building engineered STAs. Alternative Q is effective in rehydrating both the freshwater and saltwater ecological zones, but not as effective as other alternatives in producing nearshore benefits.

TABLE 5-5: SUMMARY OF MEASURES – ALTERNATIVE Q

Sub-component / Management Measure	Deering	Cutler	L-31E Flow	Barnes Sound Wetlands
Reservoir (ac.)	N/A	N/A	N/A	N/A
STA in acre-ft (ac@depth)	N/A	(1)FW-C1 (Flowway) 207 ac@3'= 621ac-ft	N/A	N/A
Pump(s)/sizes (cfs)	(1)PU-D1 20cfs	(1)PU-C1-5cfs (1)PU-C2- 5 cfs (1)PU-C3-400cfs (1)PU-D2 150 cfs	(1)PU-H1-400cfs (1)PU-H2-400cfs (1)PU-H3-50cfs (1)PU-HM (relocate existing)	(1)PU-M1-50cfs
Levees (ft./cyd)	N/A	(1)L-C1 3'x2500' (1)L-C2 3'x2500'	(1)L-H1 20,000'x3'	(1) L-M2 4000'x3'x30'wide
Canals (ft./cyd)	(1)CC-D1 600'	(1)LC-C1 3500 ft (1)CC-C2 Convey canal/ pipe	(1)SP-H1 Seepage Collector Canal	N/A

Spreader canals	N/A	(1)SC-C1 12,000 (1)SC-C2 5,000ft	(1)SC-H1	(1)SC-H1- 10'x5'
Plugs vs. backfilling canals	Mosquito ditches are plugged and allowed to fill naturally--	(1) PG-C1 plug Fill 3000 ' deep and 8' wide	(1)PG-H1-2 plugs, Plug mosquito ditches- 20 plugs total and allow to fill naturally	Remove obsolete roads
Culverts weirs & pipes	(1) S-D1 – culvert (1) S-D2 – weir 40 ft	(?) culverts	(5)S-H1-5 (3)CU-H1-3 Submerged culvert	(1)CU-M1 (3)S-M1-3
Unique measure	N/A	Lennar Flowway	N/A	N/A

5.3.5.2 Reformulation of the Secondary Array of Alternatives

Alternative O was introduced after this screening as an intermediate plan between the minimalistic Alternative M and the costly Alternative Q, which results from the great difference in infrastructure and lands between the two plans. Alternative O was crafted to capture the most desired elements of both M and Q. Alternative O is described below.

Alternative O: A blend of Alternatives M and Q that includes the use of flowways, spreader canals, culverts, piping, weirs, canal plugs, mosquito ditch plugs (102 total) and pumps to achieve the overall project goals of restoring and enhancing wetlands and near shore bay habitat by minimizing point source discharges and improving the quantity, quality, timing, and distribution of water to freshwater and tidal wetlands and to the bay.

TABLE 5-6: SUMMARY OF MEASURES – ALTERNATIVE O

Sub-component / Management Measure	Deering	Cutler	L-31E Flow/ North Canal Flowway	Barnes Sound Wetlands
Reservoir (ac.)	N/A	N/A	N/A	N/A

Detention Areas in acre-ft (ac@depth)	N/A	N/A	N/A	N/A
Pump(s)/sizes (cfs)	(1) PU-D1-100 cfs	(1) PU-C1-100 cfs (1) PU-C2-10 cfs (1) PU-C3-10 cfs	(1) PU-H1 – 50cfs (1) PU-H2 – 500 cfs (1) PU-H3 – 300 cfs (1) PU-H5 – 50 cfs	(1) PU-M2 – 50 cfs (1) PU-M1 – 30 cfs (1) PU-M4 – 50 cfs (1) PU-M3 – 20 cfs
Levees (ft./cyd)	N/A	L-C1-6000 ft, H 3 ft	N/A	L-M1
Canals (ft./cyd)	(1) C-100A – 100 cfs	N/A	N/A	N/A
Spreader canals	East ROW of Old Cutler Rd	SC-C1 – 19,700 ft	SC-H1 – SC-H3 –	N/A
Plugs vs. backfilling canals	Plug ditches downstream of weir	Plug mosquito ditches	Plug ditches east of L31E	Plug mosquito ditches
Culverts weirs & pipes	(1) CC-D1 – 600 ft (1)CC-D2 (1) weir S-D1	(1) CC-C1 – 100 cfs, 4700 ft (1) CC-C2 pipe 1000ft – 10 cfs (1) CC-C3-1000 ft – 10 cfs	(1) CC-H1 – 50 cfs (6) CC-H2 – 48” (1) CC-H3 – gated (8) CC-H4 – 48” (1) CC-H5 gated (5) CC-H6 – 48” (1) CC-H8 – 48” (6) CC-H7 – 48” (2) CC-H9 – 48” (3) CC-H10 – 48”	(1) CC-M2 (2) CC-M1 – 12” to 24”
Unique measures	Grade South ½ of Powers property	N/A	N/A	N/A

5.3.6 Final Array of Alternative Plans

Five alternatives remained after intermediate plans were screened and reformulated: No Action Alternative (No Action), Alternative YB (Restudy plan), Alternative M, Alternative O, and Alternative Q. A sixth alternative, Alternative O Phase 1 was then crafted to make the optimal use of the currently available land and water, while focusing on the nearshore and saltwater wetland ecotones.

5.4 CREATION OF ALTERNATIVE O PHASE I (SALTWATER WETLANDS PHASE)

A preliminary cost/benefit analysis of Alternatives: No Action, YB, M, O and Q was conducted and out of this array, Alternative O was identified as the plan that reasonably maximizes ecosystem restoration benefits compared to costs, consistent with the Federal objective. Realizing that the current availability of water would not enable Alternative O to function at its full potential, it became apparent that recommending the full Alternative O would not be prudent until other CERP projects come online (including the Wastewater Reuse Project) which will provide the needed additional water. This plan would typically be the NER plan and ultimately identified as the Tentatively Selected Plan (TSP), Alternative O was instead identified as a more comprehensive environmentally preferred plan for the entire study area and this plan was further refined into a new stand-alone alternative (Alternative O-Phase 1).

Several factors were considered in determining which features of Alternative O would be included in the Phase I Alternative: maximizing use of the currently available water, utilizing lands which are in current public ownership that may offer earlier realization of restoration, minimizing uncertainties, maximizing opportunities to refine knowledge through monitoring, and prioritizing features that focus on saltwater and nearshore wetlands, which are much less land intensive and therefore require limited real estate acquisition. It would be feasible to refine any of the other alternatives in the final array, but since Alternative O was identified as the NER plan during the preliminary assessment, Alternative O was the plan that was further refined.

The team identified 12 potential features based on the following three criteria:

- provide significant benefits utilizing the currently available water;
- provide critical information for development of a subsequent PIR and to adaptively manage the project, consistent with the National Research Council's Incremental Adaptive Restoration recommendation for CERP;
- maximize the efficiency and synergism of project features

This list of 12 features was additionally refined by considering cost, acres benefited, adaptive management benefits and uncertainties, Savings Clause compliance, and schedule impacts. Alternative O Phase 1 is summarized in ***Table*** 5-7 and described in greater detail in Appendix F (Plan Formulation).

As previously discussed, all formulated alternatives include management measures for each of the component areas (Deering, Cutler, L-31E, and Barnes Sound). Alternative O Phase I was refined to focus on three of the four sub-components: Deering Estate Flowway, Cutler Wetlands and L-31 East Flowway. Barnes Sound is geographically distinct from Biscayne Bay, separated from

Biscayne Bay by Card Sound, and functions in a manner that is characterized by much less fresh and saltwater mixing, due to its' increased hydrologic isolation from Biscayne Bay and the Atlantic Ocean. Barnes Sound restoration also requires substantial land acquisition in the Model Lands and greater water deliveries than currently available to achieve project benefits, contrary to the other three components. Additionally, the other three project components all directly discharge to Biscayne Bay and were all included in the refined plan due to their synergistic interaction.

TABLE 5-7: SUMMARY OF MEASURES–ALTERNATIVE O PHASE 1

Sub-component / Management Measure	Deering Estate	Cutler Wetlands	L-31E Flow/ North Canal Flow Way	Barnes Sound Wetlands
Reservoirs (ac.)	N/A	N/A	N/A	N/A
Detention Areas (ac-ft)	N/A	N/A	N/A	N/A
Pumps (cfs)	(1) S-700-100 cfs	(1) S-701-400 cfs	(1) S-703 – 50cfs (1) S-705 – 100 cfs (1) S-709 – 40 cfs (1) S-710 – 40 cfs (1) S-711 – 40 cfs	N/A
Levees (ft)	N/A	N/A	N/A	N/A
Canals (cfs)	(1) C-100A Extension–100 cfs	(1) C-701 Open Channel–400 cfs	N/A	N/A
Spreader canals (ft)	N/A	(1) C-702–19,700 ft	(1) C-711–2,400 ft	N/A
Backfilling	N/A	Plug mosquito ditches	N/A	N/A
Culverts / Structures	(1) Culvert–63in. (1) Weir S-D1	(2) Box Culvert – 6 ft, for flow way, road crossings	(4)Culvert: S-23 –36in (3)Culvert: S-706–36in (1)Culvert: S-708 –36in (2)Culvert: S-712 –36in (1) Inverted Siphon S-707 – two @ 63in	N/A
Unique measures	Grade south ½ of Powers property	N/A	N/A	N/A

Key:
ac acre
ac-ft acre-feet
cfs cubic feet per second
ft foot/feet
ft/cyd feet per cubic yard
in inches
N/A not applicable

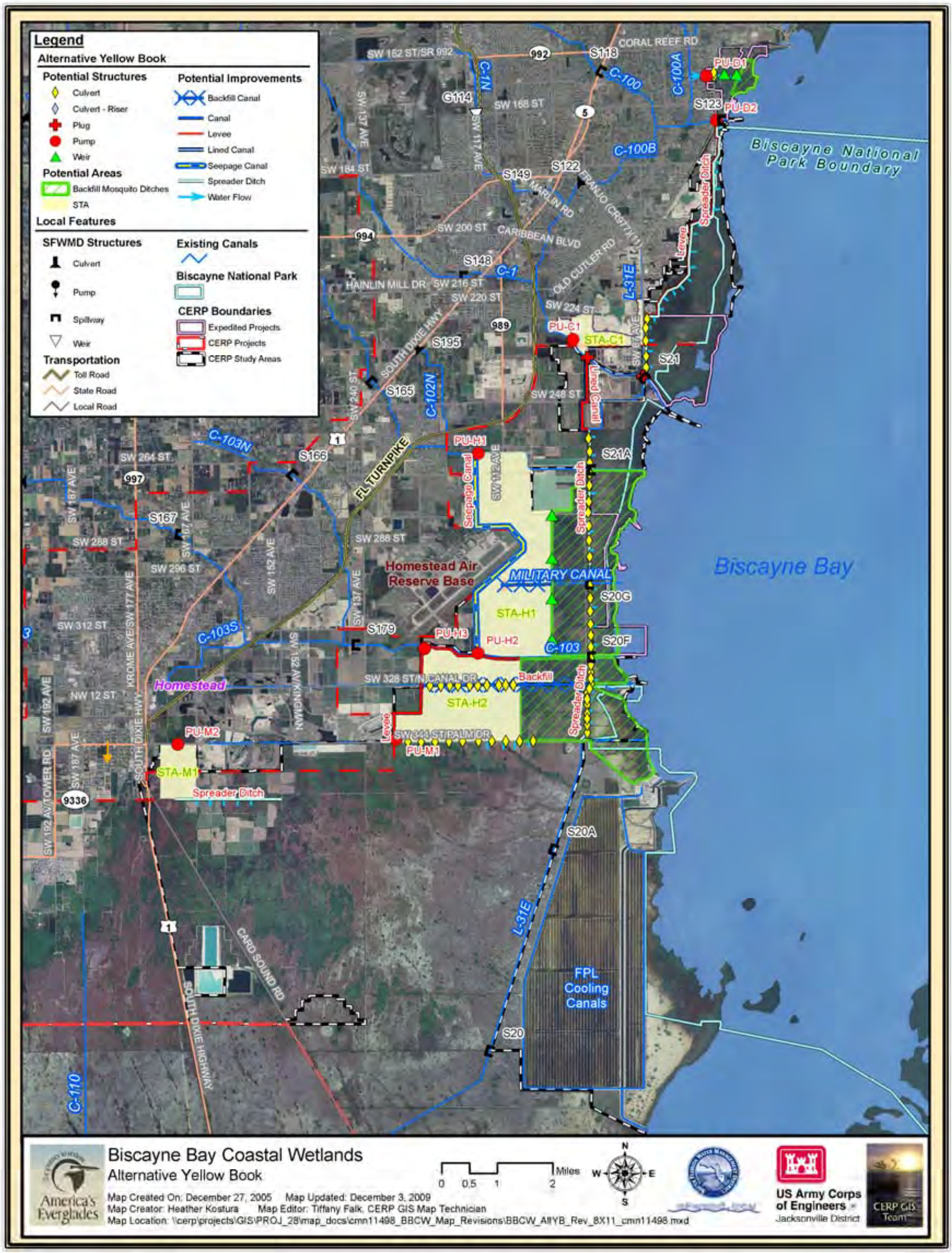

FIGURE 5-5: FINAL ARRAY OF ALTERNATIVES – ALTERNATIVE YELLOW BOOK

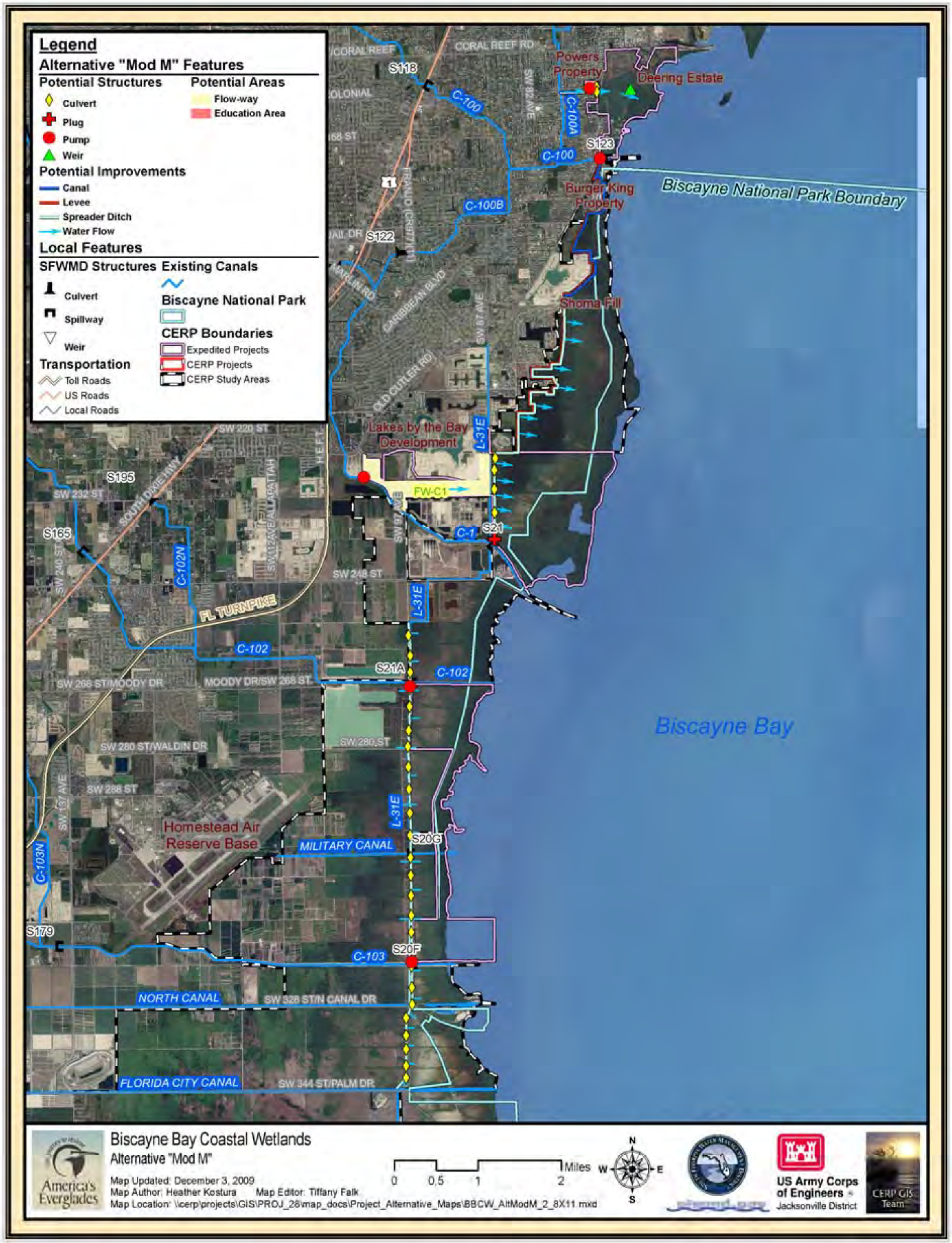

FIGURE 5-6: FINAL ARRAY OF ALTERNATIVES – ALTERNATIVE M

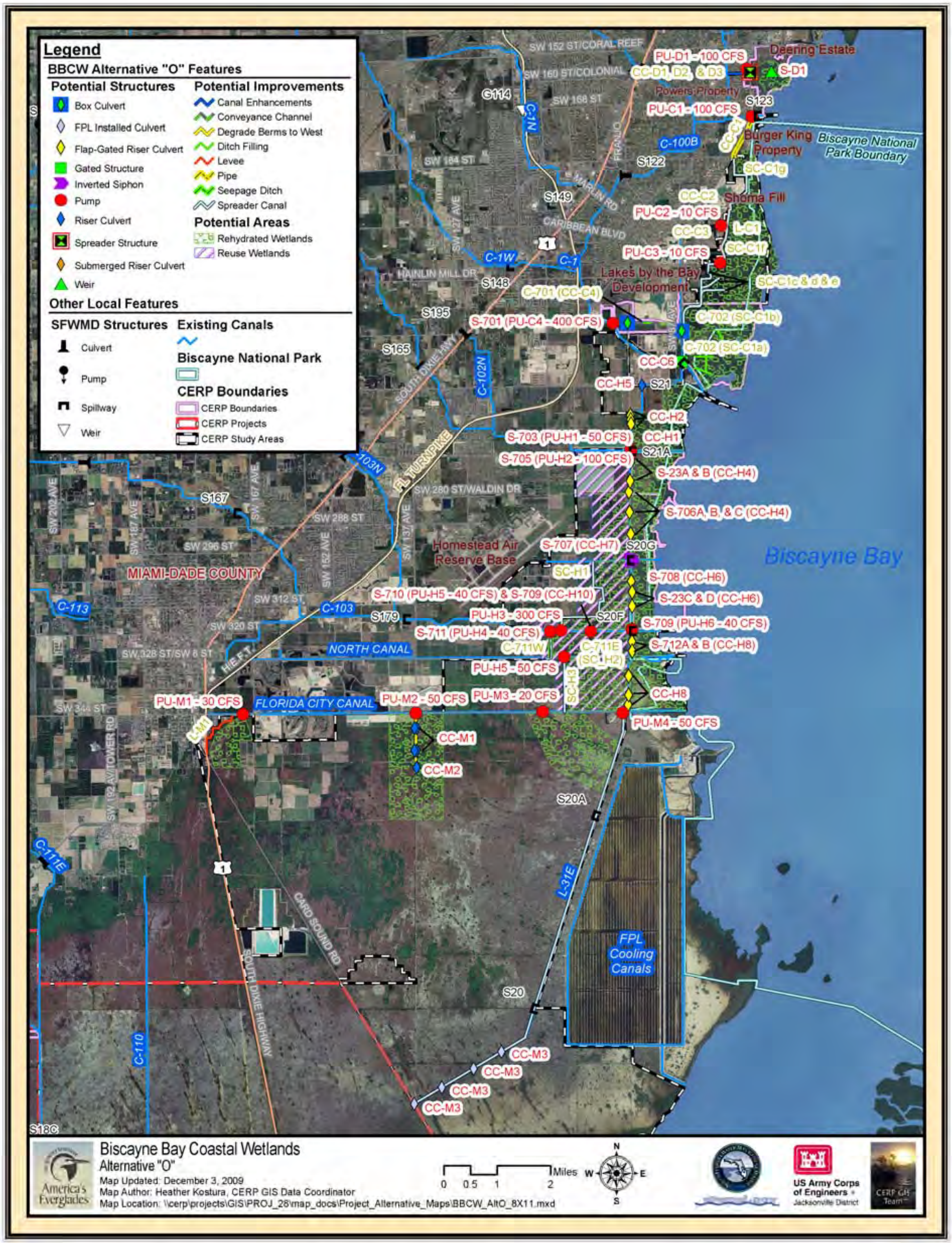

FIGURE 5-7: FINAL ARRAY OF ALTERNATIVES – ALTERNATIVE O

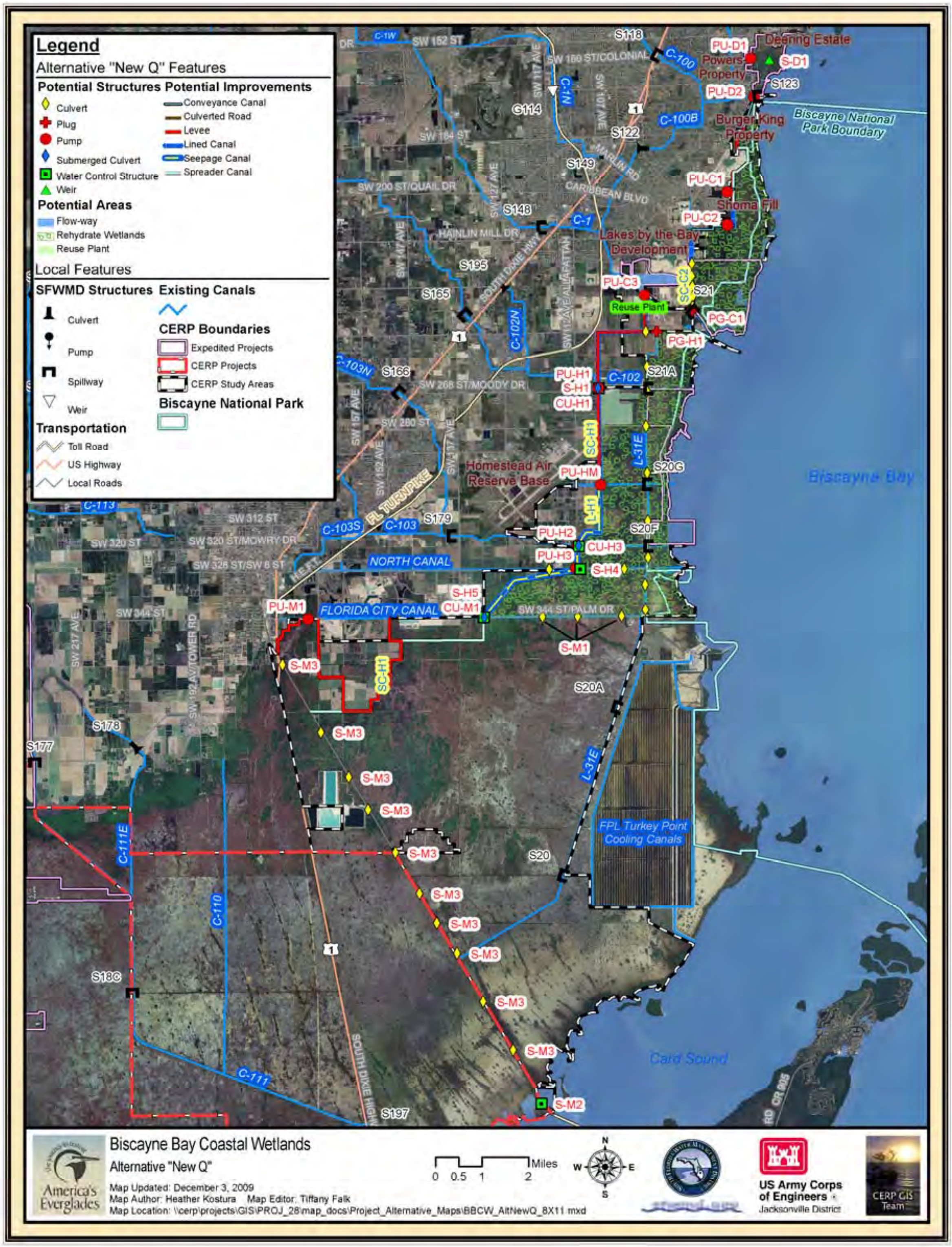

FIGURE 5-8: FINAL ARRAY OF ALTERNATIVES – ALTERNATIVE Q

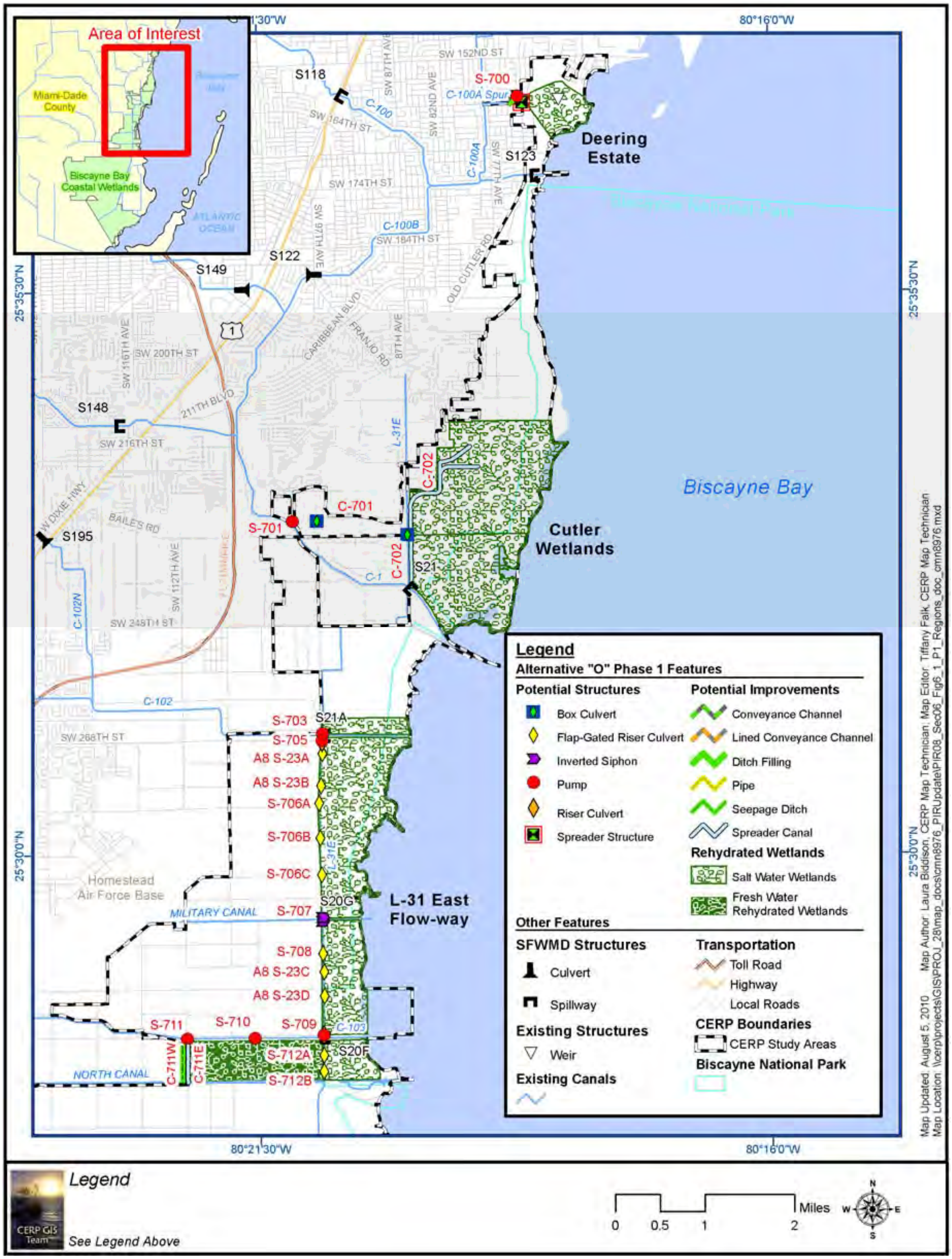

FIGURE 5-9: FINAL ARRAY OF ALTERNATIVES – ALTERNATIVE O, PHASE 1

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SECTION 6

EVALUATION AND COMPARISON OF ALTERNATIVE PLANS

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6.0 EVALUATION AND COMPARISON OF ALTERNATIVE PLANS

Upon identification of the final array of alternatives, each alternative plan was evaluated for its effects on the environment (ecological and social benefits); how well it met the project objectives and avoided constraints; benefits were quantified using the previously described performance measures; and costs were calculated for each plan. An analysis was conducted using Cost Effectiveness and Incremental Cost Analysis (CE/ICA) which maximizes environmental benefits compared to costs and resulted in the identification of the National Ecosystem Restoration (NER) plan. Subsequently all alternatives were evaluated on the Principles and Guidelines (P&G) criteria (Completeness, Acceptability, Efficiency and Effectiveness), the four system of accounts (National Economic Development, Environmental Quality, Regional Economic Development and Other Social Effects) and the Next-Added Increment Analysis. Upon completion of the evaluation and comparison the TSP was identified.

6.1 ENVIRONMENTAL EFFECTS OF FINAL ARRAY OF ALTERNATIVES

Under the No Action Alternative, there would be a continual degradation of biological communities that are presently exposed to point source canal discharges, and the estuarine communities along Biscayne Bay would continue to experience hypersaline conditions adversely affecting the overall health and productivity of these sensitive marine resources. Freshwater wetlands west of the L-31E Canal would be subject to urban and commercial development.

The project alternatives (Yellow Book Alternative, Alternative M, Alternative Q, Alternative O, and Alternative O Phase 1) would all cause similar effects on resources within the study area and immediately adjacent to the project site since they utilize the same project footprint. With the exception of Alternatives M and Alternative O Phase 1, which focuses the restoration effort on saltwater wetlands and nearshore areas of the Bay, many of the resources in this chapter are impacted by all of the alternatives equally. The difference among alternatives, in the cases where they do differ, would be of magnitude rather than type of impact, as the primary objective of all the alternatives is to provide overland flow and hydrological connectivity to rehydrate freshwater wetlands, saltwater wetlands, and nearshore bay habitat while reducing point source discharges into Biscayne Bay.

The most significant beneficial effects of the proposed project would be achieved in the coastal wetlands and adjacent estuaries. Generally, project benefits would increase directly as canal water is spread overland through the coastal wetlands, into the estuaries and along the nearshore of Biscayne Bay. All alternatives can reduce point source canal water discharge and provide overland flow to hydrate the coastal marine biological communities. Minimizing the damaging canal discharges during peak flows and redistribution of those flows through culverts into adjacent wetlands will improve the salinity regime and result in a healthier estuarine environment.

The environmental baseline used to evaluate project impacts vary for the evaluations of different resources. Wetland habitats along with fish and wildlife resources were evaluated against an existing condition baseline, whereas land use and population projections were based on urban development boundary predictions.

6.1.1 Climate

None of the with or without project conditions will have a measurable impact on climate conditions within the study area. During the period between the present and Year 2050, south Florida should experience a full multi-decadal cycle of Atlantic hurricane activity. Currently, the area is in an active phase of this cycle that started in 1995. This active phase followed a 25-year period of low hurricane activity. This suggests that between the present and Year 2050, the area would complete this active phase, pass through another low activity period, and begin another active phase. Global climate change may result in increased temperature, increased evapotranspiration and reduced rainfall.

6.1.1.1 No Action Alternative

Not anticipated to affect climate patterns in the region. Of the considered alternatives, the no action alternative provides the least ability to mitigate the probable changes in the regional climate.

6.1.1.2 Yellow Book Alternative

Not anticipated to affect climate patterns in the region. Of the considered alternatives, the Yellow Book Alternative provides the greatest ability to augment storage to partially mitigate against climate change effects such as decreased rainfall.

6.1.1.3 Alternative M

Not anticipated to affect climate patterns in the region. Relative to the other with project alternatives, Alternative M provides the least ability to mitigate for the probable changes in the regional climate.

6.1.1.4 Alternative Q

Not anticipated to affect climate patterns in the region. Similar to the Yellow Book Alternative, Alternative Q provides the second greatest ability to augment storage to partially mitigate against climate change effects such as decreased rainfall; however, the large freshwater wetland area targeted for rehydration is the most affected by climate change induced additional evapotranspiration.

6.1.1.5 Alternative O

Not anticipated to affect climate patterns in the region. Alternative O is somewhat less capable of mitigating the effects of climate change induced reduction in rainfall; however, it is less likely to fail due to increased evapotranspiration as compared to Alternative Q.

6.1.1.6 Alternative O Phase 1

Not anticipated to affect climate patterns in the region. Alternative O, Phase 1 is somewhat less capable of mitigating the effects of climate change induced reduction in rainfall than Alternative O; however, it is less likely to fail due to increased evapotranspiration since it has a smaller freshwater wetland footprint.

6.1.2 Physical Landscape: Geology, Topography and Soils

Soils and topography within the project site are expected to change under all alternatives. It is not expected that geology would be impacted under any alternative.

6.1.2.1 No Action Alternative

The geologic conditions below the surface would remain relatively unchanged, with the exception of the groundwater. The groundwater would be most affected by sea level rise which is expected to be in the range from 8 inches to 24 inches over the 50 year span of the project. Despite changes to water management operations within the basin, sea level rise is expected to alter groundwater flow patterns and increase the potential for saltwater intrusion along the south Miami-Dade Coastline.

Soil conditions may be altered in the agricultural and upland areas by residential and/or industrial development. This soil may be removed, accreted, or built upon. Soils within the upland and coastal wetlands are not expected to be disturbed. In rare instances, some development may occur in wetland areas with proper permitting from the local governing agencies. As a result, these wetland soils would be drained and/or displaced with fill materials to support development.

6.1.2.2 Yellow Book Alternative

The soil and groundwater conditions for this Alternative would be very similar to that of the Alternative Q for most of the project study area.

6.1.2.3 Alternative M

The soil and groundwater conditions for this Alternative would be very similar to that of the No Action Alternative for most of the project study area. Along the Cutler Wetlands and L-31E Saltwater Wetlands, increased groundwater stages will reduce saltwater intrusion at least relative to that which is expected under the No Action Alternative. Rock beneath the surface would be impacted only in the immediate area of excavations.

Soil condition changes resulting from land use changes would be somewhat less than that expected for the No Action Alternative. Soil conditions would be altered in the infiltration areas and the spreader canals because of soil removal at excavations or accretion over flow ways due to increased vegetative growth. Additionally, construction of levees would result in soil disturbance.

6.1.2.4 Alternative Q

Given that this project has the largest footprint of the final array of alternatives, its impact to soil and groundwater conditions is the most significant relative to the No Action Alternative. Relative to the No Action Alternative, the diversion of water into Alternative Q freshwater wetlands that are located miles from the shoreline will probably result in an acceleration of saltwater intrusion into the groundwater system in the immediate vicinity of the L-31E Levee though it may protect the groundwater aquifer immediately below the targeted freshwater wetlands. Rock beneath the surface would be impacted only in the immediate area of excavations.

Soil conditions may be altered by levee construction, spreader canals and pump stations. These features would locally degrade soil conditions, but creation of hydration areas will eventually increase the soil through increased organic accumulation from decomposing plant life. Since this project has the largest footprint its impact on soil conditions would be the greatest of the final array of alternatives.

6.1.2.5 Alternative O

The magnitude of soil and topographic impacts of this alternative are less than that expected for Alternative Q since its footprint is smaller. The geologic conditions below the surface would remain relatively unchanged, with the exception of the groundwater. Since the freshwater wetlands targeted for rehydration in this project are located closer to the shoreline and because a significant portion of the available water will be diverted directly to the saltwater wetlands, this project should result in a reduction of saltwater intrusion into the groundwater aquifer relative to the No Action Alternative. Rock beneath the surface would be impacted only in the immediate area of excavations.

Soil conditions may be altered by levee construction, spreader canals and pump stations. These features would locally degrade soil conditions, but creation of hydration areas will eventually increase the soil through increased organic accumulation from decomposing plant life. The impact on soil conditions for this alternative would be less than that projected for Alternative Q.

6.1.2.6 Alternative O Phase 1

The magnitude of soil and topographic impacts of this alternative are less than that expected for Alternative O since its footprint is smaller. The geologic conditions below the surface would remain relatively unchanged, with the exception of the groundwater. Since the freshwater wetlands targeted for rehydration in this project are minimal and a greater proportion of available water will be diverted directly to the saltwater wetlands, this project should result in a reduction of saltwater intrusion into the groundwater aquifer relative to the Alternative O as well as Alternative M and the No Action Alternative. Rock beneath the surface would be impacted only in the immediate area of excavations.

Soil conditions may be altered by levee, spreader canal and pump station construction. These features would locally degrade soil conditions, but creation of hydration areas will eventually improve the soil through increased organic accumulation from decomposing plant life. The impact on soil conditions for this alternative would be less than that projected for Alternative P.

6.1.3 Hydrology

The hydrologic evaluation of the project alternatives was done using various hydrologic, hydrodynamic, and hydraulic models in order to estimate project benefits, determine flood impacts, and predict nearshore salinity impacts.

The South Florida Water Management Model (SFWMM 2x2) is the regional hydrologic model used in the original CERP planning process. Though this model was not used to directly simulate the various project alternatives, many of the assumptions and boundary conditions for the existing conditions, base conditions, and future conditions are derived from the SFWMM itself. For this reason, this document references several versions of the 2x2 model.

To determine the impact of the project on nearshore salinity patterns, the USACE created a coupled watershed / hydrodynamic model. This modeling system was composed of the WASH 123D upland hydrology model and the TABS-MDS hydrodynamics bay model. WASH 123D is a physics-based numerical code that simulates the upland watershed as a combination of 1-dimensional canal networks, 2-dimensional overland flow regimes, and 3-dimensional groundwater flow. The TABS-MDS model is a 2 or 3-dimensional finite element hydrodynamic and salinity model as applied to Biscayne Bay. The upland WASH 123D model was used to feed surface and subsurface freshwater flows as boundary conditions on the western side of the TABS-MDS Biscayne Bay Salinity model. In addition to using these two models to predict nearshore salinity, the PDT originally intended to use the WASH / TABS modeling system to estimate project benefits. Though the PDT did use WASH123D and TABS-MDS output for some of the initial plan formulation benefits evaluations, the final array of alternatives was evaluated using a less complex benefits quantification system that relied only upon some of the TABS results. The WASH123D output was not used in the final benefits calculations to evaluate freshwater wetland rehydration effects because the PDT considered this WASH123D output as no more reliable as estimates provided by a simplified rehydration estimation equation. A discussion of the WASH123D and TABS-MDS models is included in Appendix A.

The flood impacts analysis of the selected plan was accomplished using several modeling tools. In the Deering Estate and L-31E Flow Way areas, the flood protection analysis was done using the Hydrologic Engineering Center River Analysis System (HEC-RAS) model. In the Cutler Wetlands Flow Way area, the Finite Element Surface Water Modeling System (FESWMS) was applied. In the Homestead Freshwater Wetlands Impoundment, the USGS MODBRANCH model was applied. All of the flood-protection modeling efforts are discussed in detail in Annex C of this document.

A benefits assessment tool, CBEEM (Criterion Based Ecological Evaluation Matrix), also includes two simple hydrologic modeling tools. The first is the CBEEM spreadsheet itself which estimates the daily amount of water available for diversion by project features using the historic coastal structure flows as recorded in the SFWMD DBHYDRO on-line database. Within the CBEEM spreadsheet is a simplified wetland rehydration equation which is used to estimate the net acreage of freshwater that could be rehydrated given a quantity of diverted water. This simplified method of estimating freshwater wetland rehydration does not take into account rainfall, evapotranspiration, or groundwater conditions so its predictions are considered to have a high degree of uncertainty. While the use of a very simple equation to estimate freshwater wetland benefits may have resulted in an increase in the uncertainty surrounding the estimates of freshwater wetland benefits, the decision to forego additional WASH 123D modeling efforts did reduce the time and cost of evaluating the various alternatives. The CBEEM tool uses a limited amount of output from the TABS-MDS Biscayne Bay model as part of estimating benefits that arise from changes to nearshore or saltwater wetland salinity conditions. The water reservations analysis (Annex C) required to identify water made available to the natural system by the project was done using historic flows extracted from the DBHYDRO database.

Underlying the modeling efforts conducted for this study were the assumptions used to drive these models. In the case of coastal structure flows used in the CBEEM benefits estimation tool, the team had the choice of using either simulated flows from CERP versions of the SFWMM2x2 or historic flows from the DBHYDRO database. The team evaluated the uncertainty in the accuracy of 2x2 predicted flows in the four basins by considered the current validity of some water demand assumptions used in the model, and comparing the simulated flows to DBHYDRO flows. The team decided to use DBHYDRO flows as the best available data for representing future flow conditions since they appeared to provide the most conservative estimate of future flow conditions.

6.1.3.1 No Action Alternative

Some fundamental aspects of hydrologic conditions are expected to change in the southern Miami-Dade County watershed by Year 2050. Sea level is expected to rise between 8 and 24 inches over the next 50 years. If the freshwater heads currently maintained under operational rules remain the same in Year 2050, the rise in sea level would effectively reduce the groundwater slope from the coastal ridge toward Biscayne Bay, thus reducing head pressure and groundwater flux toward the Bay. Under this scenario, the Biscayne Aquifer is likely to experience greater intrusion of salt water. The ability of the watershed to store water either within wetlands or the aquifer is expected to diminish, resulting in increased intensity of stormwater discharges through the primary canals. Reduced water storage reduces the capacity of the flood control system to accommodate runoff, and would likely lead to increased frequency of flooding events.

Hydrologic modeling results generated by the South Florida Water Management Model indicate that water withdrawals for agriculture and urban uses affect the quantity of fresh water that ultimately flows into Biscayne Bay (SFWMD, 2000). Results from the SFWMM modeling done prior to 2006 indicate that without constraints on groundwater withdrawals, well field demand in the Biscayne Bay Coastal Wetlands project area will increase by 89 percent and agricultural demand by four percent by 2020. This would result in up to a 23 percent decrease of surface water discharges to Biscayne Bay through the primary canals. Subsequent to this modeling effort, the SFWMD has agreed with the Miami-Dade Water and Sewer Authority (MDWASA) that future water demands would be met through an increase in reuse and conservation measures and would not require new groundwater withdrawal authorizations. These conservation / reuse measures should help ensure that future reductions in water available to the basin are minimal.

In summary, under the No Action Alternative, freshwater flux to Biscayne Bay is likely to diminish, flooding may increase, and stormwater runoff intensity from large storms will likely increase. The primary drivers for these changes are sea-level rise, and greatly expanded impervious areas due to development in the watershed.

6.1.3.2 Yellow Book Alternative

The Yellow Book Alternative; includes extensive use of STAs, some canal and ditch backfilling, pumps, and connector canals from C-102 to C-103, and from C-1 to the L-31E borrow canal. This alternative also uses culverts and risers under L-31E Levee to remove obstacles to flow. Similar to Alternative Q, it may be possible that the Yellow Book Alternative would exacerbate saltwater intrusion in the C-102 and C-103 basins along the coastline.

6.1.3.3 Alternative M

Alternative M includes the capacity to pump up to 20 cfs at Deering Estate, 620 cfs at the Cutler Wetlands, no water from the C-102 basin (gravity flow), and 50 cfs in the C-103 basin. Using the pump sizes and the historic flow records for each of the basins, an estimated 9% of the C-100 flows, 90% of the C-1 flows, none of the C-102 flows, and 20% of the C-103 flows would be diverted into freshwater and saltwater wetlands by this alternative. Using pump stations, this alternative would divert an average of approximately 144,000 acre ft annually out of an average annual total canal flow of 368,000 acre ft. An additional volume of water estimated to be between 10,000 and 20,000 acre ft would flow by gravity through the culverts installed through the L-31E levee. Under the full CERP build out that includes the Wastewater Reuse Project, an additional 108,000 acre ft of water would be available for distribution to the various wetlands.

Since the pump stations included in this alternative would be operated using on/off triggers very similar to the existing coastal structure operating schemes, over drainage of adjacent wetlands is not anticipated from pump operations.

6.1.3.4 Alternative Q

Alternative Q includes the pumping capacity to divert up to 170 cfs at Deering Estate, 400 cfs at the Cutler Wetlands, 400 cfs at the C-102 Basin, and 500 cfs at the C-103 Basin. Using the pump sizes and the historic flow records for each of the basins, an estimated 46% of the C-100 flows, 78% of the C-1 flows, 87% of the C-102 flows, and 85% of the C-103 flows would be diverted into freshwater and saltwater wetlands by this alternative. In total, this alternative would divert an average of approximately 294,000 acre ft annually out of an average annual total canal flow of 368,000 acre ft. In other words, approximately 80% of the available flow would be diverted on an average annual basis. Under the full CERP build-out which includes the Wastewater Reuse Project, an additional 108,000 acre ft of water would be available for distribution to the various wetlands.

A review of some of the preliminary WASH123D modeling output indicated that because this project diverts water from the canals several miles upstream of the existing coastal structures on the C-102 and C-103 canals, there is a potential for reducing groundwater stages in the reach between the Alternative Q diversion structures on these two canals and the existing coastal structures. Given this apparent effect of alternative, it may be possible that this particular alternative would exacerbate saltwater intrusion in the C-102 and C-103 basins at least directly along the coastline.

6.1.3.5 Alternative O

Alternative O includes the pumping capacity to divert up to 200 cfs at Deering Estate, 400 cfs at the Cutler Wetlands, 550 cfs in the C-102 Basin, and 520 cfs in the C-103 Basin. Using the pump sizes and the historic flow records for each of the basins, an estimated 51% of the C-100 flows, 78% of the C-1 flows, 92% of the C-102 flows, and 86% of the C-103 flows would be diverted into freshwater and saltwater wetlands by this alternative. In total, this alternative would divert an average of approximately 300,000 acre ft annually out of an average annual total canal flow of 368,000 acre ft. In other words, approximately 82% of the available flow would be diverted on an average annual basis. Under the full CERP build-out which includes the Wastewater Reuse Project, an additional 108,000 acre ft of water would be available for distribution to the various wetlands.

Since the pump stations included in this alternative would be operated using on/off triggers very similar to the existing coastal structure operating schemes, and because most of the diversion points are located in the lower reaches of the C-102 and C-103 basins over drainage of adjacent wetlands and depressed canal stages (relative to the No Action Alternatives) should be minimal for this alternative.

6.1.3.6 Alternative O Phase 1

This alternative is similar to Alternative O except that most of the features that target freshwater wetlands are not included. Alternative O, Phase 1 includes the pumping capacity to divert up to 100 cfs at Deering Estate, 400 cfs at the Cutler Wetlands, 150 cfs in the C-102 Basin, and 120 cfs in the C-103 Basin.

Using the pump sizes and the historic flow records for each of the basins, an estimated 34% of the C-100 flows, 78% of the C-1 flows, 66% of the C-102 flows, and 43% of the C-103 flows would be diverted into freshwater and saltwater wetlands by this alternative. In total, this alternative would divert an average of approximately 222,000 acre ft annually out of an average annual total canal flow of 367,000 acre ft. In other words, approximately 60% of the available flow would be diverted on an average annual basis. Under the full CERP build-out which includes the Wastewater Reuse Project, an additional 108,000 acre ft of water could be available for distribution to the various wetlands.

Figure 6-1 shows the exceedance probability of the total available and diverted flows for all four basins. Based on this figure, it appears that under drought conditions (10th percentile flow) there will be approximately 150,000 acre ft/year available and this alternative will divert roughly 78% of it. Under wet conditions (90th percentile flow) there will be approximately 520,000 acre ft available of which roughly 54% will be diverted by project features. ***Figure 6-2*** through ***Figure 6-5*** show the available and diverted flow for each basin on a monthly basin. ***Figure 6-2*** shows that under drought (10 percentile flow) and median (50 percentile flow) conditions there will be little to no water available for diversion at the Deering Estate features during the dry season (spring months). ***Figure 6-3*** shows that under drought conditions (10 percentile flow) there will be little to no water available for diversion to the Cutler Wetlands during the dry season (spring months). During median conditions (50 percentile flow), water will be available in the C-1 basin for diversion to the Cutler Wetlands. ***Figure 6-4*** shows that under drought conditions (10 percentile flow) there will be little to no water available in the C-102 basin for diversion to the L-31E Northern Wetlands during the dry season (spring months). Under median conditions, there is water available in every month of the year for diversion from the C-102 canal. ***Figure 6-5*** shows that under drought conditions (10 percentile flow) in the C-103 Basin, the lowest monthly flows available are approximately 70 and 40 acre ft which occur in April and May respectively. Under median conditions, the minimum monthly flow available in the C-103 Basin is 1,300 acre ft which occurs in April and May.

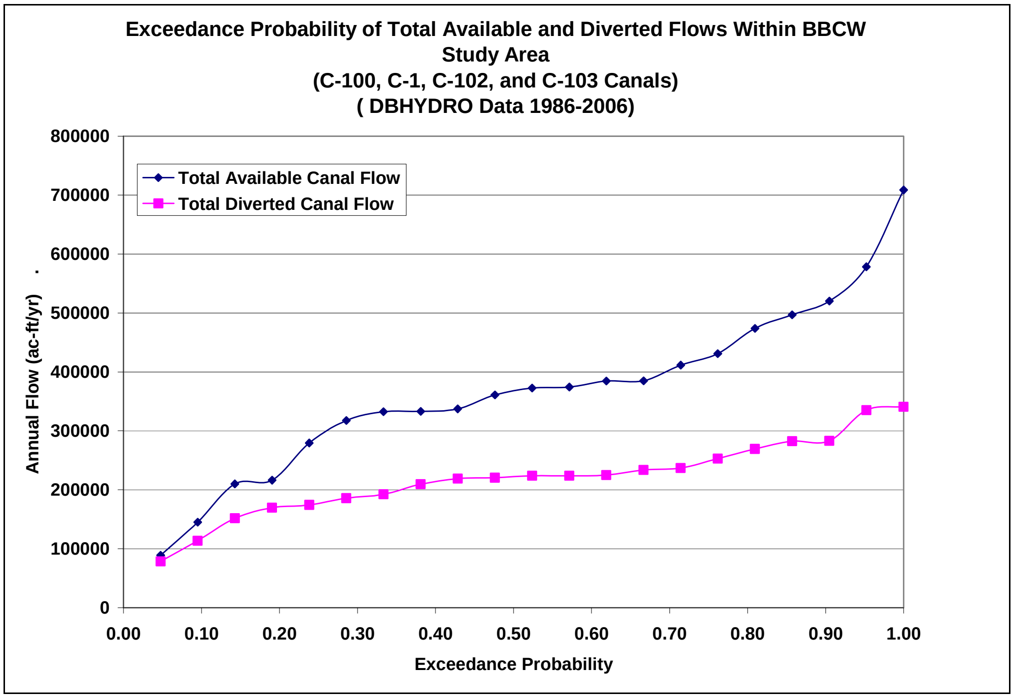


FIGURE 6-1: EXCEEDANCE PROBABILITY OF TOTAL AVAILABLE AND DIVERTED FLOWS FOR ALTERNATIVE O, PHASE 1.

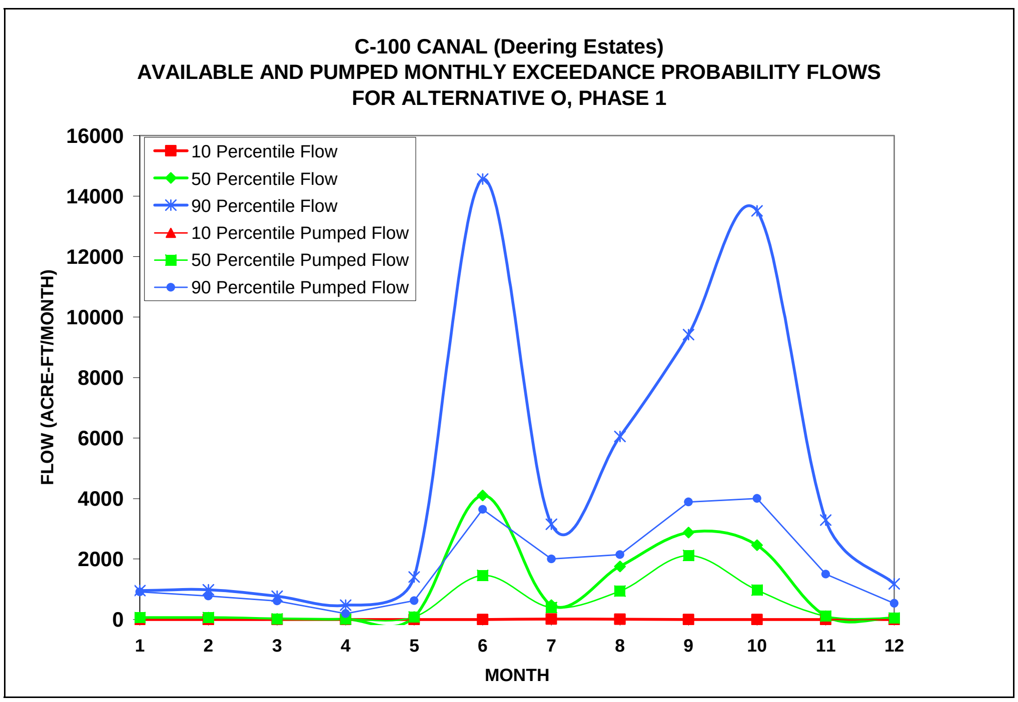


FIGURE 6-2: EXCEEDANCE PROBABILITY OF TOTAL AVAILABLE AND DIVERTED FLOWS IN THE C-100 BASIN

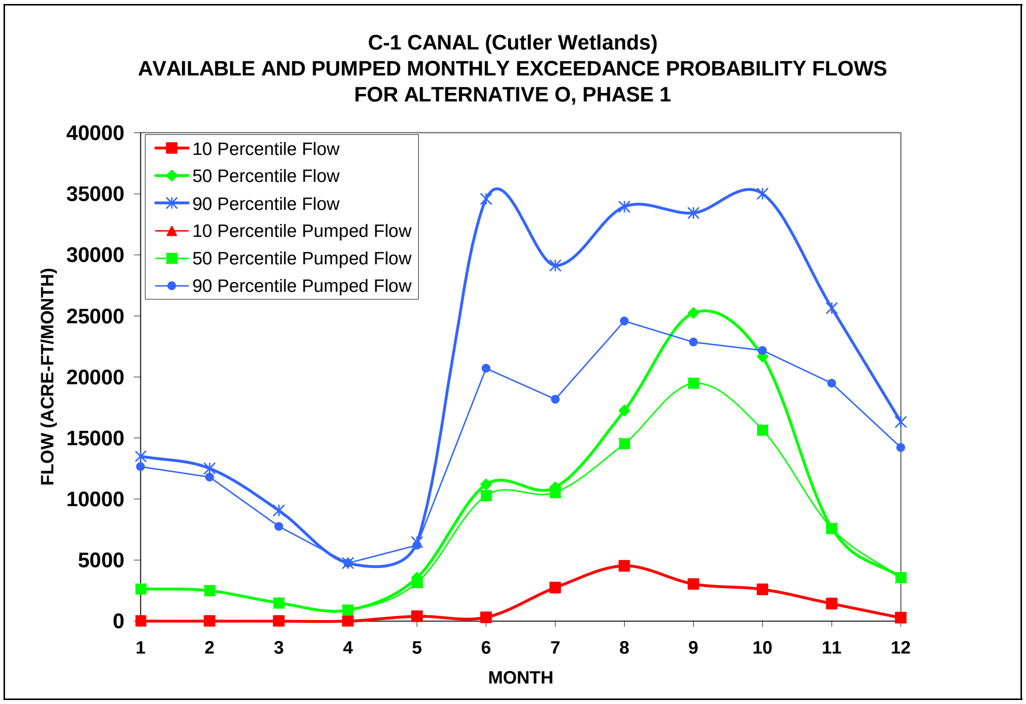


FIGURE 6-3: EXCEEDANCE PROBABILITY OF TOTAL AVAILABLE AND DIVERTED FLOWS IN THE C-1 BASIN

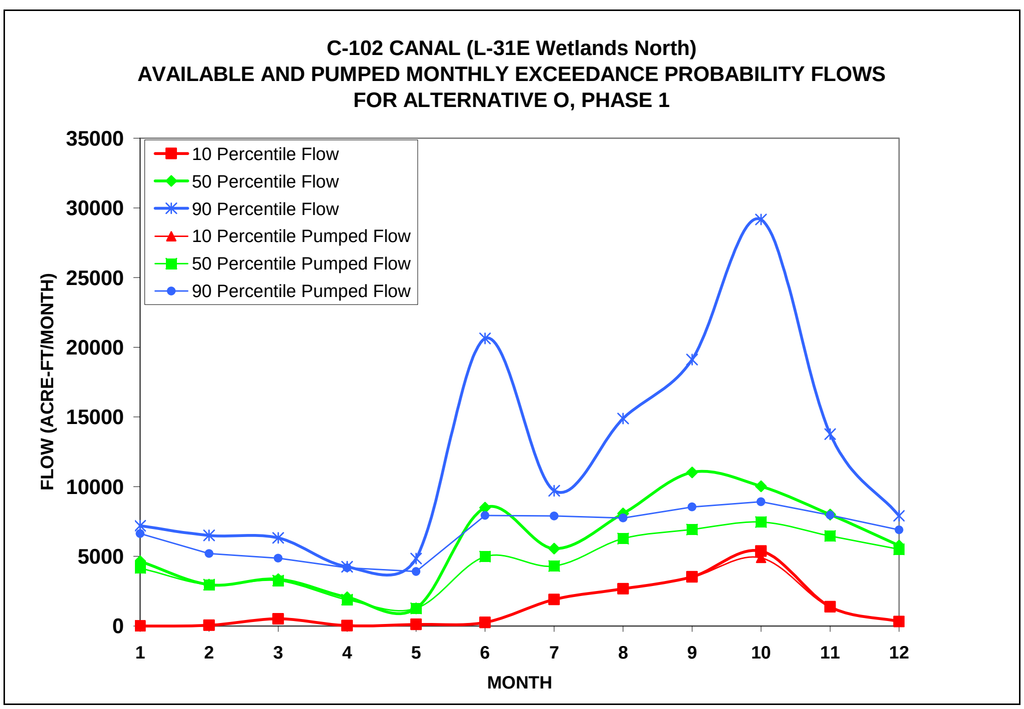


FIGURE 6-4: EXCEEDANCE PROBABILITY OF TOTAL AVAILABLE AND DIVERTED FLOWS IN THE C-102 BASIN

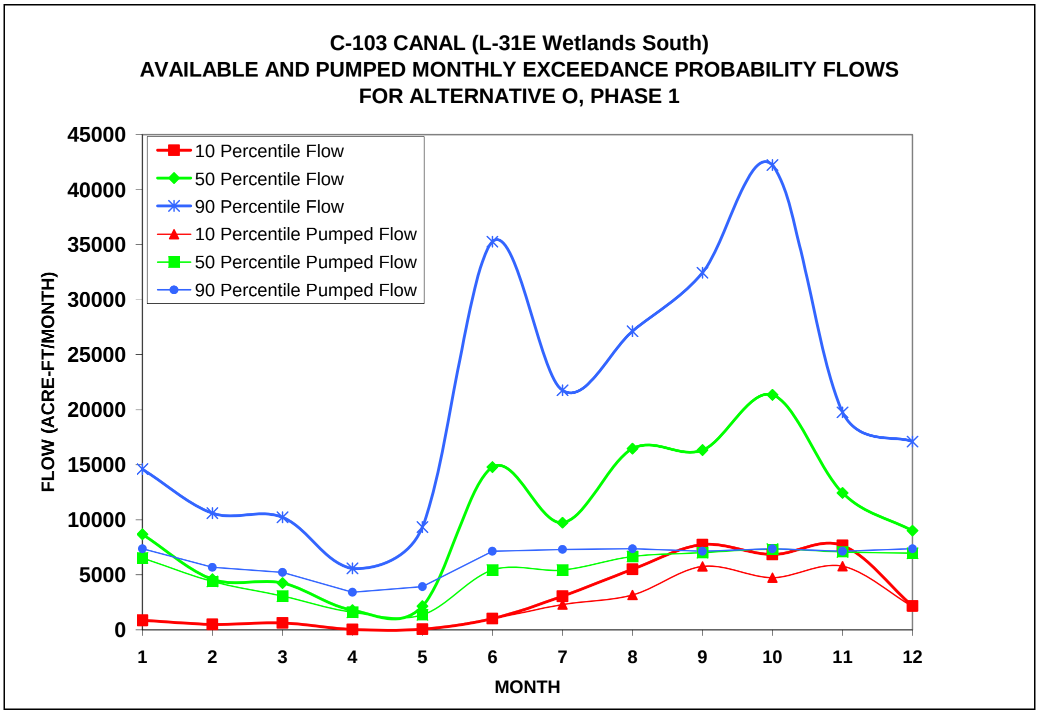


FIGURE 6-5: EXCEEDANCE PROBABILITY OF TOTAL AVAILABLE AND DIVERTED FLOWS IN THE C-102 BASIN

6.1.4 Water Management

Quantities and distributions of water through water management operations can have environmental effects. These effects include changes to water quality, salinity, and inundation of wetlands. The various alternatives may have different environmental effects based on the quantity, timing, and locations of the distributions of water. The water management operations for the different alternatives are outlined below:

6.1.4.1 No Action Alternative

With the increase in population and infrastructure, the demand for water will increase, and the shortages and restrictions will become more prominent, leading to both economic and environmental damages. In the LEC region of south Florida, groundwater is the predominant source of water for M&I uses; however, the SFWMD has recently initiated a moratorium on future permitting of addition groundwater consumptive use in southern Miami-Dade County. This will limit future additional groundwater withdrawals at least within the BBCW study area. Nonetheless, with increased mean sea level and potentially less water available for recharge, migration of the underlying salt wedge landward is expected to occur.

6.1.4.2 Yellow Book Alternative

The Yellow Book Alternative includes extensive use of STAs, some canal and ditch backfilling, pumps, and connector canals. As such, this alternative may result in depressed canal stages in areas directly upstream of the existing coastal structures on the C-102 and C-103 canals.

6.1.4.3 Alternative M

Alternative M includes the use of flow ways, culverts, piping, weirs, and plugs and pumps to achieve the overall project goal of restoring nearshore bay habitat by minimizing point source discharges and improving the quantity, quality, timing, and distribution of fresh water to the bay through a more natural flow pattern.

6.1.4.4 Alternative Q

Alternative Q is intended to reduce the proposed infrastructure to the minimum needed for the redistribution of canal discharges and water volumes associated with anticipated (Yellow Book) reuse water, while maintaining existing levels of flood risk management in developed areas. The intent is to provide maximum passive storage of water, particularly in the Model Lands area and the areas just west of the L-31E Levee. Given the distance between the diversion pump stations on the C-102 and C-103 canals, this alternative is the most likely to result in depressed canal stages (relative to the No Action Alternative) in areas directly upstream of the existing coastal structures on these two canals.

6.1.4.5 Alternative O

Alternative O includes the use of flow ways, spreader canals, culverts, piping, weirs, canal plugs, 102 mosquito control ditch plugs and pumps to achieve the overall project goals of rehydrating and restoring wetlands and nearshore bay habitat by minimizing point source discharges and improving the quantity, quality, timing, and distribution of water to freshwater and saltwater wetlands and to the bay. This alternative is expected to have minimal impact to M&I water supply.

6.1.4.6 Alternative O Phase 1

Since Alternative O Phase 1 is closely related to Alternative O, its environmental goals are very similar: rehydrate and restore wetlands and nearshore bay habitat by minimizing point source discharges and improve the quantity, quality, timing, and distribution of water to freshwater and saltwater wetlands and to the bay. Alternative O Phase 1 includes the use of flow ways, spreader canals, culverts, piping, weirs, canal plugs; mosquito control ditch plugs (102 total) and pumps. This alternative is expected to have minimal impact to M&I water supply.

6.1.5 Flood Risk Management

The existing east-west canal network and the L-31E Levee/Canal were designed to provide flood protection and water supply. Flood risk management needs have increased since the original flood control project was constructed and may continue to increase in the future. As agricultural and urban development continues, the volume, duration, and frequency of floodwaters may increase, and the actual level of flood risk management may decline in some areas. Sea level rise is expected to reduce the existing level of flood protection. There are opportunities within the Biscayne Bay Coastal Wetlands project area to further reduce the extent of damages from flooding through operational and structural changes; however, the improvement of flood risk management is not an objective of this project.

6.1.5.1 No Action Alternative

The shift in land use would likely impose additional demands on the flood control system, especially during heavy rainfall events. The percentage of impervious surface typical of agricultural land is estimated to be less than one percent, but in residential areas it is estimated at 65 percent to 70 percent. Heavy rainfall can quickly overwhelm onsite stormwater retention systems of the future constructed environment and overflow into the primary flood control system which will likely be less effective due to sea-level rise.

Sea level rise will reduce the ability of the watershed to store runoff water either within wetlands or the aquifer resulting in increased intensity of stormwater discharges through the primary canals. Reduced water storage reduces the capacity of the flood control system to accommodate runoff, and would likely lead to increased frequency of flooding events.

6.1.5.2 Yellow Book Alternative

The Yellow Book Alternative includes extensive use of STAs, some canal and ditch backfilling, pumps, and connector canals from C-102 to C-103 and from C-1 to the L-31E borrow canal. This alternative also uses culverts and risers under L-31E Levee to remove obstacles to flow. None of the alternative features are designed specifically for flood risk management.

6.1.5.3 Alternative M

Alternative M includes the use of flow ways, culverts, piping, weirs, plugs and pumps to achieve the goal of restoring nearshore bay habitats. Alternative M minimizes point source discharges and improves the quantity, quality, and timing of the freshwater distribution to the bay. Alternative M would maintain existing levels of flood risk management in developed areas through project operations.

6.1.5.4 Alternative Q

Alternative Q includes a new north-south canal for redistribution of canal discharges and water volumes associated with anticipated wastewater reuse. None of the alternative features are designed specifically for flood risk management; however, this alternative maintains existing levels of flood risk management in the developed areas and provides maximum passive storage of water in the Model Lands areas, and areas west of L-31E.

6.1.5.5 Alternative O

None of the Alternative O features are designed for flood protection; however, existing levels of flood risk management in developed areas would be maintained through project operations of existing and proposed infrastructure.

6.1.5.6 Alternative O Phase 1

None of the Alternative O Phase 1 features are designed to improve flood protection. However this alternative will maintain the existing level of flood risk management through further optimization of project operations of the existing and proposed control structures. The project team used a combination of modeling tools (the HEC-RAS, FESWMS and MODBRANCH) to perform an analysis of the flood protection impacts of the various project features. Short summaries of these analyses are provided below though a full description of this work is included in ***Annex C***

A flood impact analysis was performed using HEC-RAS to determine if the Deering Estate project features would cause or contribute to flooding. This analysis showed that the project features in this area do not cause any significant or adverse increase of water surface elevations in residential areas or local roadways. For the Cutler Wetlands area a HEC-RAS modeling effort was performed and a review of the existing permitted stormwater facilities was done to determine if the operation of the project features in this area would result in offsite flooding impacts. The conclusions from these two analyses indicate that the project would not cause offsite flooding impacts to adjacent properties. A third HEC-RAS modeling effort was conducted to determine if water diverted from the C-102 and C-103 canals in order to rehydrate saltwater wetlands to the east of the L-31E Borrow Canal would result in flooding of non-project lands. This analysis showed that there was a potential for flooding of lands to the west of the L-31E Borrow Canal if pumping continued once the water surface elevation in the borrow canal reached the elevation of the berm located just west and adjacent to the borrow canal. To eliminate this flooding potential, the Draft Operating Manual (DPOM) includes pump operation triggers that limit pumping into the L-31E Borrow Canal once the critical stage in the borrow canal is achieved.

A MODBRANCH model was set up to simulate the effect of rehydrating freshwater wetlands located in the North Canal Impoundment Wetlands feature. In addition to this modeling effort, data from a nearby stormwater detention area was reviewed to ascertain actual field conditions. Based on the results from the MODBRANCH simulations and the available stormwater detention area data, it was concluded that the operation of the North Canal Impoundment Wetland would not significantly or adversely affect the level of service for flood protection of adjacent properties.

6.1.6 Water Quality

Future water quality conditions in southern Biscayne Bay are influenced by multiple factors. The changes in land use and runoff hydrographs are likely to affect the water quality of surface water and groundwater within the watershed.

Presently, the most prolific contaminant is nitrate, which has been linked to agricultural sources. As agricultural land uses diminish in the watershed, other contaminants such as ammonia, phosphorus, trace metals and hydrocarbons more typical of urban settings are likely to become more common (Alleman et al., 1995).

Changes to nitrate loading was selected as the primary measure of water quality effects of the project because the east-west drainage canals within the project area contribute a significant load of nitrogen to Biscayne Bay which is considered to be nitrogen limited. The project team used existing water quality data, existing land use, future land use, and nitrate uptake from water diverted to freshwater and saltwater wetlands to estimate changes to nitrate loading to Biscayne Bay. A more detailed explanation of water quality impact calculations is found in the CBEEM portion of ***Appendix C***.

In addition to the reduction in nitrate loads from agricultural runoff, the nearshore bay should experience a reduction in ammonia loading coming from the South Dade Landfill and its predecessors. Though modern stormwater controls should limit the impact of urban development, changes in runoff volume and timing that will occur regardless of whether the project is constructed may increase the amount of suspended solids, which in addition to reducing water transparency, often transport phosphorus and trace metals.

6.1.6.1 No Action Alternative

The project team used existing water quality data, existing land use, and future land use to estimate changes to nitrate loading due to land use conversion expected under the No Action Alternative. Approximately two thirds of the existing nitrate loads that result from the current agricultural land uses will be eliminated by Year 2050 as agriculture gives way to urban development. This land use conversion will result in runoff quality, which is characterized by elevated phosphorus, hydrocarbons, and heavy metal concentrations that are typical of urban stormwater (Alleman et al., 1995). The nearshore bay should experience a reduction in ammonia loading coming from the South Dade Landfill and its predecessors. Additional flood storage capacity necessary to accommodate new urban development may result in additional periods of high salinity within the nearshore bay as well as rapid swings in salinity due to the increase in magnitude of flood releases. These high salinity events should be somewhat reduced in magnitude, frequency, and duration as a result of sea level rise over the next 50 years.

6.1.6.2 Yellow Book Alternative

The diversion of some canal water into the freshwater wetlands and saltwater wetland areas will result in a reduction of nutrient loading to the bay and an increase in loading to rehydrated wetlands. The use of lands west of the L-31E Levee should improve water quality in the C-102 and C-103 basins relative to present conditions given the natural treatment provided by rehydrated wetland areas and the reduction in agricultural runoff.

6.1.6.3 Alternative M

The diversion of some canal water into the saltwater wetland areas will result in a reduction of nutrient loading to the bay and an increase in nutrient loading to rehydrated wetlands. The effect of increased nutrient loading to rehydrated wetlands is not expected to result in significant adverse impact to the vegetation in these wetlands primarily because the phosphorus concentrations in the diverted canal water is relatively low (<10 ppb[parts per billion] total phosphorus [TP]). Given the limited use of lands west of the L-31E Levee, most of the changes to basin water quality that result from the conversion of agricultural lands to urban uses are expected to occur even with Alternative M. To evaluate the reduction in nitrate loading, the project team used the estimated volume of water diverted from the canal system by Alternative M and used a wetland nitrate uptake equation (Kadlec and Knight, 1996) to calculate the reduction in nitrate load delivered to Biscayne Bay. It is assumed that denitrification rates will not decrease over the life of the project since wetlands are very efficient denitrifiers. Nitrate loading under this alternative is expected to be reduced by approximately 70 percent, which is slightly better than the two-thirds reduction expected for the No Action Alternative. Thus, Year 2050 water quality conditions under Alternative M are expected to be very similar, or slightly improved, relative to the No Action Alternative conditions.

6.1.6.4 Alternative Q

The diversion of some canal water into the freshwater wetlands and saltwater wetland areas will result in a reduction of nutrient loading to the bay and an increase in loading to rehydrated wetlands. The effect of increased nutrient loading to rehydrated wetlands is not expected to result in significant adverse impact to the vegetation in these wetlands primarily because the phosphorus concentrations in the diverted canal water is relatively low (<10 ppb TP). The substantial use of lands west of the L-31E Levee in Alternative Q, should improve water quality in the C-102 and C-103 basins relative to present conditions given the natural treatment provided by rehydrated wetland areas and the reduction in agricultural runoff. To evaluate the reduction in nitrate loading, the project team estimated the volume of water diverted from the canal system by Alternative Q and used a wetland nitrate uptake equation (Kadlec and Knight, 1996) to estimate the reduction in loads delivered to Biscayne Bay. The rate of de-nitrification within the wetlands is assumed to be constant over the life of the project. Approximately 94 percent of the nitrate load will be eliminated relative to existing conditions. Thus, Year 2050 water quality conditions under this alternative are expected to be significantly improved relative to present and No Action Alternative conditions.

6.1.6.5 Alternative O

The diversion of some canal water into the freshwater and saltwater wetland areas will result in a reduction of nutrient loading to the bay and an increase in loading to rehydrated wetlands. The effect of increased nutrient loading to rehydrated wetlands is not expected to result in significant adverse impact to the vegetation in these wetlands primarily because the phosphorus concentrations in the diverted canal water is relatively low (<10 ppb TP). The substantial use of lands west of the L-31E Levee in Alternative O, should improve water quality in the C-102 and C-103 basins relative to present conditions given the natural treatment provided by rehydrated wetland areas and the reduction in agricultural runoff. To evaluate the reduction in nitrate loading, the project team estimated the volume of water diverted from the canal system by Alternative O and used a wetland nitrate uptake equation (Kadlec and Knight, 1996) to estimate the reduction in loads delivered to Biscayne Bay. The rate of denitrification within the wetlands is assumed to be constant over the life of the project. Approximately 95 percent of the nitrate load will be eliminated relative to existing conditions. Thus, Year 2050 water quality conditions under this alternative are expected to be significantly improved relative to present and No Action Alternative conditions. Relative to Alternative

Q, this alternative provides essentially the same improvement in water quality conditions.

6.1.6.6 Alternative O Phase 1

The diversion of some canal water into the freshwater and saltwater wetland areas will result in a reduction of nutrient loading to the bay but an increase in loading to the rehydrated wetlands. The effect of increased nutrient loading to rehydrated wetlands is not expected to result in significant adverse impact to the vegetation in these wetlands primarily because the phosphorus concentrations in the diverted canal water is relatively low (<10 ppb TP). Given the limited use of lands west of the L-31E Levee, most of the changes to basin water quality that result from the conversion of agricultural lands to urban uses are expected to occur even with Alternative O Phase 1. To evaluate the reduction in nitrate loading, the project team estimated the volume of water diverted from the canal system by Alternative O Phase 1 and used a wetland nitrate uptake equation (Kadlec and Knight, 1996) to estimate the reduction in loads delivered to Biscayne Bay. The rate of denitrification within the wetlands is assumed to be constant over the life of the project. Approximately 84 percent of the nitrate load will be eliminated by this alternative which is better than the results expected for the No Action Alternative, but less than the results expected for the full Alternative O or Alternative Q.

6.1.7 Vegetative Communities

The primary factors influencing the distribution of vegetation in this region are hydropattern, salinity, previous disturbance, and to a lesser extent, nutrient loading and soil type.

The dominant vegetation community in the region is a matrix of sawgrass prairie with tree islands. The tree islands vary in vegetation composition, depending upon elevation. At the highest elevations, the sawgrass prairie alternates with forested wetlands. At the lowest elevations near the coast, mangroves replace the freshwater wetlands. The transition zone between the mangroves and the freshwater prairie is a needle rush-salt grass zone on the freshwater side, but stunted scrub mangrove on the coastal side.

The plant community types present in the South Miami-Dade Wetlands Management Area 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.

Non-native invasive vegetation species present in the project area 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 South Miami-Dade Wetlands Management 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. In other regions of the county, such outlier populations have rapidly expanded to create additional problems when left untreated.

All of the alternatives include elements of exotic plant removal. That action, along with successful redistribution of fresh water into wetland communities, would retard the growth and spread of invasive, non-native plant species. Implementation of any of the alternatives would allow for the successful return of native vegetation to areas hydrated. Data from Epibenthic Vegetation Baseline Surveys, Terrestrial Vegetation Mapping, and geographic information system (GIS) were used in evaluating impacts amongst the alternatives.

6.1.7.1 No Action Alternative

It is likely that native forested/shrub wetlands and graminoid marshes east of Card Sound Road not in public ownership will no longer exist as a natural area due to urban development. This is almost certainly true of areas north of Turkey Point. Future development would also have numerous secondary effects. There is a possibility that the wetlands in the northern part of the sawgrass marshes in the Model Lands could transition from a sawgrass-dominated marsh to cattail-saltbush-dominated wetlands due to poor water quality from residential runoff and decline of available fresh water.

Changes in availability and distribution of fresh water and further disruption of natural sheet flow from discontinuities in hydrology (i.e., due to levees, roads, canals) will further exacerbate the changes occurring in the natural freshwater graminoid marshes, forested/shrub wetlands, marl prairie, tree island and mangrove ecotones.

Additionally, sea level rise will create the potential for further expansion of salt-tolerant plant species, especially mangroves, into the freshwater marsh areas.

Disruption of natural fire cycles, and related consequences, would increase in the future without-project scenario. Control of fire intensity and extent due to potential for impacts on human infrastructure can encourage establishment of woody plant species that would normally be eliminated, as well as selection against more fire-tolerant species such as sawgrass and muhly grass. Reduction of water availability can cause fires to burn more intensely, killing plant species that would normally survive a more natural “cool burning” fire, and permit organic soils to burn. Concurrently, unnatural flooding can inhibit fires and beneficial vegetation changes. Increased urbanization would exacerbate all of these processes.

Tree islands, an important component of the Everglades habitat for a variety of native plant species not adapted to growing directly in flooded marshes, are being impacted by changes in water management and invasion of exotic plant species. The No Action Alternative appears to offer little benefit to offset ongoing detrimental effects.

Urbanization and associated habitat changes and anthropogenic effects (i.e., pets, exotic species releases, wildlife mortality) would negatively affect the number and occurrence of native vegetative and wildlife species. As the population increases, activities such as all terrain vehicle (ATV) usage are expected to increase along with additional associated detrimental effects to the environment.

An increase is anticipated in the No Action Alternative project scenario in the spatial coverage of invasive non-native plant species, such as Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina* spp.), and melaleuca (*Melaleuca quinquenervia*) due to land disturbance and projected lower water levels. With the lack of project monitoring and maintenance, there would be an increase in other exotic plants including shoebutton ardisia (*Ardisia elliptica*) and old world climbing fern (*Lygodium* spp.). The spread of all these invasive non-native plant species has resulted in the conversion of large acreages with a variety of native vegetative species to less diverse, and in some cases mono-specific vegetative cover with reduced value as wildlife habitat.

6.1.7.2 Yellow Book Alternative

The Yellow Book Alternative would be effective in rehydrating the sawgrass prairies that constitute the freshwater wetlands west of L-31E Canal and the coastal wetlands to the west. Diverting water into the targeted areas should result in a reduction of woody vegetation and resurgence of herbaceous vegetation in both freshwater wetland and saltwater wetland areas targeted for rehydration. The portion of targeted saltwater wetlands directly adjacent to the L-31E Levee should see some transitioning from salt tolerant plants to freshwater vegetation species.

6.1.7.3 Alternative M

Section 5, Figure 5-6 shows the project footprint and expected areas where wetland vegetation is expected to be impacted by the project. This alternative is designed to focus on rehydrating saltwater wetlands that lie east of the L-31E Levee. However, a small area of less than 10 acres of freshwater wetlands located at Deering Estate is also targeted for rehydration. Alternative M does not propose hydration south of the Florida City Canal; therefore, vegetative communities in the Model Lands and areas west of the L-31E Canal would be exposed to an increase in exotic plant domination and the probability of urban development similar to that of a No-Action Alternative for those areas. The portion of targeted saltwater wetlands directly adjacent to the L-31E Levee and just east of the Cutler Wetlands Spreader Canal should see some transitioning from salt tolerant plants to freshwater vegetation species. This effect would be most pronounced in the Cutler Wetlands area since uses pumped flow while the L-31E saltwater wetlands will be fed solely by gravity flow through culverts.

6.1.7.4 Alternative Q

Alternative Q would be effective in rehydrating the sawgrass prairies that constitute the freshwater wetlands west of L-31E Canal and the coastal wetlands to the west. ***Section 5, Figure 5-8*** shows the areas where wetland rehydration is targeted. The targeted freshwater rehydration area lies generally north of the Florida City Canal between Homestead Joint Air Reserve Base and the L-31E Levee. A small freshwater wetland at Long Slough, near Florida City may contribute to rehydration of some of the Model Lands south of the Florida City Canal. A small area of less than 10 acres of freshwater wetlands located at Deering Estate is also targeted for rehydration. The saltwater wetland rehydration areas are east of the L-31E Levee in the area north of Florida City Canal. Diverting water into the targeted areas should result in a reduction of woody vegetation and resurgence of herbaceous vegetation in both freshwater wetland and saltwater wetland areas targeted for rehydration. The portion of targeted saltwater wetlands directly adjacent to the L-31E Levee and just east of the Cutler Wetlands Spreader Canal should see some transitioning from salt tolerant plants to freshwater vegetation species.

6.1.7.5 Alternative O

Since Alternative O contains elements of Alternatives M and Q, it has the capability of distributing water to both freshwater and saltwater wetlands, along with some hydration to the sawgrass prairies in the Model Lands. ***Section 5, Figure 5-7*** shows the targeted wetland rehydration lands for this alternative. In this alternative, the targeted freshwater wetlands are located just west of the L-31E Levee and south of the Florida City Canal at three locations downstream of the planned PU-M1, PU-M2, and PU-M3 pump stations shown in ***Section 5, Figure 5-7***. A small area of less than 10 acres of freshwater wetlands located at Deering Estate is also targeted for rehydration. The targeted saltwater wetland areas for this project are identical to that of Alternative Q. Diverting water into the targeted areas should result in a reduction of woody vegetation and resurgence of herbaceous vegetation in both freshwater wetland and saltwater wetland areas targeted for rehydration. The portion of targeted saltwater wetlands directly adjacent to the L-31E Levee and just east of the Cutler

Wetlands Spreader Canal should see some transitioning from salt tolerant plants to freshwater vegetation species.

6.1.7.6 Alternative O Phase 1

Alternative O Phase 1 provides limited hydration to the freshwater wetlands, specifically between the C-103 Canal and the North Canal. Most of the restoration focus, however, is in the coastal wetland communities. ***Section 5, Figure 5-9*** shows the wetlands targeted for rehydration in this alternative. The targeted freshwater wetlands are limited to a 400 or so acre parcel located along the North Canal and a small area of less than 10 acres at Deering Estate. Saltwater wetlands east of the L-31E Levee in the vicinity of C-102/C-103 and in the Cutler Wetlands will be rehydrated by diversions of freshwater from the canals. Saltwater wetlands directly adjacent to the diversion outfalls will likely see a greater density and extent of freshwater wetland vegetation. Saltwater wetland areas farther from the diversion outfalls will be less affected by freshwater discharges. The vegetation in the targeted freshwater wetlands adjacent to North Canal will transition from woody vegetation to herbaceous vegetation as a result of extending the hydroperiod.

6.1.8 Fish and Wildlife Resources

The region supports a variety of wetland-dependent wildlife, including several Federally and state-listed endangered and threatened wildlife species.

The USFWS has been an active member of the project team for the Biscayne Bay Coastal Wetlands project and has provided guidance through informal consultation during plan formulation and evaluation on the potential effects the proposed project may have on Federally listed threatened and endangered species that may be present in the project study area. USACE has coordinated with the National Marine Fisheries Service, Protected Resource Division, on proposed impacts to species under their purview.

The project is located in areas designated as essential fish habitat for corals, coral reef and live bottom habitat, red drum (*Sciaenops ocellatus*), shrimp, spiny lobster (*Panulirus argus*), other coastal migratory pelagic species and the snapper-grouper complex. Species generally present in the Florida region include brown shrimp, pink shrimp, white shrimp, spiny lobster, stone crab, gulf stone crab, red drum, Spanish mackerel, and gray snapper (juvenile and adult). Specifically, essential fish habitat in Biscayne Bay is comprised of seagrasses, estuarine mangroves, intertidal flats, estuarine water column, live/hard bottoms, and coral reefs.

Continued point source discharges of canal water into Biscayne Bay would limit the ability of affected organisms in essential fish habitat to sustain productivity levels generally consistent with natural marine communities. The absence of freshwater overland flow into the coastal areas of Biscayne Bay would promote hyper-saline conditions in the nearshore and estuarine biological communities, thus reducing the survivorship of juvenile shrimps and fishes, resulting in a reduction of the functional capacity and overall spatial extent of those systems. Data collected from agency wildlife investigations, outputs from the TABS model; and results of Uniform Mitigation Assessment Method (UMAM) field surveys were used in evaluating impacts amongst the alternatives.

6.1.8.1 No Action Alternative

Development and land conversion would result in an overall loss of fish and wildlife resources within the project area in the future. Aquatic vegetation community changes and subsequent disruption of aquatic productivity and function will continue to worsen under the No Action Alternative. Other issues include: 1) depression of productivity of native fish species, many are important as prey species for wading birds, due to water management practices, 2) the introduction and spread of a wide range of exotic fish species, and 3) the popular sport fishery for non-native species such as the butterfly peacock (*Cichla ocellaris*), and native largemouth bass (*Micropterus salmoides*). Sport fish populations should remain largely unaffected.

Without the environmental benefits of the Biscayne Bay Coastal Wetlands project, urbanization, water demands, direct loss of habitat, and other demands for land, as well as degradation of existing habitat function would likely result in a continued decline in populations of threatened, endangered and state-listed species.

A future without-project (FWO) scenario is likely to result in an overall decrease in the abundance and diversity of species within essential fish habitats.

An increase is anticipated in the 2050 FWO scenario in the spatial coverage of invasive non-native plant species, such as Brazilian pepper (*Schinus terebinthifolius*), Australian pine (*Casuarina spp.*), and melaleuca (*Melaleuca quinquenervia*) due to land disturbance and projected lower water levels. There would be an increase in other exotic plants including shoebutton ardisia (*Ardisia elliptica*) and Old World climbing fern (*Lygodium microphyllum*).

6.1.8.2 Yellow Book Alternative

Presently, there are an estimated total of 45 fish species, 14 amphibian species, 46 reptilian species, 14 mammalian species, and 178 avian species documented to occur throughout the project area. Alternatives with the capability of freshwater distribution to both freshwater and coastal wetlands have the highest potential of increasing the functional values of habitats utilized by these fish and wildlife resources in the area. However, implementation of any of the alternatives has the capacity to enhance the viability of wading birds, raptors, larger predatory fishes, reptiles, and mammals that presently inhabit the project area.

Species and critical habitat identified as potentially affected by the proposed project include 17 Federally listed threatened or endangered species, including designated critical habitat for the American crocodile, Everglade snail kite, West Indian manatee, elkhorn coral, and staghorn coral. Project impacts to threatened and endangered species are considered significant (largely beneficial), and similar for all alternatives. Implementation of any of the alternatives would increase the habitat functional capacity necessary to sustain the threatened, endangered species within and adjacent to the project area.

The proposed redistribution of freshwater flow across a broad front is expected to rehydrate and restore freshwater wetlands, saltwater wetlands, and nearshore bay habitat. The project is expected to create conditions that would be conducive to the re-establishment of oysters and other components of the oyster reef community, nursery habitat along the shoreline, and reduced freshwater discharges into the bay. With improvements in water deliveries and quality, the appropriate conditions for sensitive estuarine biota, such as species dependent on this habitat for egg, larval, and juvenile stages, are anticipated to benefit or rebound.

The Yellow Book Alternative includes elements of exotic plant removal. That action, along with successful redistribution of fresh water into wetland communities would retard the growth and spread of invasive, non-native plant species. Implementation of any of the alternatives would allow for the successful return of native vegetation to hydrated areas.

6.1.8.3 Alternative M

Alternative M is a minimal approach that reduces both the number of project features and has the smallest footprint practicable. It relies on trenches and small detention areas to capture and store water and focuses the restoration effort on saltwater wetlands and nearshore areas of the Bay. As a result, fish and wildlife resources inhabiting estuarine and nearshore habitats would benefit from increased hydration and subsequent reduction of hypersaline conditions. Although this alternative includes elements of exotic plant removal, Alternative M offers the least amount of freshwater wetland benefits.

6.1.8.4 Alternative Q

Same as the Yellow Book Alternative above. See ***Section 6.1.8.2***.

6.1.8.5 Alternative O

Same as the Yellow Book Alternative above. See ***Section 6.1.8.2***.

6.1.8.6 Alternative O Phase 1

Same as the Yellow Book Alternative above. See ***Section 6.1.8.2***.

6.1.9 Air Quality

6.1.9.1 No Action Alternative

Air quality through the Year 2050 is not expected to change significantly from existing conditions. Atmospheric contribution of mercury to the area would continue to decrease as existing controls on major mercury sources are fully implemented. Future, more restrictive, regulations on mercury emissions from coal-fired power plants would likely continue the trend for reduced atmospheric contributions of mercury to the Biscayne Bay Coastal Wetlands project area.

6.1.9.2 Yellow Book Alternative

Construction activities associated with implementing the Yellow Book Alternative would temporarily increase dust within the proposed project area. However, best management practices will be implemented to control dust during construction.

6.1.9.3 Alternative M

Construction activities associated with implementing Alternative M would temporarily increase dust within the proposed project area. However, best management practices will be implemented to control dust during construction.

6.1.9.4 Alternative Q

Construction activities associated with implementing Alternative Q would temporarily increase dust within the proposed project area. However, best management practices will be implemented to control dust during construction.

6.1.9.5 Alternative O

Construction activities associated with implementing Alternative O would temporarily increase dust within the proposed project area. However, best management practices will be implemented to control dust during construction.

6.1.9.6 Alternative O Phase 1

Construction activities associated with implementing Alternative O Phase 1 would temporarily increase dust within the proposed project area. However, best management practices will be implemented to control dust during construction.

6.1.10 Hazardous, Toxic and Radioactive Waste

The intent of this section is to identify the extent of potential human health and ecological risk associated with each of the six final alternatives (No Action, Yellow Book, Alt M, Alt Q, Alt O and Alt O Phase I). This section provides the results of a qualitative evaluation and ranking of the potential human health and ecological risks associated with each alternative.

A significant number of Phase I and Phase II Environmental Site Assessments (ESAs) have been completed in the planning area. The results of these ESAs were used with other relevant information to qualitatively evaluate potential human health and ecological risk for each alternative. For areas within alternatives where ESAs have not yet been completed, human health and ecological risk assumptions were made based on comparable land use types. In addition, elements of planning level design for each alternative were analyzed to determine whether or not certain design aspects play a role in potential human health and ecological risk. Examples of alternative design elements that were considered as part of the qualitative evaluation for each alternative included the use of lined channels to prevent seepage and conveyance losses, replacement of loamy soils with organic soils for wetland creation, removal or replacement of loamy soils (poor geophysical properties) for construction suitability and scraping of soils to prevent the recruitment of exotic vegetation in areas that are coincident to those that may pose a potential human health and ecological concern.

6.1.10.1 No Action Alternative

The “No Action” Alternative proposes no land use changes for improved hydrology and wetland function over the current condition. The measured levels of Contaminants of Potential Concern (COPC) pose a limited threat to human health or fish and wildlife resources under the present land use. Over a long period of time, chlorinated pesticide concentrations in the soils are likely to decline due to microbial processes; however, heavy metals concentrations are likely to remain persistent in soil, as these metals are not broken down biologically. Though the project lands currently do not require corrective action, in the absence of the project it is possible that some of the land would be converted to residential use. This land use conversion would require remedial action to ensure the protection of human health.

6.1.10.2 Yellow Book Alternative

The Yellow Book Alternative (YB) covers an extremely large area in south Miami-Dade County. Project features include canal and ditch backfilling, pumps, connector canals and stormwater treatment areas (STAs). Based on review of existing ESAs, current and historical land uses (commercial, industrial and agricultural uses), feature type planning level design and aerial extent of the Yellow Book project footprint, it is anticipated that this alternative would require an extensive amount of corrective action.

Based on these findings, the Yellow Book Alternative is considered to represent a high risk for potential human health and ecological concerns.

6.1.10.3 Alternative M

Alternative M is comprised of three primary project components that include elements associated with the Deering Estate, the Cutler Wetlands and L-31E Canal. Alternative M has been considered as having the smallest number of project features as compared to the other alternatives. This alternative uses both a pumped and gravity fed system to rehydrate near shore wetlands at Deering Estate, the Cutler Wetlands and L-31E coastal wetlands adjacent to Biscayne National Park.

Based on review of existing ESAs, extent of current and historical land uses (minimal agriculture use, no commercial or industrial use) and planning level design it has been determined that Alternative M represents a low risk for potential ecological concerns.

6.1.10.4 Alternative Q

The proposed footprint for Alternative Q includes elements of the Deering Estate, Cutler Flow Way and L-31E components of Alternative M and also includes lands that expand westward towards Homestead Air Force Base (HAFB) and populated areas of Florida City. Based on a review and analysis of the planning level design, existing ESAs, land uses (commercial, industrial and agricultural uses) and aerial extent of the Alternative Q project boundary, it is anticipated that this alternative would require an extensive amount of corrective action. Some examples include a chloride concentrated rock quarry, HAFB stormwater runoff and intense seasonal (vegetable) agricultural operations.

Based on these findings, Alternative Q is considered to represent a high risk for potential human health and ecological concerns.

6.1.10.5 Alternative O

Alternative O includes some elements of the Deering Estate, Cutler Flow Way and L-31E components of Alternative M, most of the lands west of L-31E included in Alternative Q and additional lands south of the Florida City Canal. Similar to Alternative Q but to a lesser extent, the lands west of L-31 E are likely to have potential human health and ecological concerns due to historical and present agricultural, military and industrial uses within the alternative boundary predominately driven by existing seasonal (vegetable) agricultural operations.

Based on a comparison of historical and current land use and planning level design between Alternative Q and Alternative O it has been determined that Alternative O has only a lower ecological risk than Alternative Q and therefore has been identified as a moderate risk for potential for human health and ecological concerns as conceptually designed.

6.1.10.6 Alternative O Phase 1

Alternative O Phase 1 was specifically formulated to avoid lands with known or suspected potential human health and ecological concerns (consistent with ER 1165-2-132). Alternative O Phase 1 includes most of the Deering Estate, Cutler Flow Way and L-31E components associated with Alternative M. However, Alternative O Phase 1 does not include lands directly west of L-31E and north of the Florida City Canal that are included in Alternative O, Alternative Q and YB Alternative that pose a higher risk for potential human health and ecological risk.

Based on a comparison of historical and current land use, completed ecological site assessments, and locations and feature types identified in planning level design it has been determined that Alternative O Phase 1 has a much lower human health and ecological risk than Alternatives O, Q and YB, and a slightly higher human health and ecological risk than Alternative M. Based on this analysis Alternative O Phase 1 has been identified as having a low risk potential for human health and ecological concerns.

6.1.10.7 Comparison of Ecological Risk for the BBCW Project Alternatives

While not all the lands within each of the alternatives have completed ESAs on all land tracts, it is possible to qualitatively evaluate human health and ecological risk for each of the alternatives based on existing ESAs, information known on historical and current land use types (commercial, industrial, agricultural land uses) and planning level design. As such and for the purposes of this comparison, relative ecological risk for each alternative has been assigned a rating of High, Moderate or Low based upon the aforementioned information (See ***Table 6-1*** below).

The "Low", "Moderate" and "High" rankings for each project alternative are primarily driven by the project footprint, known human health and ecological risk, historical and current land use, and planning level design. Footprints that cover larger areas with historical commercial, industrial, and seasonal agricultural operations have a higher likelihood of encountering human health and ecological concerns with hydrologic and wetland improvements. The planning level design of each individual alternative also contributes to the projects' potential ecological risk. Integral design elements within the different alternatives can either increase or decrease a particular alternatives potential ecological risk. These integral design elements including component location have been considered in the qualitative assessment that has yielded the relative rankings identified in ***Table 6-1.***

Alternatives ranked "Low" are considered to have a relatively low human health and ecological risk based upon historical land use, current land use, completion of ESAs and project design. For these alternatives no outstanding corrective actions have been identified on the project lands and only limited corrective actions are anticipated based upon a desktop review of the few remaining parcels that require additional site assessment.

Alternatives ranked "Moderate" are considered to have a moderate human health and ecological risk based upon historical land use, current land use, completion of ESAs and project design. For these alternatives no outstanding corrective actions have been identified on the project lands; however, a desktop review of past land use practices indicates that some corrective action is likely to be required.

Alternatives ranked "High" are considered to have a relatively high human health and ecological risk based upon historical land use, current land use, completion of ESAs and project design. For these alternatives, multiple locations where substantial corrective actions are likely to be required have been identified based upon a desktop review of prior land use practices.

TABLE 6-1: POTENTIAL HUMAN HEALTH AND ECOLOGICAL RISK

Alternative	Relative Ecological Risk
No Action Alternative	None
Alternative M	Low
Alternative O – Phase I	Low
Alternative O	Moderate
Alternative Q	High
Yellow Book	High

6.1.11 Cultural Resources

A cultural resource assessment survey of the Deering Estate and Cutler Flow-way projects, and a literature review for the L-31E culverts project were completed and utilized in evaluating impacts amongst the alternatives. The Corps determined that the project does not have the potential to affect historic properties. The State Historic Preservation Officer, the Miccosukee Tribe of Florida, and the Seminole Tribe of Florida concurred with this determination.

6.1.11.1 No Action Alternative

The No Action Alternative offers little or no cultural resources protection without further investigation. However, the implementation of the project would include a conservation plan, thus providing some level of protection to cultural resources.

6.1.11.2 Yellow Book Alternative

With the addition of the Model Lands south of North Canal to the Yellow Book Alternative, the area of potential effect to cultural resources for Alternative Q, Alternative M, Alternative O, and Alternative Q are essentially the same. The area of potential effect stretches along approximately eight miles of the Biscayne Bay coastline. Several archaeological and historical sites are found within the area of potential effect, mostly within the Deering Estate component of the project.

In cooperation with USACE, the State Historic Preservation Officer has determined that the installation of four culverts along the L-31E Canal would have no effect on historic properties. The State's Expedited Construction project would have no effect on historical sites 8DA2815 (Deering Estate historic district), 8DA2815D (historic wall), 8DA6518 (historic road), or 8DA11247 (historic road). The proposed repairs to the Deering Estate Bridge (8DA2815C) and channel maintenance will prevent the rise in water levels from having an adverse effect on the bridge.

6.1.11.3 Alternative M

Same as the Yellow Book Alternative above. See ***Section 6.1.11.2***.

6.1.11.4 Alternative Q

Same as the Yellow Book Alternative above. See ***Section 6.1.11.2***.

6.1.11.5 Alternative O

Same as the Yellow Book Alternative above. See ***Section 6.1.11.2***.

6.1.11.6 Alternative O Phase 1

Same as the Yellow Book Alternative above. See ***Section 6.1.11.2***.

6.1.12 Socio-Economic Conditions: Population

Population in Miami-Dade is expected to increase by almost 1.5 million people from 2000 to 2050. Due to this anticipated population growth, the county is expected to remain the most populated county in Florida. The dense urban area of the LEC of Florida has contributed to development pressure and population increases in Miami-Dade County. Miami-Dade County is expected to grow faster than the national trends until at least Year 2050. Conversion of agricultural and other unimproved lands in southern Miami-Dade County, including large areas within the Biscayne Bay Coastal Wetlands study area, will continue to be fueled in significant part by this population growth. Miami-Dade County Urban Boundary Development projections were used in evaluating impacts amongst the alternatives.

6.1.12.1 No Action Alternative

With an anticipated increase in urbanization, changes in the project area are expected to reflect population growth.

6.1.12.2 Yellow Book Alternative

The implementation of the Biscayne Bay Coastal Wetlands project will not significantly affect the population of the study area within the Yellow Book Alternative. The project will not create new water for consumption and the developable lands that are being utilized are geographically and spatially limited. Any impacts to the population as a result of the project would be statistically insignificant.

6.1.12.3 Alternative M

The implementation of the Biscayne Bay Coastal Wetlands project will not significantly affect the population of the study area within this alternative. The project will not create new water for consumption and the developable lands that are being utilized are geographically and spatially limited. Any impacts to the population as a result of the project would be statistically insignificant.

6.1.12.4 Alternative Q

The implementation of the Biscayne Bay Coastal Wetlands project will not significantly affect the population of the study area within this alternative. The project will not create new water for consumption and the developable lands that are being utilized are geographically and spatially limited. Any impacts to the population as a result of the project would be statistically insignificant.

6.1.12.5 Alternative O

The implementation of the Biscayne Bay Coastal Wetlands project will not significantly affect the population of the study area within this alternative. The project will not create new water for consumption and the developable lands that are being utilized are geographically and spatially limited. Any impacts to the population as a result of the project would be statistically insignificant.

6.1.12.6 Alternative O Phase 1

The implementation of the Biscayne Bay Coastal Wetlands project will not significantly affect the population of the study area within this alternative. The project will not create new water for consumption and the developable lands that are being utilized are geographically and spatially limited. Any impacts to the population as a result of the project would be statistically insignificant.

6.1.13 Socio-Economic Conditions: Water Supply Demands

In the LEC region, groundwater is the predominant source of water for municipal and industrial uses. With the projected increase in population and infrastructure, demands for water will increase. Water shortages and restrictions are expected to become more prominent, leading to both economic and environmental damages.

As groundwater levels continue to decrease, salinity levels will increase in wells in the study area. With more persons drawing water and less water available for recharge, migration of the underlying salt wedge leading to increased saltwater intrusion, and shortages to wells and well fields would become more prevalent.

6.1.13.1 No Action Alternative

With an anticipated increase in urbanization, changes in the project area are expected to reflect population growth under No Action Alternative. Water demands are expected to increase within the study area; however, the increased demand is expected to be largely met through reuse and conservation measures.

6.1.13.2 Yellow Book Alternative

The Yellow Book Alternative would utilize water that is being diverted from canals and currently discharged to tide. No impacts to upstream water users would be recorded; and, this alternative will not demand new water or store additional water. Water demands will increase as a result of future non-project related land use changes within the project study area.

6.1.13.3 Alternative M

Alternative M would utilize water that is being diverted from canals and currently discharged to tide. No impacts to upstream water users would be recorded; and, this alternative will not demand new water or store additional water. Water demands will increase as a result of future non-project related land use changes within the project study area.

6.1.13.4 Alternative Q

Alternative Q would utilize water that is being diverted from canals and currently discharged to tide. Of the with-project alternatives, Alternative Q has the greatest potential to positively affect M&I water supplies because the targeted freshwater wetlands in this area are closest to the existing municipal well fields. Rehydration of these wetlands would theoretically positively benefit nearby well fields; however, the benefits to municipal well fields from this alternative are expected to be minimal. Water demands will increase as a result of future non-project related land use changes associated with agricultural or urban development.

6.1.13.5 Alternative O

Alternative O would utilize water that is being diverted from canals and currently discharged to tide. No impacts to upstream water users would be recorded; and, this alternative will not demand new water or store additional water. Water demands will increase as a result of future non-project related land use changes within the project study area.

6.1.13.6 Alternative O Phase 1

Alternative O Phase 1 would utilize water that is being diverted from canals and currently discharged to tide. No impacts to upstream water users would be recorded; and, this alternative will not demand new water or store additional water. Water demands will increase as a result of future non-project related land use changes within the project study area.

6.1.14 Land Use

A review of local governments' comprehensive plans and future land use maps indicates that the portion of the study area lying within the Urban Development Boundary (UDB) is designated as "estate" and "low density residential" land uses, which ranges in density from two and a half to six dwellings per acre.

Much of the future development within the study area would occur on lands that are currently in agricultural use. Additionally, a majority of land currently designated for agricultural use and lying outside of the UDB, but within the Urban Expansion Area (UEA), is projected to be developed with similar uses once the UDB is expanded. Based on increasing residential demand in this area, it is highly probable that this section of the UDB would be expanded within the next ten years.

In areas east and south of the UDB, but landward of the coastal areas, at least some continued conversion of undeveloped lands is possible—those designated in the county land use map as "open lands" to rock mines and some undeveloped lands designated as agriculture to construction or demolition debris landfills. In addition, pressure to remove conservation easements on wetland mitigation areas within the UDB to allow development is already occurring. In cases where existing or future wetland mitigation areas are developed, additional mitigation areas would be needed to offset the loss of wetland functional values. However, based on development pressures, land costs, and the proximity of the FPL mitigation bank, it is likely that the additional mitigation would be in the form of wetland enhancement, resulting in a further net loss of the spatial extent of wetlands and other open lands within the study area.

Portions of the coastal areas adjacent to BNP that are currently designated in the county land use map as Environmental Protection and Environmentally Protected Parks within the Biscayne Bay Coastal Wetlands study area are anticipated to remain in this use. However, the remaining undeveloped coastal areas landward of the environmental protection designation within the UDB are expected to be developed within the next ten to 15 years. With a few exceptions such as the expansion of Turkey Point Power Plant, the remaining coastal wetland areas adjacent to BNP and outside the UDB are likely to remain largely unfilled and undeveloped.

6.1.14.1 No Action Alternative

Much of the future development within the study area would occur on lands that are currently in agricultural use. At least some continued conversion of undeveloped lands designated in the county land use map as open lands to rock mines, and some undeveloped lands designated as agriculture to construction/demolition debris landfills, is possible. The undeveloped coastal areas landward of the environmental protection designation within the UDB are expected to be developed within the next ten to 15 years. With a few exceptions such as the expansion of Turkey Point Power Plant, the remaining coastal wetland areas adjacent to BNP and outside the UDB are likely to remain largely unfilled and undeveloped.

Over the next 50 years, sea level rise may ultimately impact the viability of some of the agricultural operations within the study area as flood events become more frequent. As a result, the agricultural lands directly west of the L-31E levee in the C-102 and C-103 basin may be abandoned and revert to wetlands. The abandonment of some farms due to unmanageable flooding conditions that result from sea level rise will occur regardless of whether this project is implemented.

6.1.14.2 Yellow Book Alternative

The implementation of the Biscayne Bay Coastal Wetlands project would not significantly alter the current land use of the study area; instead, the project would restore the functionality and preserve some of the limited remaining wetlands in southern Miami-Dade County. A majority of the land that is being utilized for the project is either nearshore or saltwater wetlands, and would not be developable in the absence of a project. As mentioned in the FWO project condition, in the absence of a project, there is a high likelihood that agricultural and urban developers would pressure local governments to develop the existing freshwater wetlands and open lands. All of the alternatives with the exception of Alternative M include substantial freshwater wetland acreage located west of the L-31E levee.

6.1.14.3 Alternative M

Same as the Yellow Book Alternative above except this alternative does not include substantial freshwater wetland acreage west of the L-31E Levee. See ***Section 6.1.14.2***.

6.1.14.4 Alternative Q

Same as the Yellow Book Alternative above. See ***Section 6.1.14.2***.

6.1.14.5 Alternative O

Same as the Yellow Book Alternative above. See ***Section 6.1.14.2***.

6.1.14.6 Alternative O Phase 1

Same as the Yellow Book Alternative above except that this alternative includes approximately 400 acres of freshwater wetlands located west of the L-31E Levee. See ***Section 6.1.14.2***.

6.1.15 Noise

Within the major natural areas of south Florida, external sources of noise are limited and of low occurrence. As additional areas are developed within designated growth boundaries around cities, noise from general traffic, construction, and other vehicles would be expected to increase modestly between the present and Year 2050.

6.1.15.1 No Action Alternative

Within the major natural areas of south Florida, external sources of noise are limited and of low occurrence. As additional areas are developed within designated growth boundaries around cities, noise from general traffic, construction, and other vehicles would be expected to increase modestly between the present and Year 2050.

6.1.15.2 Yellow Book Alternative

Noise impacts associated with the Yellow Book Alternative would not permanently increase over what presently exists within the project area. Temporary increases in noise levels would be expected during construction of any of the alternatives; however, this would be limited to the immediate area of construction.

6.1.15.3 Alternative M

Noise impacts associated with Alternative M would not permanently increase over what presently exists within the project area. Temporary increases in noise levels would be expected during construction of any of the alternatives; however, this would be limited to the immediate area of construction.

6.1.15.4 Alternative Q

Noise impacts associated with Alternative Q would not permanently increase over what presently exists within the project area. Temporary increases in noise levels would be expected during construction of any of the alternatives; however, this would be limited to the immediate area of construction.

6.1.15.5 Alternative O

Noise impacts associated with Alternative O would not permanently increase over what presently exists within the project area. Temporary increases in noise levels would be expected during construction of any of the alternatives; however, this would be limited to the immediate area of construction.

6.1.15.6 Alternative O Phase 1

Noise impacts associated with Alternative O Phase1 would not permanently increase over what presently exists within the project area. Temporary increases in noise levels would be expected during construction of any of the alternatives; however, this would be limited to the immediate area of construction.

6.1.16 Recreational Resources

Ecosystems support a significant amount of outdoor recreation in the LEC of Florida. The State of Florida is expected to experience significant increases in demands for selected recreation activities with a commensurate need to increase development of the region's recreational resources and facilities. A significant portion of outdoor recreation related expenditures comes from tourists.

6.1.16.1 No Action Alternative

As part of the FWO project conditions, the State of Florida will experience significant increases in demands for the selected recreation activities with a commensurate need to increase development of the region's recreational resources and facilities. The SCORP for Region 11 projects a lack of recreational resources and facilities to meet future demands for hiking, freshwater fishing, tent camping, hunting, fresh and saltwater beach activities, and bicycle riding activities.

6.1.16.2 Yellow Book Alternative

The Yellow Book Alternative is not likely to adversely affect existing recreation resources within the Biscayne Bay Coastal Wetlands study area. This alternative proposes reduced infrastructure construction that may result in reduced recreation proposals. It would connect with the C-111 Spreader Canal project for potential regional trail linkages (hiking, biking) and associated recreation (environmental interpretation, bird watching, and fishing).

6.1.16.3 Alternative M

Alternative M, the minimum alternative, is not likely to adversely affect existing recreation resources within the Biscayne Bay Coastal Wetlands study area. Alternative M provides the fewest opportunities for recreation development. Public access along existing canal right-of-ways would be maintained for potential hiking, biking, fishing, environmental interpretation, and bird watching.

6.1.16.4 Alternative Q

Alternative Q is not likely to adversely affect existing recreation resources within the Biscayne Bay Coastal Wetlands study area. Alternative Q proposes reduced infrastructure construction that may result in reduced recreation proposals. It would connect with the C-111 Spreader Canal project for potential regional trail linkages (hiking, biking) and associated recreation (environmental interpretation, bird watching, and fishing).

6.1.16.5 Alternative O

Alternative O blends aspects of Alternative M and Alternative Q. Alternative O is not likely to adversely affect existing recreation resources within the Biscayne Bay Coastal Wetlands study area. Alternative O proposes the full array of project features that may provide the most recreation development potential to include: hiking, biking, paddling, tent camping, environmental interpretation, bird watching, and fishing.

6.1.16.6 Alternative O Phase 1

Alternative O Phase 1 is not likely to adversely affect existing recreational resources within the Biscayne Bay Coastal Wetlands study area. Potential restoration-compatible recreation includes: hiking, biking, paddling, tent camping, environmental interpretation, bird watching, and fishing.

6.1.17 Aesthetics

Major aesthetic qualities to be considered include geology, topography, water and vegetation. Factors to be considered for evaluating quality include air and water pollution, pests, poor climate and unsightly adjacent areas.

Current planning guidance specifies that the Federal objective of water and related resources planning is to contribute to NED consistent with protecting the nation's environment. USACE established a number of environmental goals, including:

1) Preservation of unique and important aesthetic values
2) Restoration and maintenance of the natural and man-made environment in terms of variety, beauty, and other measures of quality

However, to meet these goals, a standard of reasonableness must be applied in defining the appropriate level of expenditures for aesthetic quality for Civil Works projects. Current budgetary constraints and the intense competition for Federal funds dictate that a greater level of discipline be applied in meeting USACE responsibilities to harmoniously blend projects with the surrounding environment while avoiding excessive expenditures (ER 1105-2-100, ***Appendix C***).

All aesthetic measures must be designed so that they are fully compatible with the project purpose and in no way compromise the safety, integrity or function of the project. For example, it may be appropriate to screen a floodwall with vegetative plantings but it would be inappropriate to plant trees directly on a levee that might endanger its structural integrity or diminish its hydraulic characteristics (ER 1105-2-100, ***Appendix C***).

6.1.17.1 No Action Alternative

With an anticipated increase in urbanization, changes in the project area are expected to reflect population growth. Aesthetically, there would be more high-rise buildings, roads and infrastructure associated with development; and less open land.

6.1.17.2 Yellow Book Alternative

This alternative would result in significant restoration of freshwater wetland areas located west of the L-31E Levee. Relative to the other with project alternatives, this project offers a large footprint of restored area and thus should offer the significant improvement to aesthetically valued natural resources.

6.1.17.3 Alternative M

This alternative would result in restoration of saltwater wetland areas located east of the L-31E Levee. Restoration of the targeted wetland is expected to result in a healthier environment that will support vigorous plant communities, larger fish and aquatic animal populations, large numbers of wading birds, alligators, and sustainable populations of wide-ranging mammals, in a natural setting, in perpetuity. With the implementation of this alternative, wading bird communities within the saltwater wetland areas are expected to increase.

6.1.17.4 Alternative Q

This alternative would result in significant restoration of freshwater wetland areas located west of the L-31E Levee. Relative to the other with project alternatives, this project offers the largest footprint of restored area and thus should offer the greatest improvement to aesthetically valued natural resources.

6.1.17.5 Alternative O

This alternative would result in significant restoration of freshwater wetland areas located west of the L-31E Levee though not as many acres as Alternative Q. Relative to the other with project alternatives, this project offers the second largest footprint of restored area and thus should offer the second greatest improvement to aesthetically valued natural resources.

6.1.17.6 Alternative O Phase 1

This alternative would result in significant restoration of saltwater wetland areas located east of the L-31E Levee and approximately 400 acres of freshwater wetlands located west of the L-31E Levee. Relative to the other with project alternatives, this alternative restores less total natural area than Alternative O, but more than Alternative M.

6.2 ABILITY OF EACH PLAN TO MEET OBJECTIVES, CONSTRAINTS

The following table summarizes the ability of each plan to meet the project objectives and avoid the project constraints. Each alternative was ranked on a scale of 1 to 6 as to its relative ability to meet the objectives and constraints. The higher the score, the better the plan meets the objectives.

TABLE 6-2: SUMMARY OF EACH PLAN'S ABILITY TO MEET THE PROJECT OBJECTIVES AND AVOID PROJECT CONSTRAINTS

Alternatives	No Action	YB	M	Q	O	O-P1
Objectives						
Reestablish productive nursery habitat along the shoreline.	1	2	4	3	5	5
Redistribute freshwater flow to minimize point source discharges to improve freshwater and estuarine habitat.	1	3	2	5	6	4
Restore and improve quantity, quality, timing, distribution of freshwater to the bay, including Biscayne National Park.	1	2	4	3	5	6
Preserve and restore spatial extent of natural coastal glades habitat.	1	5	2	6	4	3
Reestablish connectivity between Biscayne coastal wetlands, C-111 Basin, Model Lands, and adjacent basins.	1	5	2	6	4	3
Restore nearshore and saltwater wetland salinity regimes.	1	2	4	3	5	5
Constraints						
Comply with all Federal, state and local laws, regulations and policies.	2	3	4	5	6	6
Maintain existing levels of flood protection to agricultural and urban lands (Savings Clause [Section 601 (h)(5)(B) of WRDA 2000]).	6	2	5	1	6	6
Maintain levels of service for existing legal users (Savings Clause [Section 601 (h)(5)(A) of WRDA 2000]).	6	2	2	4	6	6
Minimize impacts to cultural, historical and archaeological resources.	6	2	5	1	4	5
Minimize adverse socioeconomic impacts on the local economy.	6	2	4	1	4	5
Avoiding, minimizing, or providing compensatory mitigation for any impacts to pre-existing compensatory mitigation sites within the project area under Section 404 of the Clean Water Act.	6	2	5	1	6	6
Do not increase salinity intrusion into the freshwater Biscayne aquifer within the study area.	1	4	5	4	6	6
Do not adversely affect the habitats of threatened or endangered species in the study area, such as the American crocodile or the West Indian manatee.	1	3	3	4	6	6
Do not use water that violates State water quality standards for discharge into the wetlands being rehydrated/restored in the project.	2	3	4	4	6	6

6.3 ECOLOGICAL BENEFITS EVALUATION

USACE ecosystem restoration studies typically measure the ecosystem benefits of alternative plans in terms of physical dimensions (number of acres of wetlands, for example), or population counts (number of wading birds, for example), or various habitat-based scores (habitat units [HU] based on the FWS's Habitat Evaluation Procedures [HEP], for example). The BBCW team devised a project-specific tool referred to as the Criterion Based Ecological Evaluation Matrix (CBEEM) to quantify the ecological output of alternatives. CBEEM is a Microsoft (MS) Excel spreadsheet tool that utilizes hydrologic modeling results, management measure size and operation, and available hydrologic data to derive a HU score that represents the ecological lift achieved by each alternative. This method evaluated benefits within each of the three major ecological zones present within the project area (nearshore bay, saltwater wetlands, freshwater wetlands).

Performance measures have been developed to evaluate how well alternatives fulfill project objectives. The following eight CBEEM performance measures address each of the original five project objectives that were identified in the Restudy and BBCW Project Management Plan (PMP) as follows:

1. Restore nearshore salinity regime
2. Restore tidal wetland salinity regime
3. Reduce direct canal discharge
4. Potential freshwater wetland rehydration
5. Reduce nitrogen concentrations
6. Reduce TP loading to Biscayne Bay
7. Reduce non-native vegetation
8. Restore connections between basins and wetlands

Table 6-3 shows the relationship between objectives and performance measures, and indicates the pertinent ecological zones.

TABLE 6-3: RELATIONSHIP BETWEEN OBJECTIVES AND PERFORMANCE MEASURES

Performance Measures	Objectives					
	Reestablish productive nursery habitat along shoreline of Biscayne Bay	Redistribute freshwater flow to minimize point source discharges at canals to improve freshwater and estuarine habitat	Restore and improve quantity, quality, timing and distribution of freshwater to Biscayne Bay	Preserve and restore the spatial extent of natural coastal glades habitat within the study area	Re-establish connectivity between Biscayne Bay Coastal Wetlands, C-111 Basin, Model Land and adjacent basins	Restore nearshore and saltwater wetland salinity regimes
1. Restore nearshore salinity regime	Nearshore					Nearshore Saltwater
2. Restore tidal wetland salinity regime	Saltwater					Saltwater
3. Reduce direct canal discharge	Nearshore Saltwater	Nearshore Saltwater	Nearshore Saltwater	Nearshore Saltwater		Nearshore
4. Potential freshwater wetland rehydration		Saltwater	Freshwater	Freshwater		
5. Reduce nitrogen concentrations			Nearshore			
6. Reduce peak phosphorus loading			Nearshore			
7. Reduce non-native vegetation				Freshwater		
8. Restore connections between basins and wetlands (not presently used in CBEEM)			Freshwater Saltwater	Freshwater Saltwater	Freshwater Saltwater	

The CBEEM evaluation was accomplished in four steps: 1) calculate performance measure output, 2) normalize performance measure output, 3) compute quality index, and 4) compute HUs. The logic and equations used in each of these steps can be seen in more detail and with supporting documentation in Appendix C (Environmental Information). A detailed documentation sheet for each performance measure can also be located in the Appendix C. Independent reviews of the metrics and methodologies used in CBEEM were conducted under the guidance of the Ecosystem Planning Center of Expertise in September 2009 and January of 2010. Many of the reviewers suggestions were incorporated into the benefits assessment tools and the revised product has improved in terms of its scientific credence and overall quality.

Table 6-4 includes a list of the performance measures and the normalized value for each performance measure. This table displays the average percent target achieved of the combined performance measures (the quality indices), the total acreage within each ecological zone, the HUs per alternative, and the average annual lift through the year 2050 for each alternative. Detail regarding the development of the performance measures and sub-measures is included in the full benefits assessment write-up found in ***Appendix C – Environmental Information***. A summary discussion of the benefits accorded each ecozone is below.

TABLE 6-4: CBEEM ANALYSIS: TOTAL HABITAT UNIT CALCULATIONS FOR EACH ECOLOGICAL ZONE

TOTAL HABITAT UNIT SUMMARY (NET FWO CONDITION)							
	Existing Condition	**Future Without**	**Alternative O**	**Alternative M**	**Alternative Q**	**Alternative YB**	**Alternative O, P1**
NEARSHORE HABITAT LIFT *							
Nearshore Indices	0.09	0.19	0.65	0.43	0.60	0.48	0.54
Acres	8,585	8,585	8,585	8,585	8,585	8,585	8,585
Functional Habitat (acres)	**732**	**1,673**	**5,565**	**3,696**	**5,154**	**4,147**	**4,624**
2050 HU Lift		**941**	**3,892**	**2,023**	**3,481**	**2,474**	**2,950**
SALTWATER WETLAND HABITAT LIFT **							
Saltwater Indices	0.04	0.04	0.32	0.32	0.23	0.18	0.33
Acres	22,550	22,550	22,550	22,550	22,550	22,550	22,550
Functional Habitat (acres)	**973**	**1,002**	**7,176**	**7,236**	**5,292**	**4,136**	**7,398**
2050 HU Lift		**29**	**6,174**	**6,234**	**4,290**	**3,134**	**6,396**
FRESHWATER WETLAND HABITAT LIFT ***							
Freshwater Indices	0.41	0.41	0.74	0.43	0.97	0.88	0.44
Available Acreage	9,638	9,638	9,638	9,638	9,638	9,638	9,638
Functional Habitat(acres)	3,997	**3,997**	**7,108**	**4,181**	**9,311**	**8,465**	**4,280**
2050 HU Lift		**-**	**3,111**	**185**	**5,315**	**4,468**	**283**
TOTAL HABITAT LIFT							
NET 2050 Habitat Units (acre-lift)		**970**	**13,177**	**8,441**	**13,085**	**10,077**	**9,629**

Key: FWO future without
HU habitat unit

* Nearshore Habitat Lift is computed by averaging the three sub-indices and multiplying this result by the total available nearshore acreage. The three sub-indices are: 1) Percent of available water diverted from coastal structure, 2) The average of the percent nitrogen and phosphorus load targets achieved, 3) Percent of nearshore acres within 500 meters of the shoreline meeting the target salinity conditions. This habitat lift is measured in units of "acres of lift".

** Saltwater Wetland Habitat Lift is computed by averaging the two sub-indices and multiplying this result by the total saltwater wetland acreage. The two sub-metrics are 1) Percent of available water diverted directly to saltwater wetlands, and 2) Percent of saltwater wetland acreage meeting the target salinity condition. This habitat lifts is measured in units of "acres of lift".

*** Freshwater Wetland Habitat Lift is computed by averaging two sub-indices and multiplying this result by the total freshwater wetland acreage. The two sub-indices are 1) Acres of freshwater wetland with sufficient water, and 2) the acreage of freshwater wetland free of invasives and exotics. This habitat lift is measured in units of "acres of lift".

6.3.1 Freshwater Wetland Benefits

The freshwater wetland areas considered for rehydration by the BBCW project are located west of the L-31E Levee. The targeted freshwater wetlands are presently degraded as a result of lack of hydration and invasion of exotic plants. The estimation of freshwater wetland restoration benefits incorporates two aspects of restoration, the rehydration of wetlands and the removal/control of exotic species from the wetlands. The CBEEM tool described in Appendix C was used to estimate freshwater wetland habitat Lift as measured in units of "acre lift". Freshwater habitat units are computed by averaging two sub-indices and multiplying this result by the total freshwater wetland acreage. The two sub-indices are 1) Acres of freshwater wetland with sufficient water, and 2) the acreage of freshwater wetland free of invasive and exotic vegetation. Estimation of acres with sufficient hydration was done using a simply equation that tracked daily flow diverted to freshwater wetlands and the expected rate of groundwater recession within the wetland. The overall rehydration acreage estimate was computed as the average daily rehydration acreage computed over the entire period of available flow records within each basin. The estimates for acres of land without exotics / invasives were made by assuming that acreage of invasives / exotics within the freshwater wetland component of each alternative would be kept free of these undesirable plants. The estimates of exotics/invasive acreage were derived from GIS coverage of vegetation within the study area.

The results of the freshwater wetland benefits assessment are shown in ***Table 6-5***. Alternatives Q and YB provide the greatest freshwater wetland benefits due to their large footprint in areas west of the L-31E Levee. Alternative O provides approximately 2/3rds of the freshwater benefits achieved by Alternative Q as a result of having a smaller freshwater wetland footprint and also sending a greater proportion of available water directly to the saltwater wetlands. Alternative O, Phase I provides about 10% of the freshwater wetland benefits provided by Alternative O due to its small freshwater wetland footprint. ***Table 6-6*** shows the wet season and dry season net freshwater wetland rehydration lift (acre-lift) computed for sub-metric A.1 in ***Table 6-5***. The net freshwater rehydration lift for each with project alternative can be computed by subtracting out the hydration estimates provided by the future without project in ***Table 6-5***. ***Table 6-6*** shows that the average dry season rehydration lift for most of the alternatives is approximately 50 to 60 percent of that predicted for the average wet season conditions. During extreme dry seasons, the project will provide approximately 50% of the average annual freshwater wetland lift as indicated by the dry season rehydration results of the estimated annual 10% exceedance frequency flows shown at the bottom of ***Table 6-6***. The 10% exceedance frequency flows are the daily flows that occurred during the year in which the total flow from all four sub-basins is exceeded by the total flows of 90% of the years in the period of record. The fact that rehydration water is available to divert to the targeted freshwater areas even under dry season drought conditions indicates that the associated habitat lift should be sustainable.

It is not possible to provide maps showing geographically specific locations where the freshwater wetland habitat lift will occur since habitat lift is calculated as an average improvement over the target area. However, the alternative maps (***Section 5, Figures 5-6***, ***5-7***, ***5-8***, and ***5-9***) provide the boundaries of the targeted freshwater wetland rehydration areas. For alternatives such as YB and Q and O, the bulk of the freshwater wetland lift is likely to be located in areas in close proximity to the diversion outfalls since the targeted areas generally are oversized relative to the available water. For Alternative O, Phase 1, the entire targeted area will experience significant habitat lift since the area is limited in size relative to the pump capacity and water availability.

TABLE 6-5: FRESHWATER WETLAND HABITAT LIFT SUMMARY

CRITERION BASED ECOLOGICAL EVALUATION MATRIX													
DBHYDRO FLOWS													
FRESHWATER WETLAND ECOLOGICAL ZONE													
Objectives and Criteria	**Units**	**Method**	**Target**	**Existing Condition**	**Future Without Project**	**Alt O**	**Alt M**	**Alt Q**	**Alt YB**	**Alt O, Part I**	**Alt O NAI**	**Alt O, P I, NAI**	**Alt M, NAI**
A. Rehydrated wetland lift													
1. Wetlands with sufficient water (PM 4)	Acre-lift	GIS Mapping /Seepage Analysis	9638	3997	3,997	7,168	4,205	7,994	8,378	4,229	6,092	4,191	4,109
B. Reduced invasive non-native plants *													
1. Acres of Invasive/Exotics Removed (PM 7)	Acre-lift	GIS Mapping Analysis	9763	0	0	3051	160.5	6632	4555	334	3051	334	160.5
Net FW Wetland Habitat Units (Net from Future Without Condition) (acre-lift)*				**0**	**0**	**3,111**	**185**	**5,315**	**4,468**	**283**	**2,573**	**264**	**136**

Key:
Alt Alternative
FWO Future Without
GIS Geographical Information System
PM Performance Measure

* The net FW Wetland Habitat units are computed by averaging sub-metric B.1 Acres of Invasive/Exotics Removed with the net lift over existing conditions from sub-metric A.1 Wetlands with Sufficient Water. (Example for Alternative O = (3051 + (7,168-3,997))/2 = 3,111 acre-lift.)

TABLE 6-6: ESTIMATED FRESHWATER WETLAND REHYDRATION LIFT (SUBMETRIC A.1) FOR EACH ALTERNATIVE CALCULATED USING DBHYDRO FLOWS (REPORTED IN UNITS OF ACRE-LIFT)

	C-100	C-1	C-102	C-103	Reuse	With Reuse	Without Reuse
AVERAGE ANNUAL ACRES OF FRESHWATER REHYDRATION LIFT							
Alt O	6	121	416	1553	1076	3172	2096
Alt Q	6	121	568	1,984	1,318	3997	2680
Alt M	6	106	-	-	96	209	112
Alt YB	7	174	805	1,944	1,451	4381	2930
Alt O, Phase I	6	-	-	188	39	233	194
Alt O, NAI	6	121	416	1,553	-		2096
Alt M, NAI	6	106	-	-	-		112
Alt O, Phase I, NAI	6	-	-	188	-		194
DRY SEASON ACRES OF FRESHWATER WETLAND REHYDRATION LIFT							
Alt O	5	92	340	1277	1301	3015	1713
Alt Q	5	92	478	1,598	1,526	3,699	2,173
Alt M	5	79	-	-	119	202	84
Alt YB	5	133	665	1,571	1,622	3,997	2,375
Alt O, Phase I	5	-	-	167	60	232	172
Alt O, NAI	5	92	340	1,277	-		1,713
Alt M, NAI	5	79	-	-	-		84
Alt O, Phase I, NAI	5	-	-	167	-		172
WET SEASON ACRES OF FRESHWATER WETLAND REHYDRATION LIFT							
Alt O	7	151	491	1829	850	3329	2478
Alt Q	8	151	658	2,369	1,110	4,296	3,186
Alt M	8	133	-	-	74	215	141
Alt YB	8	215	945	2,317	1,281	4,766	3,486
Alt O, Phase I	8	-	-	208	18	234	216
Alt O, NAI	7	151	491	1,829	-		2,478
Alt M, NAI	8	133	-	-	-		141
Alt O, Phase I, NAI	8	-	-	208	-		216
REHYDRATION UNDER 10 PERCENT EXCEEDANCE FREQUENCY FLOW CONDITIONS							
DRY SEASON ACRES OF FRESHWATER WETLAND REHYDRATION LIFT							
	C-100	**C-1**	**C-102**	**C-103**	**Reuse**	**With Reuse**	**Without Reuse**
Alt O	2	42	141	608	1802	2595	793
Alt Q	3	42	196	734	1,901	2,875	974
Alt M	3	33	-	-	164	200	36
Alt YB	3	65	277	726	1,937	3,008	1,070
Alt O, Phase I	3	-	-	132	94	230	135
Alt O, NAI	2	42	141	608	-		793
Alt M, NAI	3	33	-	-	-		36
Alt O, Phase I, NAI	3	-	-	132	-		135

6.3.2 Saltwater Wetland Benefits

The saltwater wetland areas targeted for restoration by this project lie east of the L-31E Levee. These wetlands are characterized by saltwater tolerant vegetation such as mangrove forest with a limited coverage of freshwater wetland species on western portions of the Cutler Wetlands. Hydration of these saltwater wetlands using freshwater diverted from the coastal canals was deemed to be an important potential benefit of the project since greater water delivery and lower salinities would better mimic historic hydrology in this zone. The target salinity range was selected after considering the requirements of juvenile American crocodile which is a listed endangered species. The estimation of saltwater wetland restoration benefits incorporates two aspects of restoration, the diversion of canal flow into the saltwater wetlands, and the restoration of saltwater wetlands salinity conditions (target = <20 psu). Saltwater Wetland Habitat Lift was computed in CBEEM by averaging two sub-indices and multiplying this result by the total saltwater wetland acreage downstream of the location of diverted water. The two sub-metrics are 1) percent of available water diverted directly to saltwater wetlands, and 2) percent of saltwater wetland acreage meeting the target salinity condition (<20 psu) during the critical season for juvenile crocodile which is from June through November. This habitat lift is measured in units of "acres of lift". The percent available water diverted directly to saltwater wetlands is a measure of the capability of the alternative to direct water into saltwater wetlands. It was computed for each of the four basins by determining what fraction of the daily flow would be diverted by project pump stations discharging to saltwater wetlands. In basins where multiple pump stations are diverting water to both saltwater wetlands and freshwater wetlands, the available water was assigned to each of the pump stations in proportion to the total pump capacity. The overall percentage of water diverted for each basin was computed based upon the ratio of the total amount of water diverted to the total available as indicated by the historic flow record of releases at the coastal structures. The length of the period of record used for each basin varied from 20 years of daily flows to more than 30 years of daily flows. The estimates of saltwater wetland acreage meeting the salinity target were derived from output from the TABS-MDS model. This model was configured to simulate the saltwater wetland area located between the bay shoreline and the L-31E Levee. Post processing of TABS-MDS model output provided average annual estimates of acreage within the target saltwater wetland zone that met both hydration and salinity targets. This TABS-MDS output is a measurement of the effectiveness of the diversion of water into the saltwater wetlands. The PDT decided to use an average of the two sub-metrics to quantify the potential for saltwater wetland habitat lift.

Table 6-7 shows the saltwater wetland lift estimates for all of the considered alternatives computed using the CBEEM tool. Alternatives O, Phase 1 provides the greatest saltwater wetland lift (6,174 HU) primarily because this alternative diverts a high percentage (49%) of available water into the saltwater wetlands than even the larger Alternative O which diverts 45% of the available water to saltwater wetlands. Though Alternative M diverts as much water as Alternative O, Phase I to the saltwater wetlands it scores somewhat less than Alternative O, Phase I because it provides fewer acres of saltwater wetlands with the appropriate salinity. This may be due to its sole reliance on gravity discharge which is constrained by higher ground elevations in the saltwater wetland areas north of C-102. Alternatives Q and YB provide the two-thirds to one-half of the saltwater wetland benefits provided by Alternative O, Phase 1 primarily due to the focus on freshwater wetland rehydration which limits the amount of water that is available for tidal wetland restoration.

Table 6-8 shows the estimated percentage of targeted saltwater wetlands meeting the 20 psu target salinity for sub-metric B.1 (from ***Table 6-6***) under wet, dry, and average year hydrologic conditions. Note that in this table, TABS-MDS results were not available for the dry year simulation so these estimates were derived by adjusting the average year results proportionately based upon the availability of water during a dry year. These results show that the percentage of the available target saltwater acreage meeting the target salinity condition under dry year conditions is approximately ½ of the average year conditions. This indicates that there is some assurance that the habitat lift will be provided during low flow years. The table shows that wet year conditions provide two to three times as many acres meeting the salinity target as average year conditions.

The alternative maps (***Section 5, Figures 5-6***, ***5-7***, ***5-8***, and ***5-9***) that show the boundaries of the targeted saltwater wetland rehydration areas provide the best available indication of the locations where saltwater wetland lift is expected. The zones of greatest saltwater wetland habitat lift are expected to be closest to the locations where freshwater will be diverted into these areas as well as in the tidal creeks that form downstream of the spreader ditches. The locations of these tidal creeks are not presently known to the degree required for mapping them since flow patterns depend upon micro topography as much as on how the spreader ditches are constructed and operated.

TABLE 6-7: SALTWATER WETLAND HABITAT LIFT SUMMARY

CRITERION BASED ECOLOGICAL EVAULATION MATRIX													
DBHYDRO FLOWS													
SALTWATER WETLAND ECOLOGICAL ZONE													
Objectives and Criteria	**Units**	**Method**	**Target**	**Existing Condition**	**Future Without Project**	**Alt O**	**Alt M**	**Alt Q**	**Alt YB**	**Alt O, Part I**	**Alt O NAI**	**Alt O, P I, NAI**	**Alt M, NAI**
A. Reduced canal discharge													
1. Potential percent of surface water diverted to SW Wetlands (PM 4)	ac-ft/yr	Flow diversion using DBHydro Database	368,934	-	-	166,118	180,322	117,431	79,620	181,623	146,218	163,245	134,057
				0%	0%	45%	49%	32%	22%	49%	40%	44%	36%
B. Salinity performance													
1. Acres of tidal wetlands meeting 0-20 psu criterion (PM 2)	Acres	Average Daily SW Wetland Acres Meeting Criteria (TABS-MDS model output)	21,035	1,815	1,869	3,916	3,219	3,177	3,177	3,446	3,446	3,446	3,219
				8.63%	8.88%	18.62%	15.30%	15.10%	15.10%	16.38%	16.38%	16.38%	15.30%
Saltwater Wetlands Mean Criteria Result				0.043	0.044	0.318	0.321	0.235	0.183	0.328	0.280	0.303	0.258
Total SW Wetland Acres Available				22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550	22,550
Total SW Wetland Habitat Units (acre-lift)				973	1,002	7,176	7,236	5,292	4,136	7,398	6,316	6,836	5,822
Net SW Wetlands Habitat Units (Net from Future Without Condition) (acre-lift)				-29	0	6,174	6,234	4,290	3,134	6,396	5,314	5,834	4,820

Key: ac-ft/yr: acre feet per year, Alt: Alternative, PM: performance measure, psu: practical salinity units

TABLE 6-8: PERCENT OF TARGET SALTWATER WETLAND ACRES MEETING SALINITY TARGET OF LESS THAN 20 PSU DURING WET SEASON FOR THREE REPRESENTATIVE YEARS

ALTERNATIVE	Percent Target Saltwater Acreage Meeting Salinity Target (<20 psu) Dry Year (1999-2000)*	Percent Target Saltwater Acreage Meeting Salinity Target (<20 psu) Average Year (1998-1999)	Percent Target Saltwater Acreage Meeting Salinity Target (<20 psu) Wet Year (1995-1996)
Existing Condition	4%	9%	33%
FWO	4%	9%	32%
ALT O	8%	19%	46%
ALT M	7%	15%	38%
ALT Q	6%	15%	37%
ALT YB	6%	15%	37%
ALT O,P I	7%	16%	44%

* Dry year estimates were not available from the TABS-MDS modeling so these estimates are derived by multiplying the average year results by the ratio of dry year flows to average year flows.

6.3.3 Nearshore Benefits

The estimation of nearshore restoration benefits incorporates three aspects of restoration, the diversion of water from point-source canal discharges, the improvement in water quality due to upstream wetland application of canal water, and the maintenance of nearshore salinity to less than 20 psu. Diversion of water from the coastal structures was considered an important measure of an alternatives ability to improve nearshore habitat because diversion is thought to limit rapid and ecologically undesirable salinity changes that occur in the bay immediately east of the canal mouths as a result of large discharge events. Water quality improvement was considered an important measure of the potential for nearshore habitat improvement because poor water quality associated with untreated discharge of canal water adversely affects nearshore seagrass habitat. Achieving nearshore salinity targets favorable to oysters, pink shrimp, and juvenile fish was considered an important measure of the potential to improve nearshore habitat since salinity conditions are critical to these ecologically important species. Nearshore habitat lift was computed by averaging the three sub-indices and multiplying this result by the total available nearshore acreage. The three sub-indices are: 1) percent of available water diverted from coastal structure, 2) the average of the percent nitrate and peak total phosphorus load targets achieved, 3) percent of nearshore acres within 500 meters of the shoreline meeting the target salinity conditions. This habitat lift was measured in units of “acres of lift”. The water diversion index was computed for each of the four basins by determining what fraction of the daily flow would be diverted by all project pump stations. The water quality improvement index was computed as the average of the nitrate and total phosphorus target load removal achieved. The nitrate load reduction was based on an estimate of the nitrate uptake in the wetlands receiving the diverted water. The peak total phosphorus load reduction was based on the percent of total available water diverted into the target wetlands. The index for nearshore acreage within 500 meters meeting the salinity target was estimated using historic daily canal flows and estimates of the target freshwater flow volume required to achieve the salinity target within the zone. The target freshwater flow volume in each basin necessary to maintain nearshore salinity within the desired range was determined by analyzing the results of Scenario 10 of the preliminary scenario runs (PSR) of the Biscayne Bay TABS-MDS model. The ability of each alternative to meet the target salinity was evaluated by comparing the volume diverted to the saltwater wetlands to the flow requirements predicted by the Scenario 10 flows. Though a daily estimate of the percent target achieved was computed, the overall salinity sub-index was reported based on the average daily percent flow target achieved. The three sub-indices were weighted equally in computing an overall nearshore habitat lift estimate.

Table 6-9 shows the nearshore benefits predicted using the CBEEM tool. Alternative O provides the greatest nearshore lift primarily because it provides a high level of water quality improvement and also diverts the greatest amount of water from the point source canal discharges. Alternative Q provides the second best lift to the nearshore area also because of the extensive water quality improvement and volume of water diverted from the canal outfalls. Alternative YB does not perform as well as Q or P primarily due to its reduced efficiency with regard to maintaining nearshore salinity. Alternative O, Phase 1 provides approximately two-thirds of the nearshore benefits accorded Alternative O as a result of having smaller pump capacity available to divert flows from the canals. Also its reduced footprint provides less water quality improvement.

Table 6-10 shows the wet and dry season nearshore acres meeting the salinity target as estimated for average hydrologic conditions. In addition, the table includes the dry season acreage meeting the salinity target for the drought conditions as represented by the 10% exceedance probability flows. This data shows that the dry season acreage is approximately 60 to 75 percent of the wet season acreage for average hydrologic conditions. Dry season response under drought conditions (10% exceedance frequency flows) is approximately one-third of the acreage of the average wet season hydrologic conditions. Under drought conditions (10% exceedance probability flows), Alternative O, Phase 1 provides approximately 25% of the average wet season nearshore acreage meeting the salinity target as shown in ***Table 6-9***. Though this is an indication that low-salinity estuarine habitat may be maintained on average during the dry season, even during drought years, there may be periods of 30 days or more when little to no water is available for diversion into the nearshore areas. The monthly available and diverted flows in the C-100, C-1, C-102, and C-103 canals (shown in ***Figure 6-3***, ***6-4***, ***6-5***, and ***6-6***) indicate that under average hydrologic conditions (50% exceedance probability flows) water will be available during all of the dry season months in the C-1, C-102 and C-103 basins. Under drought conditions (10% exceedance probability flow conditions), only a small amount of water will be available during a couple of dry season months. The C-100 canal system has almost no flow under average and dry hydrologic conditions during the dry season. Under the 1 in 10 year dry season drought conditions, there are a couple of months with almost no flow available in any of the four sub-basins to sustain nearshore salinity within the target range. However, during these low flow periods, suitable refugia should be available in enclosed tidal creeks and pools located along the shoreline as evidenced by the existing populations of juvenile fish and pink shrimp in the nearshore habitat zone.

The best indication where nearshore habitat lift will occur for each alternative is shown in ***Section 5, Figures 5-6***, ***5-7***, ***5-8***, and ***5-9***. Nearshore habitat lift is expected to occur within the 500 or so meters directly east of the targeted saltwater wetland shown in the figures for each alternative. The greatest nearshore habitat lift is likely to occur at the mouths of tidal creeks since these creeks are likely to receive a large proportion of the diverted freshwater.

TABLE 6-9: NEARSHORE HABITAT LIFT SUMMARY

CRITERION BASED ECOLOGICAL EVALUATION MATRIX													
DBHYDRO FLOWS													
NEARSHORE ECOLOGICAL ZONE													
Objectives and Criteria	**Units**	**Method**	**Target**	**Existing Condition**	**Future Without Project**	**Alt O**	**Alt M**	**Alt Q**	**Alt YB**	**Alt O, Part I**	**Alt O NAI**	**Alt O, P I, NAI**	**Alt M, NAI**
A. Reduced canal discharge													
1. Potential percent of surface water diverted from canal (PM 3)	ac-ft/yr	Flow quantity diverted from canals (DBHYDRO)	368,934	-	-	300,496	144,549	294,952	223,557	216,943	300,496	216,943	144,549
				0%	0%	81%	39%	80%	61%	59%	81%	59%	39%
B. Reduced contaminant concentrations and loads													
1. Nitrate Load Reduction (PM 5)	Mtons/yr	GIS Land use / Nitrate Removal Eqn.	23	847	305	49	232	54	104	143	49	143	232
				0%	66%	97%	75%	96%	90%	85%	97%	85%	75%
2. Phosphorus Peak Load Reduction (PM 6)	Mtons/yr	USGS Flow / Conc Eqn.	0	33	33	21	9	20	14	15	21	15	9
				0%	0%	62%	27%	61%	44%	47%	62%	47%	27%
Average % Target Achieved				0%	33%	80%	51%	79%	67%	66%	80%	66%	51%
C. Salinity performance													
1. Acres of Bay bottom meeting 20 psu criterion (within 500 M of shore) (PM 1)	Acres	TABS / PSR Run Analysis with Flow Diversion Calcs	3462	886	886	1157	1348	744	605	1268	973	1089	909
				25.6%	25.6%	33%	39%	21%	17%	37%	28%	31%	26%
Nearshore Mean Criteria Result				0.085	0.195	0.648	0.430	0.600	0.483	0.539	0.631	0.521	0.388
Total Available Nearshore Acres				8,585	8,585	8,585	8,585	8,585	8,585	8,585	8,585	8,585	8,585
Total Nearshore Habitat Units (acre-lift)				732	1,673	5,565	3,696	5,154	4,147	4,624	5,413	4,475	3,333
Nearshore Habitat Units (Net from Future Without) (acre-lift)				-941	0	3,892	2,023	3,481	2,474	2,950	3,740	2,802	1,660

Key: Alt Alternative performance measure M meter
GIS Geographical Information System PSR preliminary scenario runs USGS US Geological Survey

PM

TABLE 6-10: NEARSHORE SALINITY LIFT ESTIMATED FOR AVERAGE WET AND DRY SEASON HYDROLOGIC CONDITIONS AND DRY SEASON 10% EXCEEDANCE FLOWS

WET SEASON RESPONSE (AVERAGE HYDROLOGIC CONDITIONS) NEARSHORE ACRES OF BAY BOTTOM MEETING SALINITY CONDITION (<20 PSU) WITHIN 500 METERS OF SHORELINE (acres)					
ALTERNATIVE	**DEERING**	**CUTLER**	**NORTH HOMESTEAD**	**SOUTH HOMESTEAD**	**TOTAL**
ALTERNATIVE O	22	840	310	183	1355
ALTERNATIVE Q	14	837	0	0	851
ALTERNATIVE M	2	1078	0	393	1473
ALTERNATIVE YB	0	682	0	0	682
PHASE I, ALTERNATIVE O	10	870	446	145	1471
NAI ALTERNATIVE O	22	668	310	183	1183
NAI ALTERNATIVE M	2	672	0	393	1067
NAI ALTERNATIVE O, PHASE 1	10	703	446	145	1304
DRY SEASON RESPONSE (AVERAGE HYDROLOGIC CONDITIONS) NEARSHORE ACRES OF BAY BOTTOM MEETING SALINITY CONDITION (<20 PSU) WITHIN 500 METERS OF SHORELINE (acres)					
ALTERNATIVE O	12	632	199	116	958
ALTERNATIVE Q	7	630	0	0	637
ALTERNATIVE M	1	913	0	308	1223
ALTERNATIVE YB	0	528	0	0	528
PHASE I, ALTERNATIVE O	5	651	303	107	1066
NAI ALTERNATIVE O	12	437	199	116	763
NAI ALTERNATIVE M	1	441	0	308	751
NAI ALTERNATIVE O, PHASE 1	5	459	303	107	875
DRY SEASON RESPONSE (10% EXCEEDANCE FLOWS) NEARSHORE ACRES OF BAY BOTTOM MEETING SALINITY CONDITION (<20 PSU) WITHIN 500 METERS OF SHORELINE (acres)					
ALTERNATIVE O	2	402	81	47	533
ALTERNATIVE Q	1	402	0	0	403
ALTERNATIVE M	1	750	0	189	939
ALTERNATIVE YB	0	368	0	0	368
PHASE I, ALTERNATIVE O	1	416	125	55	598
NAI ALTERNATIVE O	2	166	81	47	296
NAI ALTERNATIVE M	1	170	0	189	360
NAI ALTERNATIVE O, PHASE 1	1	183	125	55	364

6.3.4 Overall Ecological Benefit Estimates

The CBEEM tool integrates multiple performance metrics into a single value to represent the habitat enhancement provided by each alternative. The overall Total Habitat Units for each of the alternatives is shown in the bottom line of ***Table 6-4***. Alternative O provides the highest lift, followed closely by Alternative Q. The difference between these two alternatives is reflected in the sub-measure scores. For instance, Alternative Q features are designed to favor freshwater wetland restoration and subsequently scores higher than Alternative O in terms of freshwater habitat lift. Conversely, Alternative O features are designed to restore both freshwater wetlands and saltwater wetland so it scores higher in saltwater wetland restoration relative to Alternative Q. The difference between Alternative O and Alternative O, Phase I is primarily a result of the reduced freshwater wetland restoration that will occur in Phase I.

The Project Delivery Team (PDT) considered several options for weighting the evaluation metrics and performance measures prior to applying ecological benefits indices to the acreages in the various ecological zones of the project. These options included weighting performance measures applicable to a given objective and weighting objectives applicable to a given region. Given the likelihood of sea level rise impacting the project area, the PDT considered applying different weights to the three ecozones. For instance, benefits to the nearshore zone appear to be most susceptible to sea level rise while freshwater wetland benefits appear to be least susceptible to sea level rise. Using this logic, the team might have given a low weight to nearshore benefits while giving a higher weight to freshwater wetland benefits. However, the team determined that nearshore habitat enhancement and preservation was critical in the short-term given the relative scarcity of high functioning nearshore habitat within the project area. In the long-term, the team believes that the preserved nearshore habitat would translocate inland as mean sea level increases. The team discarded overweighting the freshwater wetland benefits since in the intermediate time-frame (20-30 years) sea level rise may result in the involuntary conversion of farmland to abandoned farmland which will revert to freshwater wetlands and ultimately saltwater wetlands. Over or under weighting the saltwater wetland benefits was not considered by the team probably because the saltwater wetland zone is necessary to move water from the upland to the nearshore zone. After due consideration, the PDT decided to treat the evaluation metrics, performance measures, and objectives with equal weighting since this scheme satisfied the greatest number of team members and provided the best separation between alternatives.

6.3.5 Benefit Assessment Risk and Uncertainty Analysis

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. An uncertainty analysis is typically used to quantify risks and potentially avoid the likelihood of the three adverse outcomes listed above. For the Biscayne Bay Coastal Wetlands project, the most apparent sources of uncertainty in the estimated project benefits and the selection of the preferred plan arise from the use of the CBEEM model for the prediction of project benefits, the uncertainty in habitat response to hydrologic change, the effect of climate change on water availability, and the effect of sea level rise on future project benefits.

6.3.5.1 Uncertainty in Habitat Response to Hydrologic Change

One source of uncertainty in project benefits results from the lag between hydrologic change and the expected habitat response. Ecological patterns and processes in Everglades wetlands respond to interannual variability in rainfall (amount & timing) and canal flows and inputs (which are management driven and do not always parallel rainfall patterns) in many ways. Ecological processes often respond to environmental drivers with time lags of longer than months (e.g. years) and changes in ecological patterns nearly always lag environmental changes by several years. The performance measures average a time series of results across different hydrologic conditions (wet, dry, average years) and across seasons to create one habitat unit score for each of the three habitat types. The habitat improvement that results from this project will not occur immediately after project features begin operation but rather will occur over a period of 10 years as vegetation and wildlife respond to the altered hydrology.

Each year type and season may not be an equally important predictor of ecological benefits. For example, extreme salinity during dry years may be ecologically limiting and, thus, perhaps weigh more heavily on overall habitat improvement. Since these ecological response lags are likely on the order of 5 to 10 years while the project planning timeframe is 50-years, multi-year lags in ecological and/or hydrologic responses were not as critical to interpretation of the CBEEM benefit model outputs.

6.3.5.2 Uncertainty in the Availability of Water

Benefits from this project are closely linked to the availability of water. The CBEEM estimates of project benefits reflect average hydrologic conditions within the project area as computed using long-term historic canal discharge records. To determine the sustainability of the project, project benefits were estimated under extreme hydrologic conditions. Total annual flow estimates for the 10, 50 and 90 percent exceedance frequencies were calculated using DBHYDRO flow data from C-100, C-1, C-102, and C-103 for the 1986 to 2006 period. The total annual flows for all four canals were summed to calculate the annual flow available to the project.

These annual total available flows were sorted and ranked. The years chosen to represent the 10, 50, and 90 percent flow conditions were then selected based upon the ranking of total flows as well as the ranking of annual total flows in each basin. The 10 percent exceedance frequency annual total flow is approximately 150,000 acre ft which occurred in 1990. The 50 percent exceedance frequency annual total flow is approximately 360,000 acre ft which occurred in 1992. The 90 percent exceedance frequency annual total flow is approximately 490,000 acre ft which occurred in 2002. Three special CBEEM model runs were completed using the 10, 50, and 90 percent flow records. ***Table 6-11*** shows the project benefits estimated for dry, average, and wet hydrologic conditions as represented by the 10 percent, 50 percent, and 90 percent exceedance frequency annual total flows. To generate comparable 10 and 90 percent nearshore benefits, the target flow diversion quantity was set to the median (50% exceedance frequency) flow volume for all three exceedance frequencies. Also, where TABS-MDS model output was not available for the sub-metric of tidal wetland acres meeting target salinity conditions, estimates were generated by multiplying the average hydrologic condition response by the ratio of exceedance flows (10 and 90 percent) to median flows (50 percent). The ***Table 6-11*** results indicate that for Alternative O, Phase I, drought years (10 percent exceedance) will provide about 80 percent of the benefits estimated for the 50 percent exceedance flow quantity. Wet hydrologic conditions (90 percent exceedance flows) appear to provide approximately 20 to 80 percent more benefits than the benefits estimated for median flow conditions. The impact of water availability on the freshwater wetland benefits predicted for Alternative O, Phase 1 is not large primarily due to the fact that less than 500 acres of freshwater wetlands are targeted for rehydration in this alternative. The alternatives with larger freshwater wetland target zones such as Alternatives O, Q and YB are more likely to have freshwater wetlands that are insufficiently hydrated under drought conditions. Alternatives O, Phase 1, and Alternative M with their limited freshwater wetland target areas are more likely to have sufficient water supplies to hydrate the targeted freshwater wetland areas.

Nearshore and tidal wetland zones show greater correlation between water availability and predicted benefits than that shown for the freshwater wetland zone. The limited differences between the benefit estimates for the 10 percent and 50 percent exceedance is due to the inclusion of non-hydrologic sub-metrics in the calculation of benefits for the three ecosystem benefit zones. If only hydrologic metrics are used in the calculation of habitat improvement, the impact of low flow and high flow conditions is more evident. The estimated acres of nearshore bay bottom meeting the target salinity condition of less than 20 psu under drought, average, and wet hydrologic conditions are shown in ***Table 6-12***. For Alternative O, Phase 1, the acres meeting the target salinity condition for drought years is less than 15% of the acreage meeting the target for median conditions (50 percent exceedance flows). Under wet conditions (90 percent exceedance flows) the acreage meeting the target salinity is more than twice the acreage under the median condition for Alternative O, Phase I. The importance of reuse flows is shown in the results for the next added increment versions (NAI). For Alternative O, Phase 1 without reuse water (NAI conditions), nearshore acreage meeting the target salinity is less than that expected for the Future Without Alternative. This is due to diversion of water to the freshwater wetlands. Overall this analysis shows that project benefits, particularly in the nearshore ecozone, will be limited under drought conditions equivalent to the 10 percent exceedance frequency flows. While drought conditions are expected to reduce habitat productivity, they occur infrequently (1 in 10 years). The target species (juvenile fish, shrimp, oysters) are able to survive as evident by existing populations of these species within the project area.

The impact of water availability on project benefits as shown in ***Table 6-11*** and ***Table 6-12*** were computed under the assumption that future water availability can be estimated using historic hydrologic conditions. As noted in the hydrology discussion of Section 4.0, there is now evidence of anthropogenic changes to global climate patterns that will likely have an impact on South Florida in terms of rainfall, evapo-transpiration, and temperature. Projections for rainfall show a reduction of up to 20% in rainfall in South Florida by 2100 as compared to the historic conditions experienced between 1980 and 1999. Climate change is likely to result in fewer project benefits than those projected in the CBEEM results because of reduced rainfall, higher evapotranspiration, and longer durations between rainfall events. The impact of climate change on project benefits is difficult to predict given the uncertainty in the benefit calculations as well as in predictions of future weather patterns and water management strategies. Using a simple assumption that project benefits are linearly correlated to water availability, a 10% reduction in rainfall over the next 50 years would correspond to a 10% reduction in project benefits.

TABLE 6-11: RELATIONSHIP BETWEEN PROJECT BENEFITS AND WATER AVAILABILITY

PROJECT BENEFITS UNDER DIFFERENT HYDROLOGIC CONDITIONS										
Hydrologic Conditions	Existing Condition	Future Without	Alt. O	Alt. M	Alt. Q	Alt. YB	Alt. O, P1	Alt. O, NAI	Alt. O-P1, NAI	Alt. M, NAI
NEARSHORE BENEFITS (acres of functional habitat)										
10% Exceedance Freq. Flows	732	1,655	4,648	2,795	4,413	4,128	4,125	4,455	3,934	2,324
50% Exceedance Freq. Flows	732	1,662	4,878	3,379	4,473	3,729	4,173	4,715	4,096	2,987
90% Exceedance Freq. Flows	732	1,682	6,022	4,215	5,541	4,540	5,353	5,920	5,262	4,000
SALTWATER WETLAND BENEFITS (acres of functional habitat)										
10% Exceedance Freq. Flows	415	427	4,138	5,510	3,079	2,757	4,590	2,897	3,456	2,677
50% Exceedance Freq. Flows	973	1,002	6,435	6,538	4,541	3,742	6,682	5,485	6,034	4,914
90% Exceedance Freq. Flows	3,721	3,608	13,349	13,302	9,975	7,733	13,667	11,991	12,534	10,469
FRESHWATER WETLAND BENEFITS (acre of functional habitat)										
10% Exceedance Freq. Flows	3997	3997	7011	4178	9100	8213	4359	6310	4331	4111
50% Exceedance Freq. Flows	3997	3997	7096	4179	9291	8437	4360	6525	4341	4120
90% Exceedance Freq. Flows	3997	3997	7179	4181	9458	8660	4362	6769	4346	4159
TOTAL PROJECT BENEFITS (acres of functional habitat)										
10% Exceedance Freq. Flows	1,147	2,082	12,216	8,490	12,905	11,381	9,195	9,774	7,799	5,116
50% Exceedance Freq. Flows	1,705	2,664	14,990	10,103	14,815	12,338	11,336	12,964	10,559	8,025
90% Exceedance Freq. Flows	4,453	5,290	23,321	17,705	21,653	17,371	19,504	21,085	18,247	14,634
NET PROJECT BENEFITS (acre-lift of functional habitat) (Net Future Without Conditions)										
10% Exceedance Freq. Flows	(935)	0	9,719	6,405	10,514	9,020	6,995	7,584	5,644	3,034
50% Exceedance Freq. Flows	(959)	0	11,749	7,436	11,645	9,248	8,554	10,065	7,811	5,361
90% Exceedance Freq. Flows	(837)	0	17,264	12,412	15,688	11,647	14,095	15,393	12,855	9,341

Note: 10% Exceedance Frequency Flow is estimated as 150,000 acre ft/yr Total for C-100, C-1, C-102, and C-103 (1990 flows DBHYDRO)
50% Exceedance Frequency Flow is estimated as 360,000 acre ft/yr Total for C-100, C-1, C-102, and C-103 (1992 flows DBHYDRO)
90% Exceedance Frequency Flow is estimated as 490,000 acre ft/yr Total for C-100, C-1, C-102, and C-103 (2002 flows DBHYDRO)

TABLE 6-12: SALINITY RESPONSE FOR ALTERNATIVE O, PHASE 1

NEARSHORE SALINITY RESPONSE (NET FWO CONDITION)								
Hydrologic Conditions	**Alt. O**	**Alt. M**	**Alt. Q**	**Alt. YB**	**Alt. O, P1**	**Alt. O, NAI**	**Alt. O P1, NAI**	**Alt. M, NAI**
NEARSHORE SALINITY PERFORMANCE SUBMETRIC C.1 Acres of Bay bottom meeting 20 psu criterion (within 500 M of shore)								
10 Percent Exceedance Flows	(99)	279	(362)	(419)	43	(333)	(188)	(292)
50 Percent Exceedance Flows	164	372	(246)	(356)	297	(33)	203	(103)
90 Percent Exceedance Flows	712	672	160	(87)	813	588	703	412

6.3.5.3 Uncertainty in the CBEEM Benefits Tool

The Biscayne Bay Coastal Wetlands project is a water resource based ecosystem restoration effort targeting freshwater wetlands, tidal wetlands, and nearshore estuarine zones. As such, the primary means of altering habitat functionality is through the diversion of freshwater from water supply / drainage canals into or toward the three habitat zones. The premise of the benefits assessment methodology is that changes to habitat functionality can be quantified by comparing differences between hydrologic outputs such as wetland rehydration and salinity conditions that result from alternative implementation. There is uncertainty in the degree to which the post-processing methods used to convert CBEEM inputs into performance metric signals accurately reflects the direction and magnitude of changes to habitat functionality.

The freshwater wetland performance metric is composed of the exotic/invasive vegetation sub-metric and the wetlands rehydration sub-metric. The exotic/invasive sub-metric was performed using available GIS vegetation maps and best professional judgment regarding the effectiveness of vegetation management activities. It is possible that the lift associated with vegetation management within the targeted freshwater wetland areas may not be maintained over the life of the project. This risk is the least for Alternatives O, Phase I and M that have small freshwater wetland footprints. The rehydration sub-metric relies upon a simple equation that incorporates wetland stage recession rates and daily water availability to estimate acres of wetlands sufficiently rehydrated. To reduce uncertainty in the results for this sub-metric, two estimates for the rate at which water stage falls within a wetland impoundment were used. These two "recession rate" estimates are from comparable wetlands located in Miami-Dade County (S-332C Impoundment, and Military Canal Demonstration Wetland). Additional uncertainty in this sub-metric comes about from the simplicity of the rehydration equation that does not incorporate rainfall, evapotranspiration, or site specific groundwater stage conditions. This rehydration equation is most likely to provide high estimates of freshwater wetland acres rehydrated for alternatives with large freshwater wetland footprints such as Alternative O, Q, and YB. This is particularly so for the YB alternative given the relatively small size of the total diversion pump capacity (600 cfs) in comparison to the size of the target wetland area (>9,000 acres). The freshwater wetland rehydration estimates for Alternative O, Phase I and Alternative M suffer from less risk of over estimation since these two alternatives have smaller target freshwater wetland areas and proportionally larger diversion pumps for these areas. The estimate of freshwater wetland acres rehydrated under Alternative O, Phase I is considered to be fairly certain given the limited area targeted for rehydration (400 acres), appropriately sized pump capacity (120 cfs), and availability of water (particularly under drought conditions).

A spreadsheet wetland rehydration model was created to address comments by the IEPR reviewers regarding uncertainty in the freshwater wetland benefit estimates. This model was created to simulate the effect of discharging available water into freshwater wetlands within the C-103 basin. The model uses simple assumptions to predict the percentage of time that the groundwater stage would be favorable for wetland vegetation under the existing condition and under the rehydration condition. Inputs to this model are: historic groundwater stage (G-1183 Monitoring Well), historic S-20F discharge from the C-103 basin, target wetland acreage, impoundment recession rate (ft/day), and an estimate of the average ground elevation in the area. The model uses the groundwater stage record at the G-1183 surficial monitoring well that is located approximately ½ mile east of the 430 acres of freshwater wetlands targeted for rehydration in Alternative O, Phase 1. Rainfall and evapotranspiration were considered to be incorporated implicitly in the G-1183 groundwater stage record. The prediction of the groundwater stage as affected by rehydration was done by adding the predicted depth of added water minus the impoundment recession rate to the difference between the G-1183 predicted stage at Time = Ti and Ti_{+1}. This calculation was used for each subsequent day's stage unless the measured stage (G-1183) for a given day exceeded the predicted stage in which case the rehydrated wetland stage was set to the measured stage. The daily impoundment recession rate (0.14 ft/day) is from the Miami-Dade County Test wetland located adjacent to Military Canal. The impoundment recession rate is applied on days when the simulated wetland stage exceeds the surface elevation. The daily depth of rehydration was estimated using the available water from the S-20F discharge record, the pump capacity, and wetland size. Rehydration water was not applied during periods when the predicted stage exceeded the ground elevation by more than 1.5 ft.

The results of this simple model are presented in ***Figure 6-6*** and ***Table 6-13***. ***Figure 6-6*** shows the historic and predicted rehydration hydrographs for Alternative O, Phase 1 wetlands in the C-103 Basin. This simulation used G-1183 groundwater stage data and S-20F structure flow data for the period from June 1, 1985 to October 31, 2007. The target acreage used in this simulation was 430 acres (North Canal Freshwater Wetland area) and the pump capacity was 100 cfs. The average elevation of the target wetland in this simulation is set to 2.4 ft NGVD. Summary stage and hydration statistics for Alternative O, Phase 1 are shown in Table 1. The baseline hydroperiod is estimated to be an average of 71 days per year which is a reasonable estimate of actual field conditions for unrestored wetlands in the C-103 basin. A hydroperiod of at least 130 days per year is considered to be necessary for sustainable graminoid wetland habitat in south Florida. Note that the dry season baseline hydroperiod is estimated to be only 9 days which would be one cause of the low function of the unrestored wetlands in the C-103 basin. The model results indicate that Alternative O, Phase 1 will raise the wet and dry season stage by approximate 0.30 ft on average. The number of days that the North Canal Rehydration Wetland stage will exceed the average surface elevation will increase in the dry season from 9 to 52 days and in the wet season from 62 to 137 days. The overall number of days of inundation per year will increase from 72 to 192 days per year.

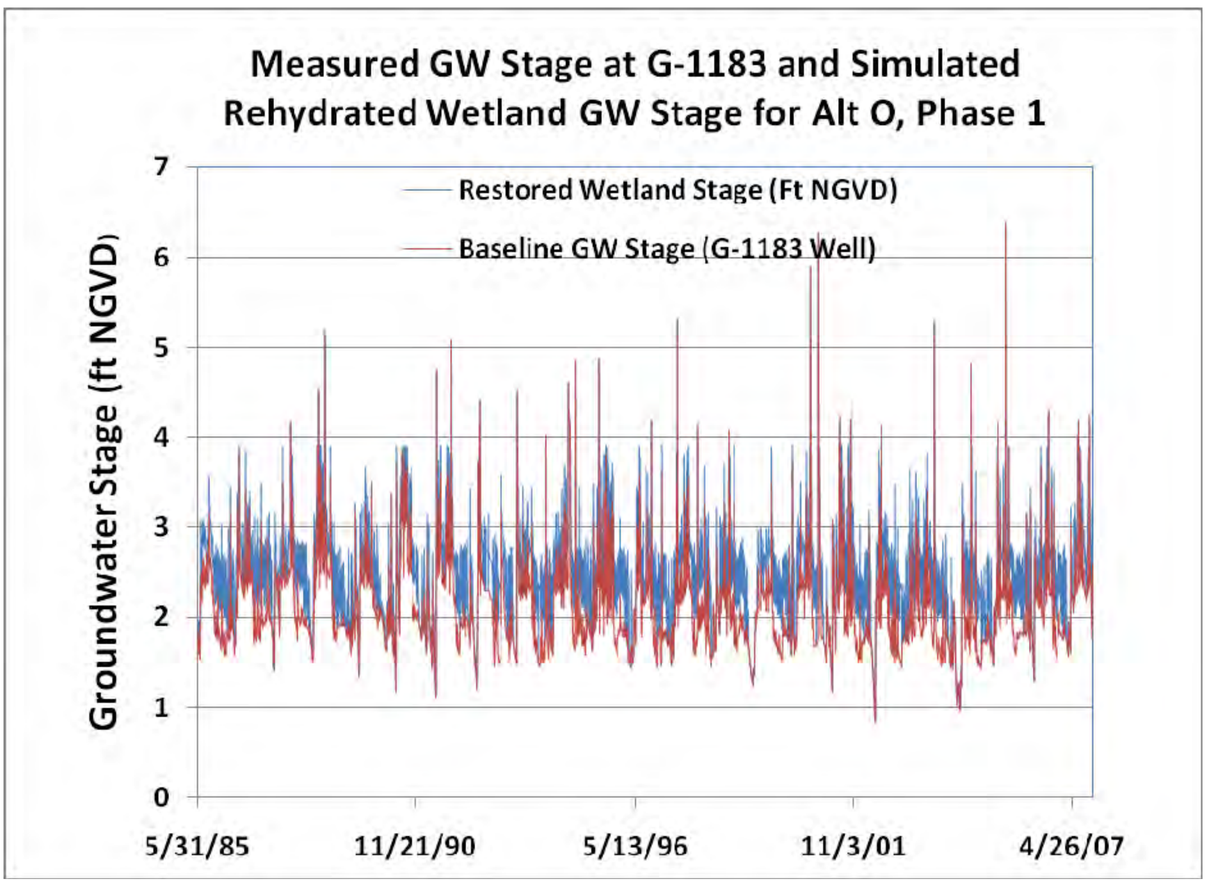


FIGURE 6-6: MEASURED GROUNDWATER STAGE AT G-1183 AND SIMULATED REHYDRATED WETLAND GROUNDWATER STAGE FOR ALTERNATIVE O, PHASE 1 (NORTH CANAL REHYDRATION WETLANDS)

It appears under the with-project condition, the rehydration of the Alt O, Phase 1 freshwater wetland feature on North Canal will be sufficient to sustain a high functioning wetland since with the project; the hydroperiod will exceed the target range for south Florida graminoid wetlands of between 130 to 340 days per year. The results of this analysis indicate that the CBEEM prediction of approximately 435 acres of restored freshwater wetland habitat is achievable given the available water in the C-103 canal and the pump size planned for the North Canal Restoration Wetlands site.

This wetland rehydration simulation tool was also used to check the reasonableness of the freshwater wetland restoration benefits accorded Alternative Q and Y by the CBEEM benefits tool. ***Figure 6-7*** shows the output of this model assuming a pump size of 500 cfs and under several different freshwater wetland footprints possible for the C-103 basin. This figure shows that for target freshwater wetland acreage less than 1,500 acres, the historic water available in the C-103 canal is sufficient to increase the hydroperiod to greater than 130 days per year. There appears to be insufficient water in the basin to support more than 1,500 acres of freshwater wetland rehydration. This was confirmed by making several model runs with pump capacities greater than 500 cfs. The CBEEM model predicted the rehydration of twice as much freshwater wetland acreage for Alternatives Q and YB than that shown possible by the hydroperiod analysis. Given the disagreement between the two estimates, the risk that Alternatives Q, YB or O would not provide the freshwater wetlands predicted by CBEEM remains substantial. Given that freshwater wetland benefits represent 30% to 50% of the total project benefits as estimated by CBEEM for these three alternatives, the risk associated with selecting one of these alternatives is likely unacceptable.

TABLE 6-13: EFFECT OF WATER DIVERSION ON TARGETED FRESHWATER WETLANDS IN THE C-103 BASIN UNDER ALTERNATIVE O, PHASE 1

	Groundwater Stage (ft NGVD)			Number of Days Stage > 2.4 ft		
	Overall Average	Dry Season Average	Wet Season Average	Overall Average	Dry Season Average	Wet Season Average
Rehydrated Wetland GW Stage (simulated)	2.41	2.18	2.67	192	52	137
Baseline Wetland GW Stage (G-1183 Well)	2.10	1.86	2.33	72	9	62
Difference	+0.31	+0.32	+0.34	120	43	75

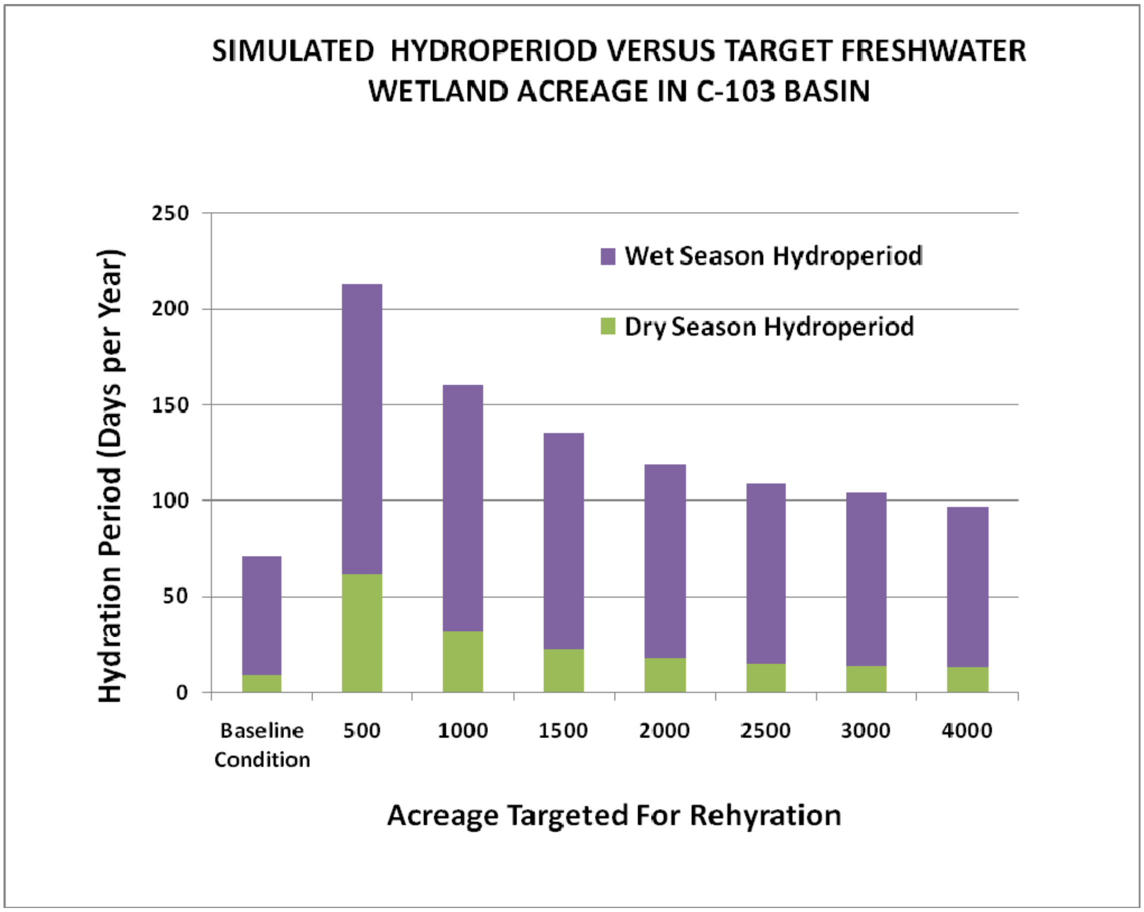


FIGURE 6-7: SIMULATED WETLAND HYDROPERIOD VERSUS TARGET FRESHWATER WETLAND ACREAGE IN THE C-103 BASIN

It should be noted that the assumptions used in the CBEEM freshwater wetland methodology and the hydroperiod simulation tool are gross simplifications of real world wetland hydrology. Neither incorporates all of the hydrologic processes nor were they calibrated and verified against field data. Despite these failings, the two methodologies are considered to be sufficiently robust for predicting small scale (<500 acres) freshwater wetland rehydration acreage for this project. If the selected plan is other than Alternative O, Phase I or Alternative M, then additional modeling of freshwater rehydration using MODBRANCH and/or DRAINMOD is warranted to verify the freshwater wetland rehydration estimated provided by CBEEM.

The saltwater wetland performance metric is computed by averaging the results from the reduced canal discharge sub-metric and the tidal wetland salinity sub-metric. The reduced canal discharge provides a strong signal of the relative ability of a given alternative to maximize saltwater wetland lift. This assumes that there is a linear relationship between the fraction of water diverted to these wetlands and the habitat suitability of these wetlands. While linearity may not necessarily be the case, the two endpoints are known from the present condition with no water diverted to the wetlands and the past condition when overland flow resulted in fully functional habitat prior to the construction of the canals and levees. The tidal wetland salinity sub-metric provides the strongest link between the proposed hydrologic changes and the resulting habitat condition; however, since these estimates come from the TABS-MDS model for Biscayne Bay they suffer from the inherent uncertainty of numerical model inputs. The topographical data used in the TABS-MDS model provides one significant source of uncertainty. The diversion of freshwater into the saltwater wetland area will likely result in preferential flow paths within these wetlands. These preferential flow paths were not incorporated into the TABS-MDS model simply because their location and size are unknown at this time. While preferential flow paths will tend to limit the areal extent of rehydrated saltwater wetlands, these flow paths are expected to develop into tidal creeks which are ecologically productive features of the tidal wetland area. The averaging of the two sub-metrics used in this performance measure is intended to reduce the possibility of over-estimation of saltwater wetland benefits. Overall, the uncertainty in the estimates of saltwater wetland benefits is not considered to be a critical factor in the selection of the preferred plan given that all of the alternatives have similar saltwater wetland footprints.

The nearshore performance metric is computed by averaging the results from the reduced canal discharge sub-metric, the reduced contaminant concentration/load sub-metric, and the nearshore salinity sub-metric. The reduced canal discharge provides a strong signal of the relative ability of a given alternative to maximize nearshore lift by avoiding point source discharges from the canal mouths. These discharges cause rapid and severe salinity swings in the nearshore zone. In CBEEM, the assumption is that there is a linear relationship between the quality of nearshore habitat and the percentage of available water diverted from the canals. While linearity may not necessarily be the case, the two endpoints are known as indicated from the present degraded habitat condition with all canal water discharged through the coastal structures and the past condition when overland flow resulted in fully functional nearshore habitat. In CBEEM a simple linear relationship is used to tie contaminant concentration/load sub-metric to nearshore habitat improvement. While this may be an oversimplification of the underlying relationship between water quality and habitat suitability, developing a more robust mathematical relationship was not possible given the available data. Other sources of uncertainty in this sub-metric come from the use of average concentrations in the estimation of the nitrate load reduction and in the use of the USGS regression equations to estimate phosphorus concentrations. The third sub-metric (nearshore salinity) provides the most direct measurement of the nearshore area where salinity conditions are likely to be favorable to target species (juvenile fish, pink shrimp, and oysters). This sub-metric is evaluated using measured salinity in the nearshore area for existing conditions and Scenario 10 of the TABS-MDS Preliminary Scenario Runs (PSR) to estimate the effect on nearshore salinity of diverting water into the tidal wetlands. The Scenario 10 PSR runs were set up to determine the spatial and temporal distribution of freshwater inflow necessary to continuously meet the target nearshore zone salinity of <= 20 psu. The most significant source of uncertainty related to this sub-metric is related to the assumption used in the PSR model runs that the available water will be equally distributed between 11 tidal creeks located along the shoreline. Preferential flow paths are likely to occur as a result of distributing water into the saltwater wetland zone. As a result, the pattern of water distribution may not match that used in the PSR model runs. This may result in more or fewer nearshore acres meeting the salinity target than that predicted in this sub-metric.

The estimation of all three of the ecozone performance metrics suffer from the use of averaging either of inputs and outputs. Averaging inputs and results is a necessary and many times unavoidable simplification required to develop a single result by which different alternatives are compared. The danger of using average conditions is that extreme conditions (high salinity, extended drought periods, etc.) can be the factors that limit project benefits. Where possible, the BBCW PDT looked at annual, seasonal and monthly hydrologic inputs and outputs to make sure that the "average" results also reflected to some extent the potential for benefits during extreme hydrologic conditions.

6.3.5.4 Uncertainty in Effect of Sea Level Rise on Predicted Benefits

Since the study area elevation varies between +10.0 – 0.0 feet NGVD29, it is apparent that sea level rise will affect project features and the expected ecological benefits. Corps planning guidance (EC 1165-2-211) calls for evaluating the effects of sea level rise (SLR) under multiple scenarios. The multiple scenarios recommended include analysis of sea level rise at low, intermediate and high levels at 20, 50, and 100 years following the completion of project construction. ***Figure 6-8*** below shows the expected benefit response pattern as it is impacted by sea level rise. The response curves in this figure are based on the assumption that it takes 10 years to build up to the expected maximum habitat improvement. The expected impacts to the three ecozones that result from the 20 year and 50 year high sea level rise scenarios analyzed for EC-1165-2-211 are shown by the decline in annual benefit performance after year 10. Linear interpolation is used to estimate benefit performance between the inflection points. In this analysis, there is not expected to an impact to nearshore benefits at year 20 but at year 50, these benefits are estimated to be reduced by approximately 12 percent. At year 20 the saltwater wetland benefits are estimated to be reduced by approximately 12 percent while at year 50, these benefits would be reduced by approximately 54 percent. There is not expected to be an impact to freshwater wetland benefits at year 20 but at year 50, these benefits are estimated to be reduced by approximately 52 percent. Average annual project benefits for Alternative O, Phase 1 are expected to be reduced by sea level rise by 17% over the 50 year life of the project as compared to the annualized benefit estimates for future conditions not impacted by sea level rise. Alternatives

O, Q, and YB should be somewhat less affected given that a larger percentage of their benefits come from freshwater wetland habitat.

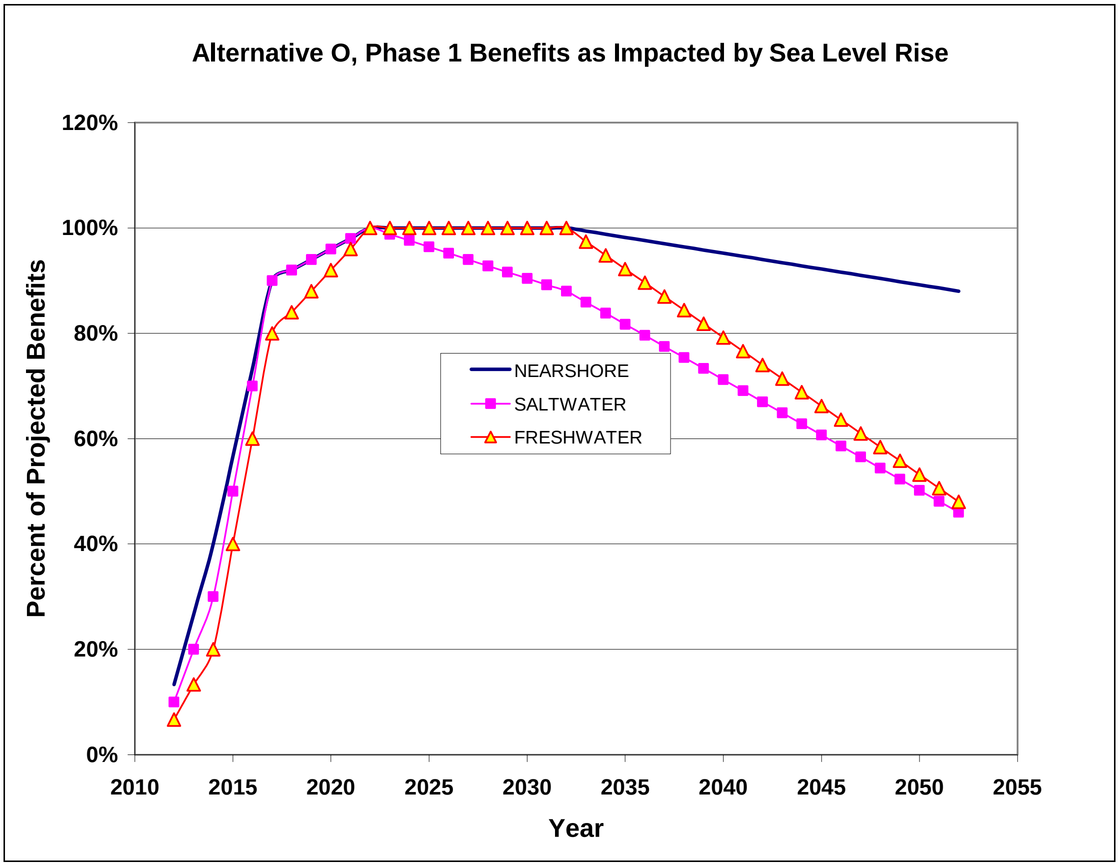


FIGURE 6-8: EFFECT OF SEA LEVEL RISE ON PROJECTED BENEFIT STREAM FOR ALTERNATIVE O, PHASE I

6.3.5.5 Conclusions

In general, the estimation of habitat restoration benefits is less a science than an art. In addition to a lack of universal measurements of “habitat condition”, there is little agreement within the scientific community regarding what constitutes scientifically defensible metrics and evaluation procedures. For each project, the study team is responsible for conceiving and implementing benefit assessment methods that likely are unique since study areas as well as hydrologic modeling tools are project specific. As with any ecosystem benefits estimation exercise, there are unlimited ways in which modeling results can be mathematically manipulated to arrive at a single number that represent the net project benefits. One methodology is not necessarily more correct than the next; however, it is important that logical methods are used and can be adequately defended. For the Biscayne Bay Coastal Wetlands project, the project delivery team created performance metrics with the goal of quantifying the expected change to habitat functionality that will result from project implementation. The team limited the assessment to three performance metrics that were design to address the critical aspects of project hydrology: rehydration of freshwater wetlands, rehydration of saltwater wetlands, and maintaining optimal salinity conditions in the nearshore. Critical aspects of project success such as water quality improvement and exotic/invasive vegetation management were included in the evaluation process as sub-metrics.

The risk and uncertainty analysis of the benefits assessment results was done in a qualitative manner since the benefit stream could not be fully characterized stochastically. Though there is uncertainty in the magnitude of the predicted benefits, there is little question that each of the proposed alternatives will improve the targeted habitat. Alternative M and Alternative O, Phase 1 presents the lowest risk of project failure simply because they have the smallest footprints. Of the two, Alternative O, Phase 1 is the least risky in terms of delivering the predicted benefits because it relies on pumps to deliver water to the saltwater wetlands east of the C-102 and C-103 rather than gravity flow as in Alternative M. The impact of sea level rise on the predicted benefit stream for Alternative O, Phase 1 is estimated to be 17% over the 50 year life of the project assuming that sea level rise is as much as 24 inches over this time period.

The greatest risk to project success is the uncertainty in the future availability of water, particularly during the late dry season. The hydrologic information provided here indicates that in the C-1, C-102, and C-103 basins there are months during the dry season where there is limited water available for diversion into the saltwater wetlands. These dry periods are only about two months long during average hydrologic years. During drought years, the dry periods can last three or more months which may be critically stressful to some of the target species. The diversion of water into the saltwater wetlands will have the effect of extending the residence time of freshwater in the nearshore, particularly in tidal creeks. This is expected to result in larger populations of the target species since long duration events of no freshwater in the nearshore should be minimized by the project. During drought years, the project is not likely to result in improved nearshore habitat; however, given that the drought events are expected to occur once in 10 years, the target species are not likely to be critically affected since their lifespan is on the order of less than a year to two or so years. Climate change (excluding sea level rise) may result in a reduction of up to 10% of the project benefits assuming a linear response to the expected reduction in rainfall over the next 50 years.

One significant complexity with developing a benefit estimation system is that the outcome and utility of the system is difficult to predict before applying it to the project plan formulation efforts. In this case, a benefits estimation system created to utilize both simulation outputs and best professional judgment was successfully applied to the evaluation of the project alternatives. While there is no single "right answer" to the estimation of habitat restoration benefits, independent external peer reviews (IEPR) of the metrics and methodologies used here were conducted under the guidance of the Ecosystem Planning Center of Expertise in September of 2009 and January of 2010. Many of the reviewers' suggestions were incorporated into the benefits assessment tools and the revised product was improved in terms of its scientific credence and overall quality. The Biscayne Bay Coastal Wetlands project team believes that the methodology for estimating habitat benefits used here employs available models, local knowledge, and scientific rigor to the extent practicable. The results of the benefits assessment are believed to adequately reflect the merits of the project alternatives. The BBCW PDT believes that using the CBEEM tool to help select the project plan minimizes the risk of selecting an alternative that causes harm or is not an optimal solution for the problems targeted by this project.

6.3.6 Significance of Ecological Benefits

As stated, the purpose of the BBCW project is to restore the natural hydrology and ecosystem in an area degraded by drainage systems and land development. The principal benefit of the project, therefore, is to redirect the fresh water that is currently discharged directly to the Bay through man-made canals to coastal wetlands in order to restore a more natural water flow pattern to Biscayne Bay. The diversion of water from canals would re-establish sheet flow, tidal creek flow, more natural hydropatterns, spatial extent of wetlands, and desirable salinity ranges for the benefit of aquatic fauna, submerged aquatic vegetation, and commercial marine resources, including threatened and endangered species inhabiting the area.

In determining the significance of project benefits to wetlands and the adjacent nearshore area of Biscayne Bay, the following factors were evaluated: institutional, technical, and public recognition of importance. The remaining freshwater and saltwater wetlands of southern Miami-Dade County are significant from an institutional perspective because they are a rare and unique resource in the area due to the intense urban and agricultural development of south Florida over the past 100 years. This resource is technically significant due to the economic value of increased productivity of commercial and recreational shrimps and fishes. Wetlands, estuaries, and nearshore coastal areas are significantly important to the public for aesthetic and recreational purposes. The northern portion of Biscayne Bay has been heavily developed such that there remains very little of the mangrove coastline except for areas within the project study area. Similar habitat south of Biscayne Bay, in the Florida Keys has also been heavily impacted by development. The overall significance of restoring wetland and nearshore habitats within the BBCW project study area is due to relative scarcity of the resource, high public demand for natural system habitat for recreational and aesthetic enjoyment, and the critical functional ecosystem value (connectivity, biodiversity, etc.) of the remaining habitat.

6.4 PLANNING LEVEL COST ESTIMATES

The cost estimate for the alternatives includes construction, lands, easements, right-of-ways, and relocation (LERR), pre-construction, engineering and design (PED) costs, and construction management. Data for initial construction/implementation, land acquisition, monitoring, and periodically recurring costs for OMRR&R, have been developed through engineering design and cost estimation, and real estate appraisal efforts (refer to ***Appendix B - Cost Estimates*** for details of data development for cost estimates).

6.4.1 Real Estate Costs

A detailed analysis of the real estate requirements of the final array was completed. Each parcel required for construction or restoration activities was identified, characterized, and a value calculated. The real estate was valued in fee, however, lesser estates and interests in land could be considered.

The project footprint for Alternative M is comprised of approximately 6,561 acres with an estimated real estate cost of $239,492,000. The project footprint for Alternative O is comprised of approximately 11,312 acres with an estimated real estate cost of $360,211,000. The project footprint for Alternative Q is comprised of approximately 19,035 acres with an estimated real estate cost of $483,801,000. The project footprint for Alternative O, Phase 1 is comprised of approximately 3,761 acres with an estimated real estate cost of $76,662,000.

The area of expected benefit for Alternative O exceeds the 11,312 acres of lands to be acquired for this project. The acquisition of the 11,312 acres covers those freshwater and tidal wetlands where project related hydrologic impacts necessitate the acquisition of lands from either private parties or local government agencies. Nearshore benefited areas do not require acquisition as they are geographically located in state/federal waters. Some BNP lands would be benefited but would not require acquisition. Within the tidal wetland area, the benefited acreage that is below the mean high water line is owned by the United States of America and will not require acquisition due to the fact that no construction will occur in these areas.

6.4.2 Construction Costs

Data for initial construction/implementation, land acquisition and periodically recurring costs for operation, maintenance, repair, replacement and rehabilitation (OMRR&R), have been developed through engineering design and cost estimation, and real estate appraisal efforts. Details of that data development are explained and discussed elsewhere in this report. The main issues requiring economic evaluation attention include equivalent time basis calculations, price levels, and timing of project spending.

Costs represent the difference between conditions without any plan (the "base condition" or "without project condition") and with a plan or alternative. For purposes of this report and analysis, NED costs (National Economic Development costs, as defined by federal and USACE policy) are expressed in 2010 price levels and are based generally on costs estimated to incur over a 40-year period of analysis. Costs of a plan represent the value of goods and services required to implement and operate/maintain the plan. The costs presented in ***Table 6-14*** are total initial costs of construction and real estate. The operation and maintenance (O&M) cost are annual estimates for fully implemented components.

TABLE 6-14: INITIAL COST OF CONSTRUCTION, REAL ESTATE AND O&M

BISCAYNE BAY COASTAL WETLANDS COSTS					
	Alternative YB	**Alternative O**	**Alternative M**	**Alternative Q**	**Alternative O Phase 1***
Construction	**$277,660,000**	**$146,900,000**	**$130,600,000**	**$272,470,000**	**$45,100,000**
S/A	$27,250,001	$14,690,000	$13,060,000	$27,250,000	$4,510,000
PED	$22,210,000	$11,710,000	$10,450,000	$21,780,000	$3,690,000
Total Construction	$327,120,001	$173,300,000	$154,110,000	$321,500,000	$53,300,000
Real Estate	$559,854,000	$360,210,000	$360,210,000	$483,800,000	$76,660,000
Total First Cost	**$886,970,000**	**$533,510,000**	**$393,600,000**	**$805,300,000**	**$129,960,000**
Annual OMRR&R	**$5,900,000**	**$3,700,000**	**$3,700,000**	**$5,990,000**	**$1,400,000**

*Costs are planning level costs based on a rough order of magnitude and do not coincide exactly with the detailed costs of the TSP presented in other sections of the report.

6.5 COMPARISON OF ENVIRONMENTAL BENEFITS AND COSTS OF ALTERNATIVE PLANS

This analysis is based on and follows guidance from the U.S. Army Corps of Engineers Institute for Water Resources publication, Evaluation of Environmental Investment Procedures Manual, Interim: Cost Effectiveness and Incremental Analyses, May 1995, IWR Report #95-R-1. Costs are based initially on a rough order of magnitude (ROM) and include pre-construction engineering and design (PED) and construction costs, Interest During Construction, as well as operations and maintenance costs after construction. The most feasible cost effective plans reflect estimates based on ROM quantities. Benefits are based on the result of the CBEEM analysis and are presented in an average annual form.

As per this guidance, CE/ICA analysis compares the alternative plans' average annual costs against the appropriate average annual habitat unit estimates. The average annual outputs are calculated as the difference between with-plan and without-plan conditions over the period of analysis (through year 2050). The following sections present the average annual costs, average annual benefits and the results of cost effectiveness and incremental cost analysis for the alternative plans

6.5.1 Cost-Effectiveness/Incremental Cost Analyses

The purpose of a CE/ICA is to evaluate and compare the production efficiency of a given set of alternatives, thus helping to identify the plan that reasonably maximizes ecosystem restoration, which is considered the NER plan. Cost effectiveness analysis begins with a comparison of the costs and outputs of alternative plans to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at the same cost, or at a lesser cost, as other alternative plans. Alternative plans identified through this comparison are the cost effective alternative plans. Next, through ICA, the cost effective alternative plans are compared to identify the most economically efficient alternative plans, that is, the "Best Buy" alternative plans that produce the "biggest bang for the buck." Cost effective plans are compared by examining the additional (incremental) costs for the additional (incremental) amounts of output produced by successively larger cost effective plans. The plans with the lowest incremental costs per unit of output for successively larger levels of output are the best buy plans. The results of these calculations and comparisons of costs and outputs between alternative plans provide a basis for addressing the decision question "Is it worth it?" i.e., are the additional outputs worth the costs incurred to achieve them?

6.5.2 Average Annual Benefits

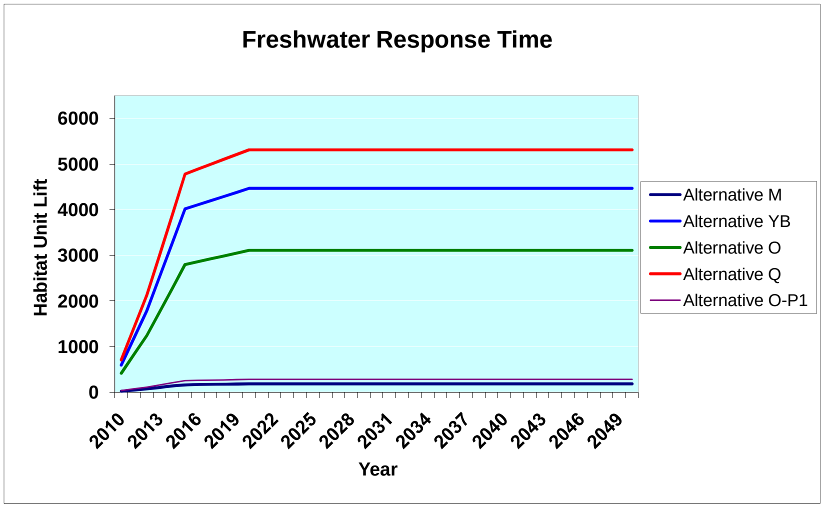
CE/ICA requires a comparison of average annual costs and average annual benefits. The average annual outputs were calculated as the difference between with-plan and without-plan conditions over the period of analysis (through year 2050). Costs and output used for the CE/ICA are displayed in ***Table 6-14***. The period of analysis for benefit amortization that was utilized is 40 years. The base year, or the first year benefits begin to accrue, is in 2010 (advanced construction of BBCW is being expedited by the non-federal sponsor). The average annual HU lift is calculated as subtracting the future without project HUs from the future with project HUs for each year and averaging over the life of the project, which in this case is 40 years. Note that the output values shown reflect the differences between without project and with project on an average annual basis (i.e., ecological "lift" provided by each of the alternatives). In order to calculate the average annual lift associated with each alternative per ecozone, it is important to project the anticipated time it will take to realize the benefits. The annual lift is calculated by measuring the delta between the no action alternative and each respective alternative for each year of the period of analysis. Since the full benefits are not achieved in the first year of construction, it becomes important to project the expected lift for each year and average each year over the period of analysis, to account for the temporal aspect of the benefits.

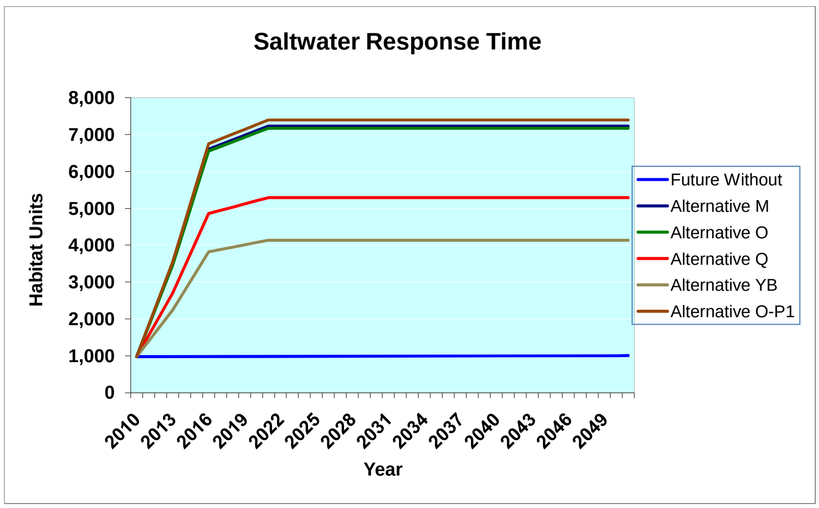
The analysis of ecological response times for large, diverse ecosystems is extremely difficult to calculate. For example, when analyzing an estuarine system, certain attributes would have to be examined when predicting the response to changes in salinity. Oysters may provide responses within a year of salinity change towards normal conditions. Seagrasses would normally respond quickly, but these responses are difficult to measure since there would be relocation of certain populations in response to specific currents and salinity concentrations. Small invertebrate and fish species should respond quickly; however, large vertebrate species would take longer to increase as they take longer to mature and reach reproductive ages.

The same difficulty occurs in the examination of freshwater systems. Different attributes, such as sawgrass marshes, periphyton mats, and bayheads respond differently in time to changes in hydroperiods and hydropatterns. Sawgrass marshes are in intense competition with other grasses, sedges and freshwater marsh species. Changes in the content of certain species could occur fairly rapidly in certain areas; however, the competition of populations and/or communities along ecozones could take a much greater amount of time for species, populations and communities to become established. Periphyton has been shown to respond rapidly to changes in hydroperiod and hydropattern. Forested wetlands, including bayheads, would take a much longer time to respond to hydrologic changes in terms of tree species transitions. As such, the team took a linear approach to predict ecological response time in each of the three ecozones that were defined as can be noted in the below table (***Table 6-15***) and for a graphical representation see ***Figure** 6-9*.

TABLE 6-15: TYPICAL ECOLOGICAL RESPONSE TIME

Ecological Response Times of Ecozones				
% benefit achieved over time				
Years	**0-2**	**2-5**	**5-10**	**10-15**
Freshwater Wetlands	20	80	90	100
Saltwater Wetlands	30	90	100	100
Nearshore Habitat	40	90	100	100





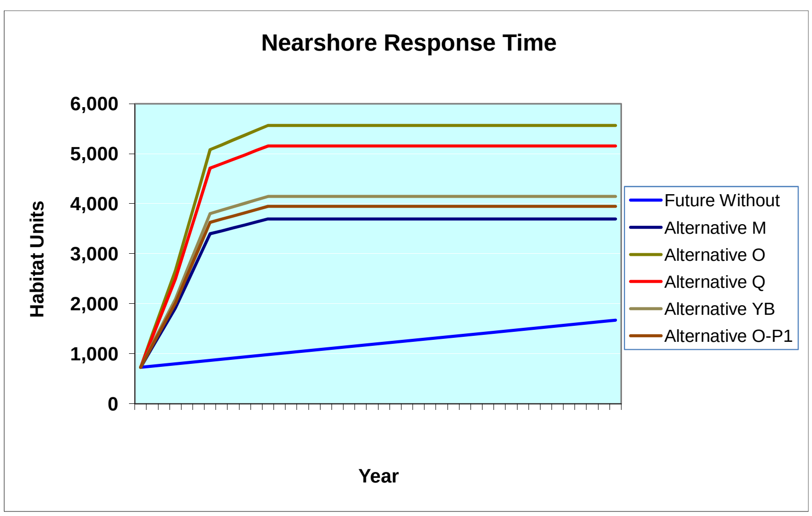


FIGURE 6-9: ECOLOGICAL RESPONSE TIMES

The following table (***Table 6-16***) presents the habitat units for the existing conditions, the 2050 without project condition and the 2050 with project conditions. The table also includes the average annual lift when taking into account the ecological response time. It should be noted that the future without project condition for Nearshore habitat is greater than the existing condition due to improved water quality that results from changes to land use within the upstream basin, so there is a greater lift in the early years of the project which leads to a higher average annual lift than what occurs in the year 2050.

TABLE 6-16: AVERAGE ANNUAL HABITAT UNITS

TOTAL HABITAT UNIT SUMMARY (NET FWO CONDITION)							
	Existing Condition	Future Without	Alternative O	Alternative M	Alternative Q	Alternative YB	Alternative O, P1
NEARSHORE HABITAT LIFT							
Functional Habitat (acres)	732	1,673	5,565	3,696	5,154	4,147	4,624
2050 HU Lift		941	3,892	2,023	3,481	2,474	2,950
Avg. Ann. HU			3,974	2,251	3,595	2,666	3,106
SALTWATER WETLAND HABITAT LIFT							
Functional Habitat (acres)	973	1,002	7,176	7,236	5,292	4,136	7,398
2050 HU Lift		29	6,174	6,234	4,290	3,134	6,396
Avg. Ann. HU			5,704	5,759	3,967	2,901	5,909
FRESHWATER WETLAND HABITAT LIFT							
Functional Habitat (acres)	3,997	3,997	7,108	4,181	9,311	8,465	4,280
2050 HU Lift			3,111	185	5,315	4,468	283
Avg. Ann. HU			2,868	171	4,900	4,119	261

6.5.3 Average Annual Costs

For purposes of this report and analysis, NED costs (NED costs, as defined by Federal and USACE policy), are expressed in 2010 price levels and are based generally on costs estimated to incur over a 40-year period of economic analysis, depending on the length of construction. These costs are included in ***Table 6-14*** and were used in the cost effectiveness analysis of the alternatives.

The timing of a plan's costs is important. Construction and other initial implementation for component costs cannot simply be added to periodically recurring costs for project operation, maintenance and monitoring. Construction costs incurred in a given year of the project cannot simply be added to construction costs incurred in other years if meaningful and direct comparisons of the costs of the different components are to be made. A common practice of equating sums of money across time with their equivalent at an earlier single point in time is the process known as discounting. Through this mathematical process, which involves the use of an interest rate (or discount rate) officially prescribed by Federal policy for use in water resource planning analysis (set at 4.375% at the time of the evaluation), the cost time stream for the alternative plans were mathematically translated into an equivalent time basis value.

There is some uncertainty as to how any of the plans, if approved and adopted, would be implemented. It is recognized that any of the plans would likely be implemented over a considerable length of time. For purposes of this evaluation, construction costs are assumed to incur on an equal monthly basis during the implementation of the alternative plans as defined.

ER 1105-2-100 requires that interest during construction be computed, which represents the opportunity cost of capital incurred during the construction period. Interest was computed for pre-construction, engineering and design costs from the middle of the month in which the expenditures were incurred until the first of the month following the estimated construction completion date. Interest during construction was computed for both real estate and construction costs. Interest during construction was computed for the total real estate cost starting from the month prior to construction commencing. The cost of a project is the investment incurred up to the beginning of the period of analysis. The investment cost at that time is the sum of construction and other initial cost such as real estate and pre-construction, engineering and design cost plus interest during construction. *Table 6-17* summarizes the total investment cost and total annual equivalent costs of each alternative plan.

TABLE 6-17: PLANNING LEVEL CONSTRUCTION AND INVESTMENT COST OF ALTERNATIVE PLANS

BBCW INVESTMENT COST					
	Alternative M	**Alternative O**	**Alternative Q**	**Alternative O P-1**	**Alternative YB**
Construction	**$130,600,000**	**$146,900,000**	**$272,470,000**	**$45,100,000**	**$277,660,000**
S/A	$10,450,000	$11,710,000	$21,780,000	$3,690,000	$22,210,000
PED	$13,060,000	$14,690,000	$27,250,000	$4,510,000	$27,250,001
Total Construction	**$154,110,000**	**$173,300,000**	**$321,500,000**	**$53,300,000**	**$327,120,001**
Construction Schedule (Months)	33	34	38	33	40
Real Estate	**$239,492,494**	**$360,210,986**	**$483,800,963**	**$76,662,218**	**$559,854,000**
Certification for IDC (Months)	36	37	41	36	43
Total First Cost	**$393,600,000**	**$533,510,000**	**$805,300,000**	**$129,960,000**	**$886,970,000**
IDC Construction	$9,440,000	$10,950,000	$25,340,000	$3,265,000	$24,500,000
IDC Real Estate	$21,120,000	$50,840,000	$76,220,000	$10,500,000	$92,840,000
TOTAL INVESTMENT	**$424,160,000**	**$595,300,000**	**$906,860,000**	**$143,730,000**	**$1,004,310,000**
O&M	$3,700,000	$3,700,000	$5,990,000	$1,400,000	$5,900,000
First Year for Benefits	2010	2010	2010	2010	2010
Amortized Cost (38 Years)	$22,640,000	$31,780,000	$48,410,000	$7,670,000	$54,130,000
Average Annual Cost	**$26,340,000**	**$35,480,000**	**$54,400,000**	**$9,070,000**	**$60,030,000**

*Note – Final Costs of Selected Plan will be revised based on additional engineering and design. NER costs do not include Recreation Cost for Plan Formulation
*Costs are planning level costs based on a rough order of magnitude and do not coincide exactly with the detailed costs of the TSP presented in other sections of the report.

6.5.4 Cost Effective Analysis

Cost effectiveness analysis begins with a comparison of the annual costs and annual outputs of alternatives to identify the least cost plan for every level of output considered. Alternative plans are compared to identify those that would produce greater levels of output at equal or lower costs than other alternative plans. The three criteria for cost effectiveness screening:

1. the same output level could be produced by another plan at less cost;
2. a larger output level could be produced at the same cost; or
3. a larger output level could be produced at less cost.

Sometimes it is difficult to summarize the results of CE/ICA when the analyses are performed separately on HUs for distinct species or communities. This phenomenon often occurs simply because different management measures or alternative plans "do" different things - provide different types of output, and provide benefits to different biological communities. This is the case for the BBCW features and alternatives, in which certain features or alternatives provide greater benefits to the freshwater wetlands in the watershed, while other alternatives provide greater benefits for the nearshore habitats. It was determined that the separate ecological zones were all considered to be of equal importance. It was also believed that a combined HU score summing all three zones, while not appropriately representing the significance of each ecological zone, would provide a valuable cumulative impact analysis for determining the plan which best meets the needs of the watershed. The results of the CE/ICA on each ecological zone were examined both independently and combined and plan selection was based upon utilizing an aggregate of these results.

The results will be demonstrated in the various following charts and graphs. In summary, CE/ICA was performed using the following four metrics to represent various ecosystem outputs of the BBCW alternatives:

1. Combined HU Score
2. Freshwater Ecological Zone
3. Saltwater Ecological Zone
4. Nearshore Ecological Zone

CE/ICA was conducted for each of the BBCW alternative plans. The analyses compared the alternative plans' average annual costs against the appropriate average annual HU estimates. The average annual outputs were calculated as the difference between with-plan and without-plan conditions over the period of analysis (through year 2050). A summary of the average annual lift calculations and average annual costs used in the CE/ICA analysis are provided in ***Table 6-18***.

The total cost of CERP is not included in this CE/ICA. The cost of the balance of the CERP features, those not included in the BBCW alternatives, is the same for all the BBCW alternatives. As such, including it in this analysis does not bring any additional insight or differentiation between alternatives. For this analysis, the difference between the alternatives can be shown through a display of the outputs and costs of each BBCW alternative without the cost of the "other CERP" features.

TABLE 6-18: COSTS AND OUTPUTS USED IN CE/ICA

Alternative	Annual Cost	Freshwater HU's	Saltwater HU's	Nearshore HU's	Total System-Wide HU's
Alternative O	$35,480,000	2,868	5,704	3,974	12,546
Alternative M	$26,340,000	171	5,759	2,251	8,181
Alternative Q	$54,400,000	4,900	3,967	3,595	12,462
Alternative YB	$60,030,000	4,119	2,901	2,666	9,687
Alternative O, P1	$9,070,000	261	5,909	3,106	9,276

Notes: Values for alternatives are differences between "Without" plan and "With" plan on an average annual basis. Values assume system benefits (ecosystem outputs that would accrue to the BBCW study area if rest of CERP were constructed).

6.5.4.1 Cost Effectiveness Analysis – Total System-Wide Combined Outputs

Table 6-19 and ***Figure 6-10*** show that Alternatives O and Alternative O Phase 1 are cost effective in the overall production of habitat units. Alternatives M has a higher average annual cost than that of Alternative O-P1, and Alternative Q and YB have a much greater annual cost than Alternative O, while providing less total benefits, rendering them non cost-effective. Alternative O has more than thirty-five hundred more habitat units than does Alternative O Phase 1. Alternative O Phase 1 produces habitat units at the lowest average cost per unit of output at $978 per habitat unit, which is about one third of the cost per habitat unit of Alternative O.

TABLE 6-19: RESULTS OF COST EFFECTIVENESS ANALYSIS: ALL PLANS ARRAYED BY INCREASING OUTPUT FOR EACH OUTPUT CATEGORY–COMBINED HABITAT UNITS

Name	Annual Cost	Combined	Cost Per HU	Cost Effective
No Action Plan	0	0		
Alternative M	$26,340,000	8,181	$3,220	No
Alternative O-P1	$9,070,000	9,276	$978	Best Buy
Alternative YB	$60,030,000	9,687	$6,197	No
Alternative Q	$54,400,000	12,462	$4,365	No
Alternative O	$35,480,000	12,546	$2,828	Best Buy

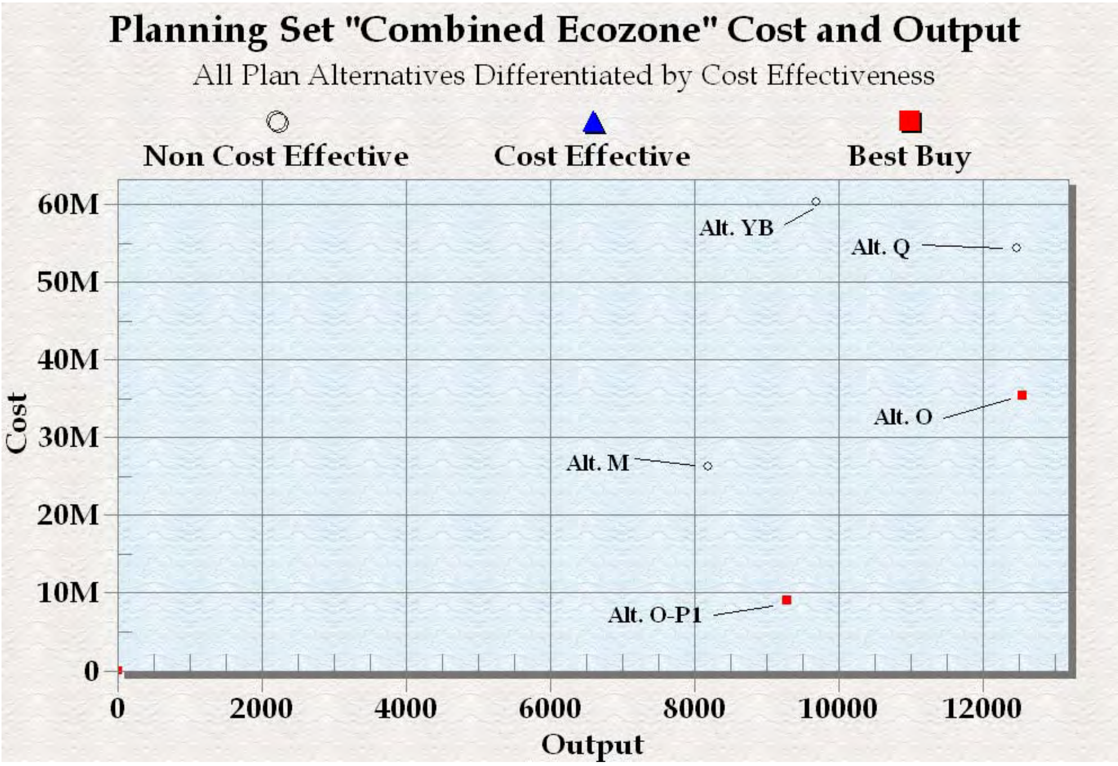


FIGURE 6-10: PLANNING SET "CE/ICA ON TOTAL SYSTEM-WIDE HABITAT UNITS" COST AND OUTPUT

6.5.4.2 Cost Effectiveness Analysis – Freshwater Zone Outputs

Table 6-20 and ***Figure*** *6-11* show that Alternative O, Alternative Q and Alternative O Phase 1 are all cost effective in the production of freshwater habitat. Alternative M provides the least average annual habitat unit lift, and this alternative also has a higher average annual cost than Alternative O Phase 1 making it non cost-effective in the production of freshwater habitat. Alternative O has more than fifteen times the total output as Alternative M, and Alternative Q has more than twenty times the total output. Alternative Q produces the greatest amount of benefits and also is the least cost per benefit, identifying it as the only best buy plan.

TABLE 6-20: RESULTS OF COST EFFECTIVENESS ANALYSIS: ALL PLANS ARRAYED BY INCREASING OUTPUT FOR EACH OUTPUT CATEGORY - FRESHWATER HABITAT UNITS

Name	Annual Cost	Freshwater	Cost Per HU	Cost Effective
No Action Plan	**$0**	**0**		
Alternative M	$26,340,000	171	$154,432	No
Alternative O-P1	$9,070,000	261	$34,763	Yes
Alternative O	$35,480,000	2,868	$12,370	Yes
Alternative YB	$60,030,000	4,119	$14,573	No
Alternative Q	$54,400,000	4,900	$11,102	Best Buy

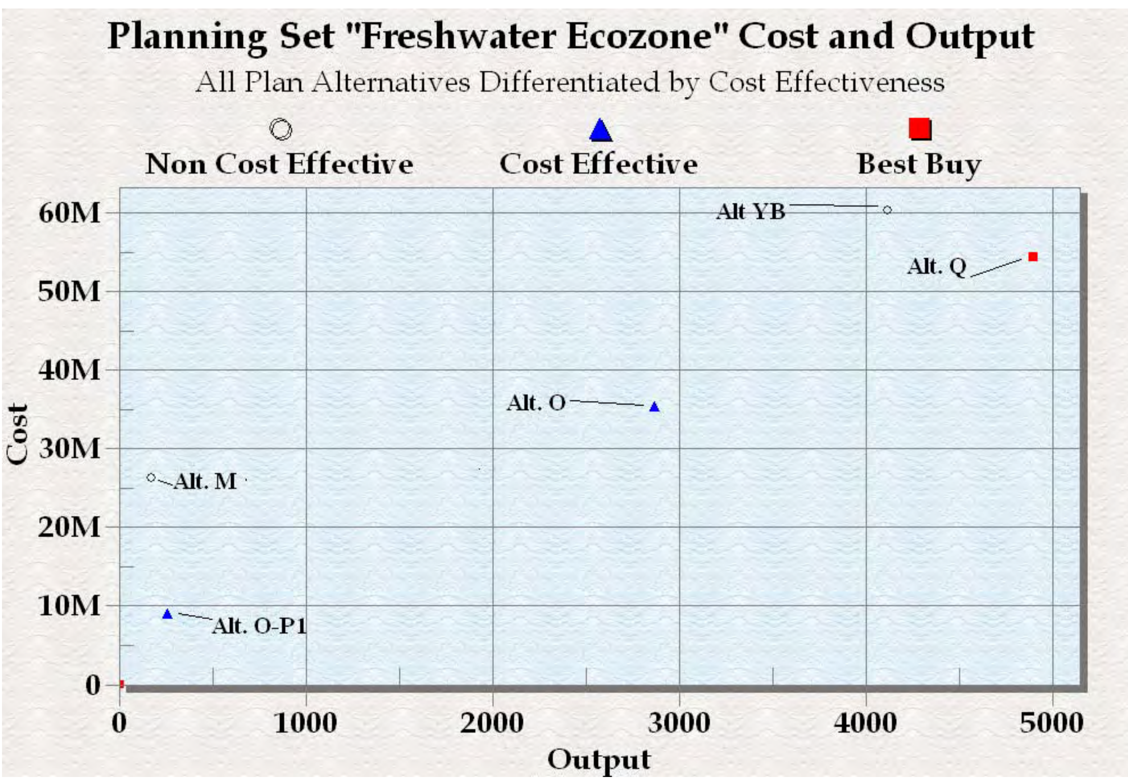


FIGURE 6-11: BBCW ALTERNATIVE PLANS– CE/ICA RUN ON FRESHWATER WETLAND HABITAT

6.5.4.3 Cost Effectiveness Analysis – Saltwater Wetlands Habitat Units

Table 6-21 and ***Figure 6-12*** show that only Alternative O Phase 1 is cost effective in the production of saltwater wetlands habitat. Alternative O produced just slightly less saltwater lift than Alternative M; the overlying reason for the cost difference between Alternatives O and Alternative M is related to freshwater and nearshore features. Alternative O Phase 1 provides approximately three percent greater average annual habitat units than Alternatives O and M, yet costs almost one-third less per unit of output than Alternative M.

TABLE 6-21: RESULTS OF COST EFFECTIVENESS ANALYSIS: ALL PLANS AND COST EFFECTIVE PLANS ARRAYED BY INCREASING OUTPUT FOR EACH OUTPUT CATEGORY–SALTWATER HABITAT UNITS

Name	Annual Cost	Saltwater	Cost Per HU	Cost Effective
No Action Plan	$0	0		
Alternative YB	$60,030,000	2,901	$20,691	No
Alternative Q	$54,400,000	3,967	$13,713	No
Alternative O	$35,480,000	5,704	$6,220	No
Alternative M	$26,340,000	5,759	$4,573	No
Alternative O-P1	$9,070,000	5,909	$1,535	Best Buy

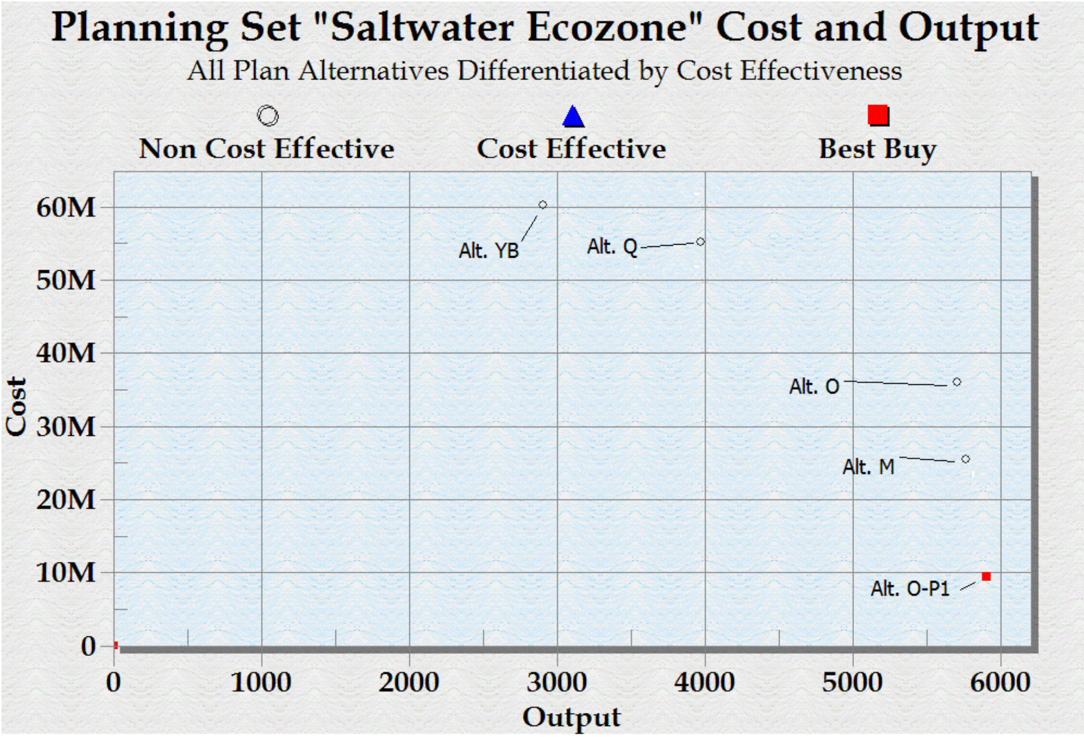


FIGURE 6-12: BBCW ALTERNATIVE PLANS – CE/ICA RUN ON SALTWATER HABITAT

6.5.4.4 Cost Effectiveness Analysis – Nearshore Habitat Units

Table 6-22 and ***Figure 6-13*** show that Alternative O Phase 1 and Alternative O are the only alternatives that are cost effective in the production of nearshore habitat. Alternative O Phase 1 has a much lower average annual cost per unit of output than does either Alternative O or Alternative M. Alternative O Phase 1 has almost 800 more habitat units than Alternative M while the average annual cost per habitat unit is less than one quarter of the average annual cost per habitat unit for Alternative M. Alternative O Phase 1 has about 25 percent fewer benefits than Alternative O while costing approximately 70 percent less.

TABLE 6-22: RESULTS OF COST EFFECTIVENESS ANALYSIS: ALL PLANS & COST EFFECTIVE PLANS ARRAYED BY INCREASING OUTPUT FOR EACH OUTPUT CATEGORY–NEARSHORE HABITAT UNITS

Name	Annual Cost	Nearshore	Cost Per HU	Cost Effective
No Action Plan	$0	0		
Alternative M	$26,340,000	2,251	$11,703	No
Alternative YB	$60,030,000	2,666	$22,513	No
Alternative O-P1	$9,070,000	3,106	$2,920	Best Buy
Alternative Q	$54,400,000	3,595	$15,133	No
Alternative O	$35,480,000	3,974	$8,928	Best Buy

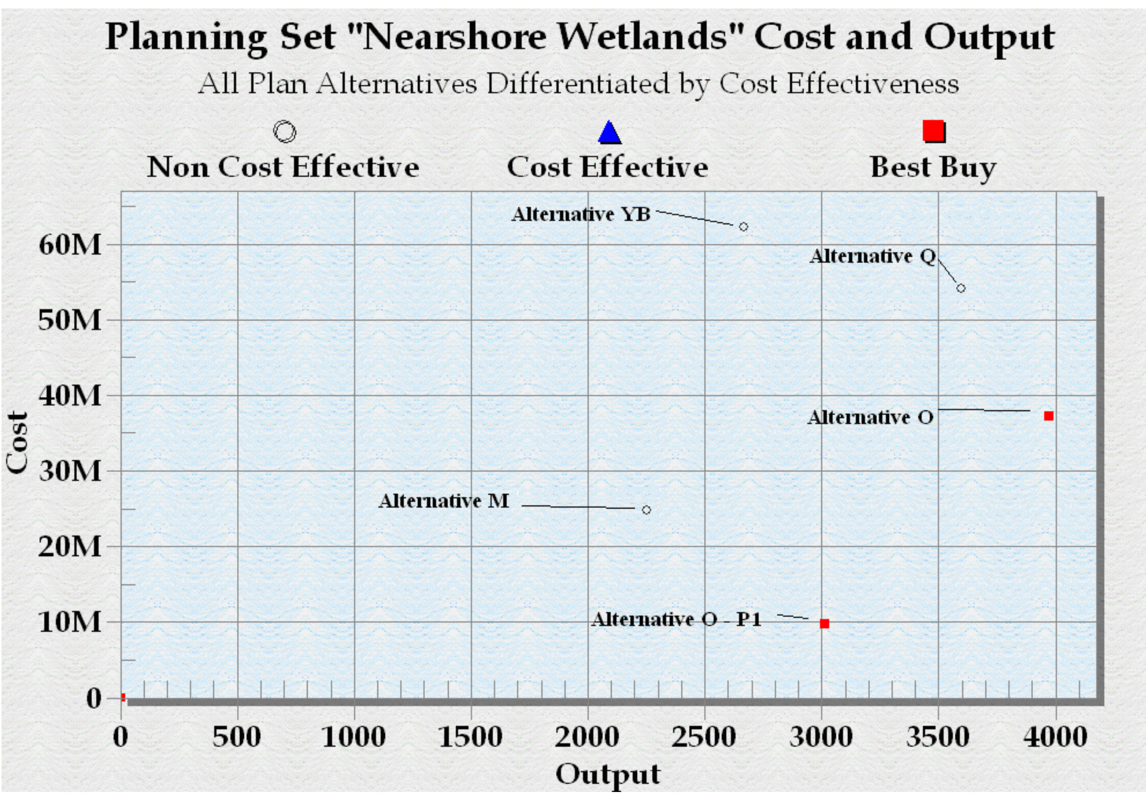


FIGURE 6-13: BBCW ALTERNATIVE PLANS – CE/ICA RUN ON NEARSHORE HABITAT

6.5.5 Incremental Cost Analysis

Table 6-23 through ***6-26*** and ***Figure 6-14*** through ***6-17*** present the results of the incremental cost analysis for the Biscayne Bay Coastal Wetlands alternative plans for respective ecological zones and the combined results. Only the cost effective plans are arrayed by increasing output to clearly show changes in cost (i.e., increments of cost) and changes in output (i.e., increments of output) of each cost effective alternative plan compared to the without plan condition. The plan with the lowest incremental costs per unit of output of all plans is the first best buy plan. After the first best buy plan is identified, all larger cost effective plans are compared to the first best buy plan in terms of increases in (increments of) cost and increases in (increments of) output. The alternative plan with the lowest incremental cost per unit of output (for all cost effective plans larger than the first best buy plan) is the second best buy plan. There are no more than two best buy plans for any ecological zone for the Biscayne Bay Coastal Wetlands alternatives.

6.5.5.1 Incremental Cost Analysis – Combined Habitat Units

Table 6-23 and ***Figure 6-14*** show that there are two best buy plans for the combined ecological zone HU production, Alternative O Phase 1 and Alternative O. Upon examination of the graph, there is an obvious jump in cost per unit of output when comparing Alternative O Phase 1 to Alternative O. Alternative O Phase 1 has the lowest incremental costs per unit of saltwater habitat output of any of the alternatives ($978 per combined habitat unit). The next best alternative in terms of average cost per combined habitat unit is Alternative O. It provides an increment of 3,270 (~35% increase) additional habitat units over Alternative O Phase 1 at an incremental cost of over $26,400,000 ($8,076 per habitat unit). Alternative O also has a higher average cost ($2,828 per habitat unit), and the incremental cost per unit of output is about eight times greater than for Alternative O Phase 1.

TABLE 6-23: RESULTS OF INCREMENTAL COST ANALYSIS: COST EFFECTIVE & BEST BUY PLANS ARRAYED BY INCREASING OUTPUT FOR COMBINED ECOLOGICAL ZONE HABITAT UNITS

	Average Annual Cost	Output	Average Cost Per Unit of Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per unit of Output
Combined Habitat Units						
Without Plan	$0	0	N/A	N/A	N/A	N/A
Alternative O-P1	$9,070,000	9,276	$978	$9,070,000	9,276	$978
Alternative O	$35,480,000	12,546	$2,828	$26,410,000	3,270	$8,076

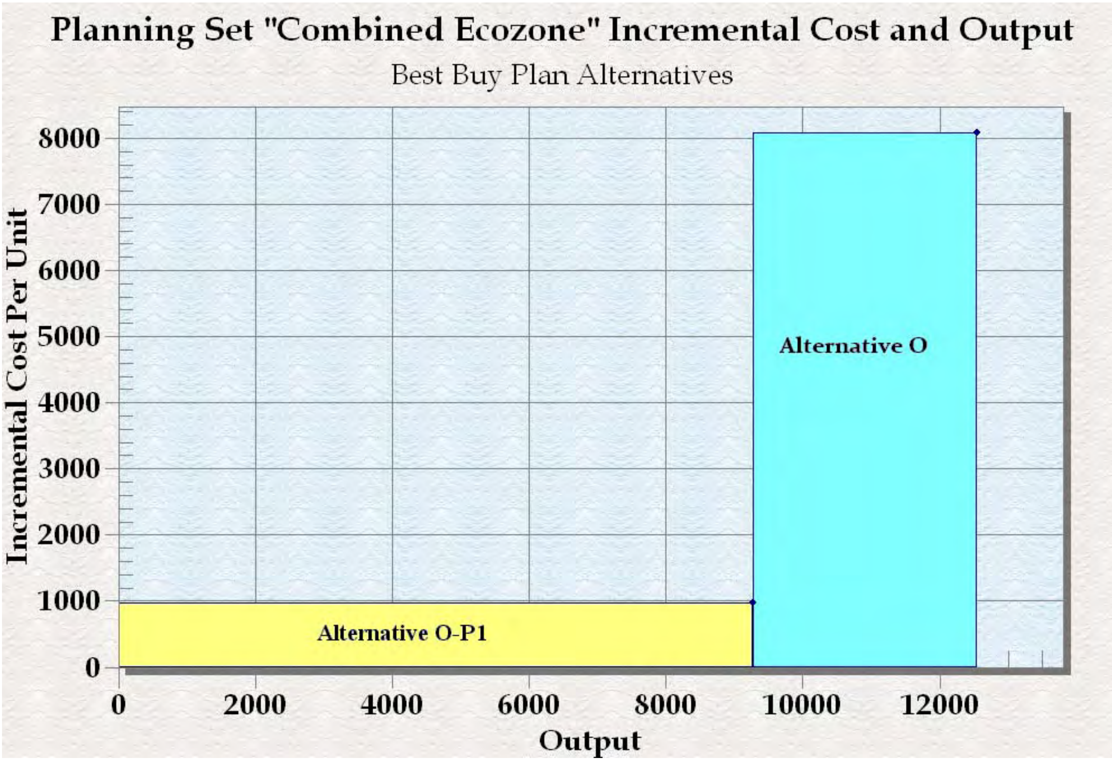


FIGURE 6-14: BEST BUY PLANS FOR COMBINED HABITAT UNITS

6.5.5.2 Incremental Cost Analysis – Freshwater Ecological Zone

Table 6-24 and ***Figure 6-15*** shows that there is only one best buy plan for freshwater wetlands habitat: Alternative Q.

TABLE 6-24: RESULTS OF INCREMENTAL COST ANALYSIS: COST EFFECTIVE & BEST BUY PLANS ARRAYED BY INCREASING OUTPUT FOR FRESHWATER HABITAT

	Average Annual Cost	Output	Average Cost Per Unit of Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per unit of Output
Freshwater Habitat Units						
Without Plan	$0	0	N/A	N/A	N/A	N/A
Alternative Q	$54,400,000	4,900	$11,102	$54,400,000	4,900	$11,102

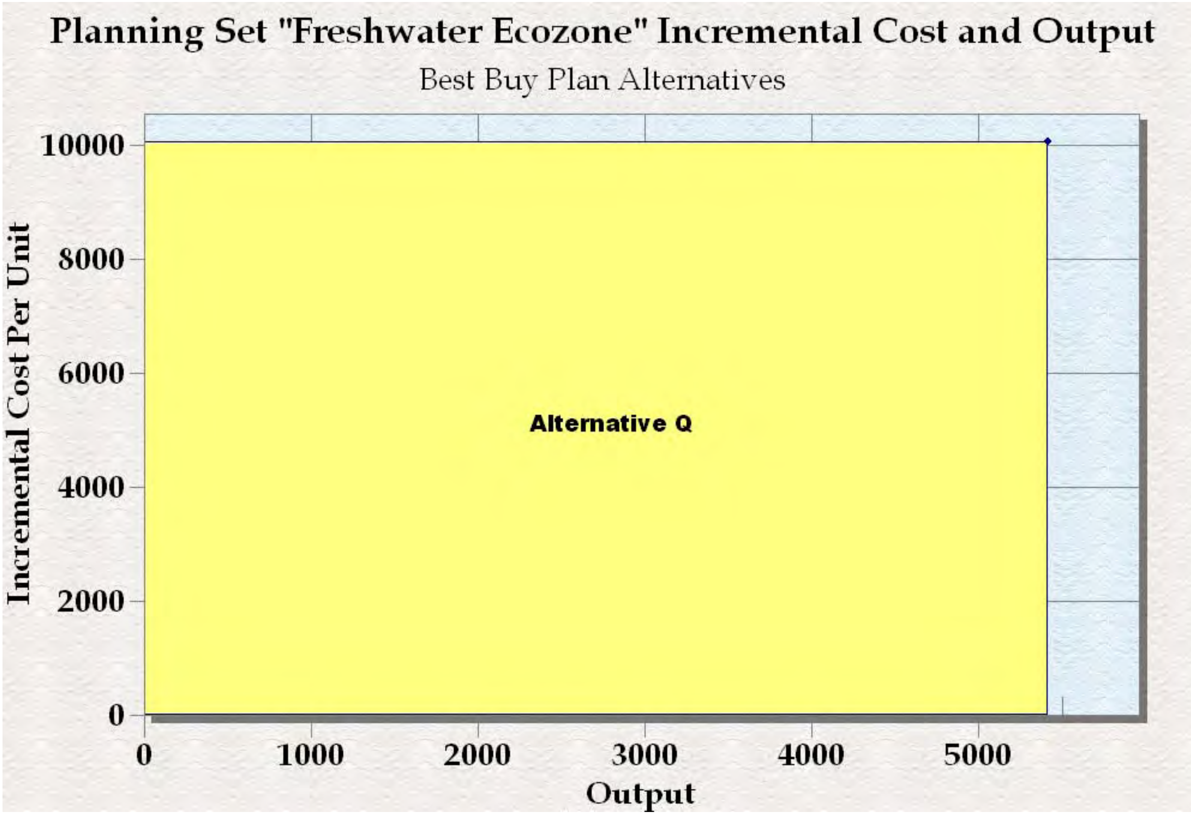


FIGURE 6-15: PLANNING SET FOR FRESHWATER WETLANDS INCREMENTAL COST AND OUTPUT

6.5.5.3 Incremental Cost Analysis – Saltwater Ecological Zone

Figure** 6-16* and ***Table 6-25 show that there is only one best buy plans for saltwater wetland habitat, Alternative O Phase 1. None of the other alternatives are cost effective in the production of saltwater habitat units.

TABLE 6-25: RESULTS OF INCREMENTAL COST ANALYSIS: COST EFFECTIVE & BEST BUY PLANS ARRAYED BY INCREASING OUTPUT FOR SALTWATER ECOLOGICAL ZONE

	Average Annual Cost	Output	Average Cost Per Unit of Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per unit of Output
Freshwater Habitat Units						
Without Plan	$0	0	N/A	N/A	N/A	N/A
Alternative O-P1	$9,070,000	5,909	$1,535	$9,070,000	5,905	$1,535

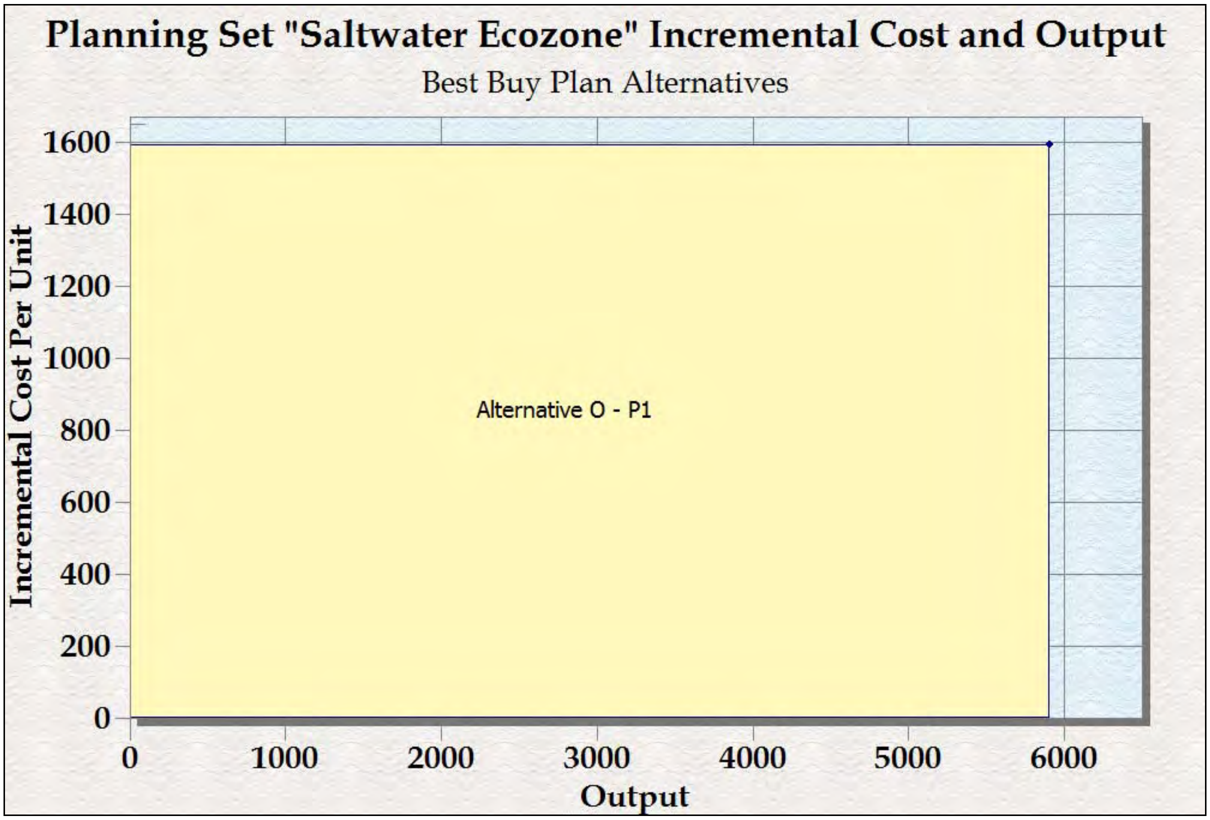


FIGURE 6-16: BEST BUY PLANS FOR SALTWATER WETLAND HABITAT

6.5.5.4 Incremental Cost Analysis – Nearshore Ecological Zone

Table 6-26 and *Figure 6-17* show that there are two best buy plans for the production of nearshore wetland habitat, Alternative O and Alternative O Phase 1. Alternative O Phase 1 has the lowest incremental costs per unit of nearshore output than all of the other alternatives ($2,920/habitat unit). Alternative O provides approximately thirty percent more output than does Alternative O Phase 1, but comes at an incremental cost per unit of output that is almost ten times greater than the incremental cost per unit of output that Alternative O Phase 1 produces.

TABLE 6-26: RESULTS OF INCREMENTAL COST ANALYSIS: COST EFFECTIVE AND BEST BUY PLANS ARRAYED BY INCREASING OUTPUT FOR NEARSHORE HABITAT

	Average Annual Cost	Output	Average Cost Per Unit of Output	Incremental Average Annual Cost	Incremental Output	Incremental Cost Per unit of Output
Combined Habitat Units						
Without Plan	$0	0	N/A	N/A	N/A	N/A
Alternative O-P1	$9,070,000	3,106	$2,920	$9,070,000	3,106	$2,920
Alternative O	$35,480,000	3,974	$8,928	$26,410,000	868	$30,426

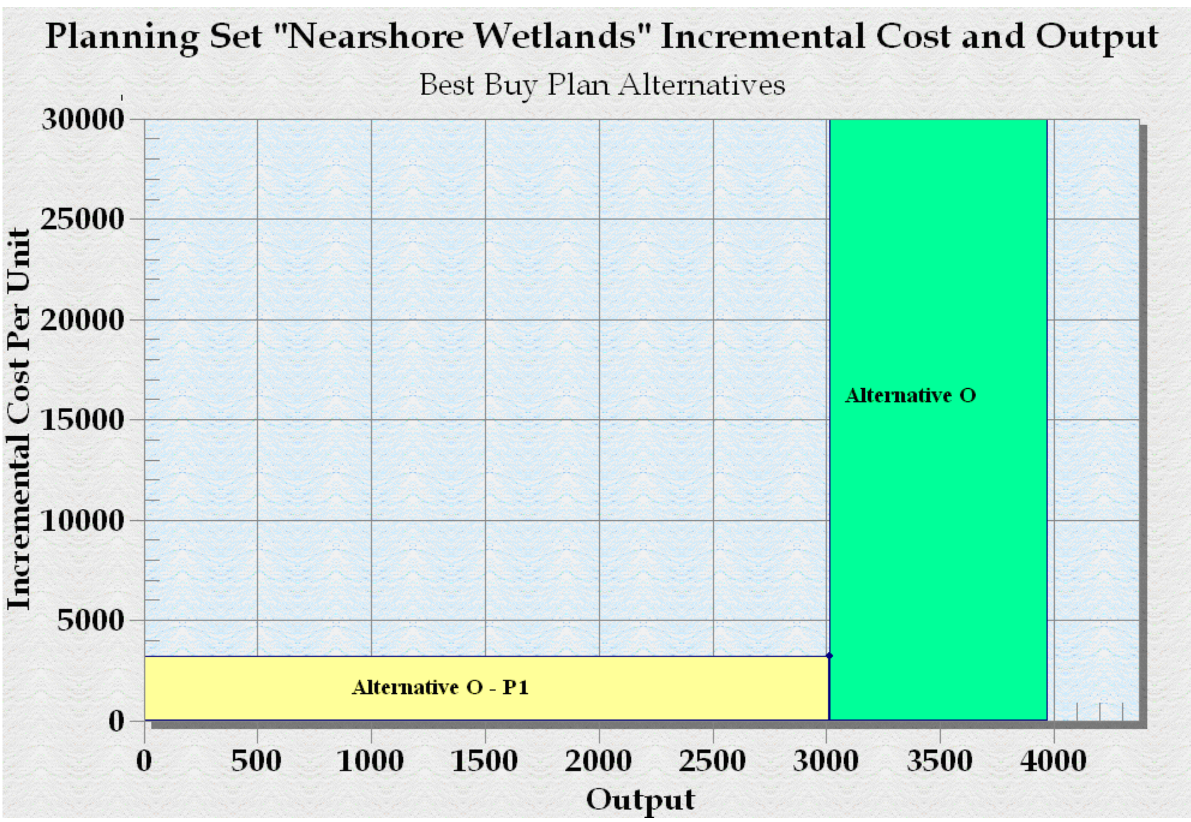


FIGURE 6-17: BEST BUY PLANS FOR NEARSHORE HABITAT UNITS

6.5.5.5 Summary of Cost Effectiveness/Incremental Cost Analysis

As can be seen in the following summary table, Alternative O Phase 1 is the only plan that is cost effective for the combined ecological zone and all of the ecological zones separately while examining the system-wide impacts of the Biscayne Bay

Coastal Wetlands alternatives implementation. Alternative O Phase 1 is also the most efficient at producing Nearshore, Saltwater and Combined Wetland Habitat Units. None of the other alternatives are cost effective in all three ecological zones, and only Alternative O is also effective and best buy plans in the production of combined eco-zone output. Alternative Q is the most efficient plan at producing habitat for the freshwater zone. Alternatives M and YB are not cost effective for any of the ecological zones. Alternative O Phase 1 will provide substantial ecological restoration benefits. Alternative O is not considered a cost effective plan in saltwater restoration since it produces approximately the same saltwater habitat units as Alternative M, but at a much higher cost. It should be noted that the cost increase between Alternative O Phase 1 and Alternative O is attributed to substantially greater freshwater wetland improvements.

TABLE 6-27: RESULTS OF CE/ICA

	Alternative O Phase 1	Alternative M	Alternative O	Alternative Q	Alternative YB
Combined Habitat Units	Cost Effective and Best Buy		Cost Effective and Best Buy		
Freshwater Ecological Zone	Cost Effective		Cost Effective	Cost Effective and Best Buy	
Saltwater Ecological Zone	Cost Effective and Best Buy				
Nearshore Ecological Zone	Cost Effective and Best Buy		Cost Effective and Best Buy		

6.6 NATIONAL ECOSYSTEM RESTORATION PLAN

As a result of the cost effective/incremental cost analysis, Alternative O Phase 1 was identified as the National Ecosystem Restoration plan. It is the plan that reasonably maximizes the production efficiency for each of the ecological zones, in that it contains the lowest average cost per unit of output, is cost effective for all ecological zones, and is a logical first step towards achieving restoration of the Biscayne Bay Coastal Wetlands study area, given the currently available quantity of water that is usable for the project. This alternative provides a substantial improvement in the much needed restoration of the Biscayne Bay nearshore and saltwater wetlands.

6.6.1 Alternative O – Phase II

Alternative O is a cost effective plan and would provide more comprehensive watershed restoration than Alternative O Phase 1 (due to the large increases in freshwater wetland benefits), and thus has been identified as the environmentally preferred plan. Alternative O Phase 1 is a compatible subset of Alternative O, therefore the remaining components of Alternative O, including the Barnes Sound component, could be further studied and constructed in the future, with no conflicts with the current Alternative O Phase 1 configuration.

As previously described, Alternative O Phase I was identified as the NER plan primarily due to the current availability of water deliveries. Although there is no set schedule to proceed with Phase II planning at this time, as the increased water deliveries required to realize the full utility of the Phase II components become available via the construction of other projects, consideration of Phase II implementation will be supportable.

6.7 PLANNING PRINCIPLES AND GUIDELINES EVALUATION CRITERIA

The final array of alternatives was evaluated using the Planning Principles and Guidelines (P&G) evaluation criteria. These are:

- Acceptability,
- Completeness,
- Efficiency, and
- Effectiveness.

Acceptability is the workability and viability of the alternative plan with respect to acceptance by state and local entities and the public and compatibility with existing laws, regulations, and public policies.

Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects.

Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

In the following table (***Table 6-28***), each plan, except the "No Action" alternative, was rated on a scale of 0 to 2 on the ability of each plan to meet the specified criteria (0 = does not meet; 1 = partially meets; 2 = fully meets).

TABLE 6-28: P&G EVALUATION CRITERIA

	Alt A (No Action)	Alt YB (Restudy)	Alt M	Alt Q	Alt O	Alt O, Phase 1
Acceptability	0	0	1	0	1	2
Completeness	0	2	1	2	2	1
Efficiency	0	1	1	0	2	2
Effectiveness	0	2	1	2	2	1

Alternative O is the alternative that best meets the P&G evaluation criteria. The "No Action" alternative does not meet any of the P&G criteria.

6.8 SUMMARY OF OUTPUTS FOR THE FOUR ACCOUNTS

While the CE/ICA of the various alternatives in obtaining habitat outputs is the primary evaluation technique in the selection of the NER plan. Engineering Circular (EC) 1105-2-409 states that in regards to plan selection: "Any alternative plan may be selected and recommended for implementation if it has, on balance, net beneficial effects after considering all plan effects, beneficial and adverse, in the four Principles and Guidelines evaluation accounts: NED, Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE)."

This section provides a full discussion and display of the beneficial and adverse effects of each plan, and a comparison of costs and effects among plans as well as cumulative effects.

6.8.1 National Economic Development

NED benefits are defined as increases in the economic value of the goods and services that result directly from a project. These are benefits that occur as a direct result of the project and are national in perspective. Benefit categories considered by the BBCW analysis include recreation, water supply and flood control. While these three categories represent important national considerations this project is not formulated to maximize NED benefit streams. NED benefits of the BBCW project would therefore be classified as incidental. Water supply and flood control benefits would be included only as a qualitative discussion. Recreation benefit quantification is necessary as those benefits would be used to offset costs of construction of proposed recreation features.

6.8.2 Environmental Quality

Cultural Resources: The USACE has reviewed information regarding historical properties that might be affected by the BBCW project, in compliance with Section 106 of the National Historic Preservation Act of 1966 (PL 89-665), As Amended; its implementing regulations (36 CFR Part 800) and the Archaeological and Historic Preservation Act of 1974 (PL 93-291), as amended.

A review of the Florida Master Site Files indicated several known archaeological sites within the BBCW project area. These sites include one of the oldest prehistoric sites in the state, Deering Estates an early 20th century historic site listed on the National Register of Historic Places, and the "Old Cutler Road" designated as a State Historic Highway. These include: 8DA7 (Cutler Key), 8DA8 (Cutler Mound), 8DA2001 (Cutler Fossil Site), 8DA2815 (Deering Estate historic district), 8DA2815D (historic wall), 8DA6518 (historic road), 8DA11247 (historic road), and 8DA2815C (Deering Estate Bridge). Due to the existence of known historical properties, tree islands and the high probability of unrecorded sites within the general vicinity that have the potential to be impacted by construction, a professional archaeological survey was completed in September 2007. Cultural resources including prehistoric archeological sites as well as historic structural and archeological sites were considered in this survey.

Coordination with the State Historic Preservation Officer (SHPO), the Miccosukee Tribe of Florida, and the Seminole Tribe of Florida was conducted. All consulting parties concurred with the Corps determination of no potential effect to historic properties eligible for listing on the National Register of Historic Places.

The Environmental Quality outputs for this project were portrayed as habitat outputs/units and were assessed for cost effectiveness and incremental cost.

6.8.3 Regional Economic Development

All alternatives are anticipated to provide RED benefits. In particular the construction of any recommended features would have a beneficial effect on employment and demand for local goods and services during the construction period. In addition, if recreational features are included it is anticipated that some lasting benefits would accrue to the area as a result of additional recreational use and the associated economic activity. The Economic Appendix contains the economic impact the construction expenditures have on employment, sales and gross regional product.

6.8.4 Other Social Effects

Potential areas of social effects have been assessed as part of the study process. The key areas analyzed to date are summarized below. Relatively similar impacts would be anticipated for all alternatives, greater water supply benefits could result from the larger reservoir alternatives.

Prime and Unique Farmland: The majority of land within the project area is coastal wetlands and nearshore/open bay habitat with minimal potential for reduction in unique farmland. While some property has already been purchased there will be some loss of farmland associated with the project.

Environmental Justice: *Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires the federal government to achieve environmental justice by identifying and addressing high, adverse and disproportionate effects of its activities on minority and low-income populations. It requires the analysis of information such as the race, national origin and income level for areas expected to be impacted by environmental laws, regulations and policies. It also requires federal agencies to identify the need to ensure the protection of populations relying on subsistence consumption of fish and wildlife, through analysis of information on such consumption patterns and the communication of associated risks to the public.
BBCW project would provide benefits to quality of life by improving the estuarine environment. The project would improve the quality of human life by providing improved estuarine conditions for fish and wildlife. It would translate into aesthetic and economic benefits for sport fishing and other recreational communities. No home owners would be displaced by the project.

The BBCW project does not present any environmental impacts that are high, adverse and disproportionate to low income, minority, or Tribal populations. Through the public participation process of the outreach and NEPA scoping, no high or adverse impacts were identified. There was sufficient public input to feel confident that scoping was successful and that the breadth of the potential impacts were communicated and understood by the public.

6.9 SELECTED PLAN

It is recommended to authorize and construct Alternative O Phase 1, the first increment of the BBCW project, a subset of the Watershed Plan Alternative O. The first increment has been identified to provide benefits towards achieving the project objectives, but also acknowledging the risk and uncertainty inherent in this project and incorporate the concepts of AM. The first increment contains most of the features of the Deering Estate sub-component including a 100 cfs pump, spreader canal, culverts and improvements to a canal. In the Cutler Wetlands sub-component, the selected plan includes a 400 cfs pump, culverts, a canal, and restoration of the Lennar Flowway. In the L-31E Flowway/North Canal Flowway sub-component, the selected plan includes pumps, a spreader canal and several culvert structures to manage water flow between C-102, L-31E, Military Canal, C-103 and nearby wetland restoration areas. No construction activities are recommended in the first increment for the Barnes Sound sub-component.

In order to describe the benefits attributable to the recommended construction features, the amount of flow diverted from canals and into wetlands was calculated. The acres of land estimated to benefit from rehydration was calculated. No qualitative adjustments were made to the acres calculated to arrive at HUs. For Alternative O, the total of nearshore, freshwater and tidal wetlands that could be hydrated with the available water (as shown in the NAI analysis) was 10,134 acres. The recommended construction features would be able to hydrate 4,594 acres or 45 percent of the acres for Alternative O.

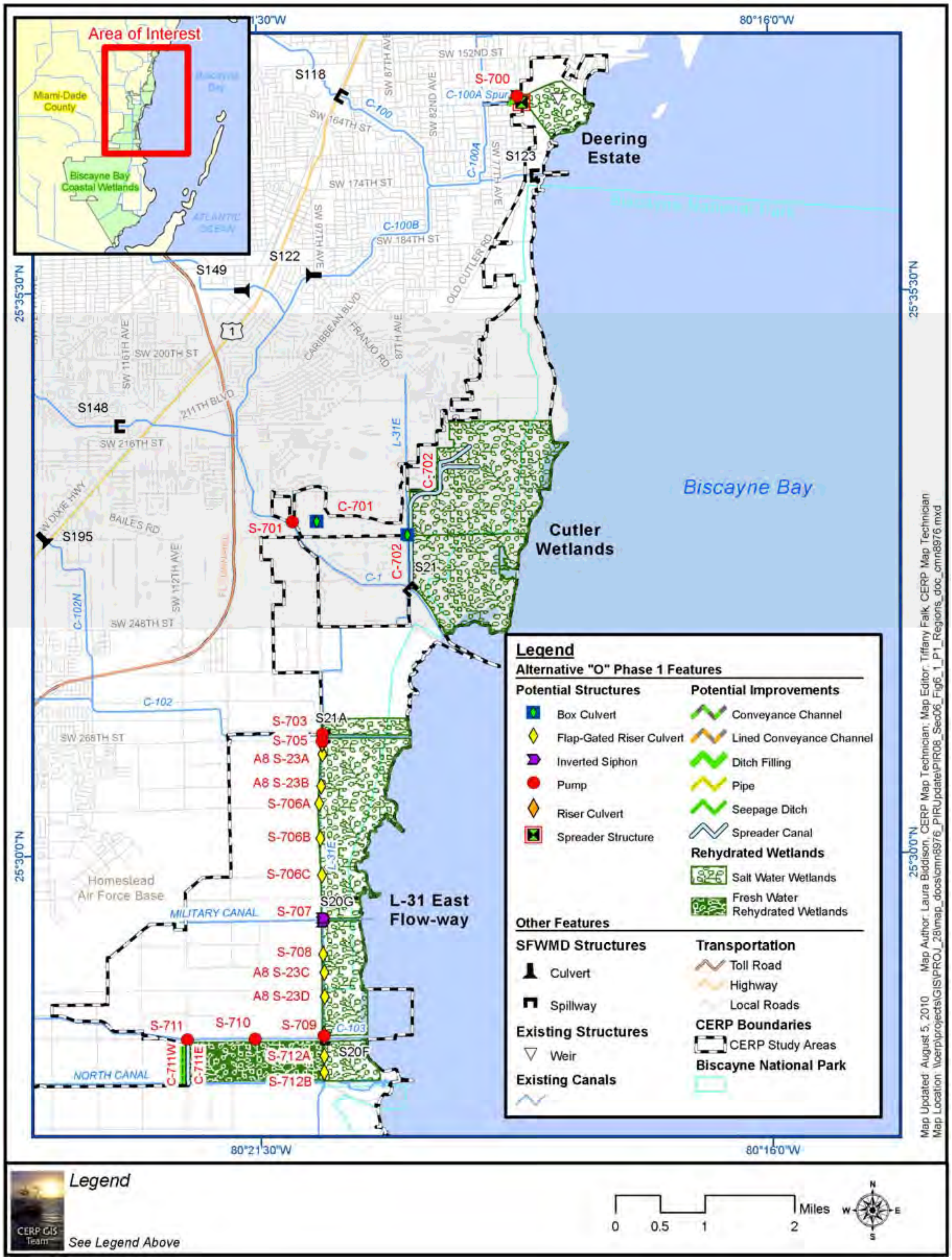


FIGURE 6-18: SELECTED PLAN

SECTION 7
THE SELECTED PLAN

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7.0 THE SELECTED PLAN

The Biscayne Bay Coastal Wetlands project is planned and designed to rehydrate coastal wetlands and reduce damaging point source freshwater discharge to Biscayne Bay. The project will be implemented in two phases. The Selected Plan of this PIR, Alternative O Phase 1, seeks to restore approximately 400 acres of freshwater wetlands, reestablish overland flows to the estuary, and improve salinity patterns in Biscayne Bay. The remaining features of Alternative O, which will be studied in a subsequent report, would further achieve the goals of the CERP by increasing the extent of freshwater wetlands and further restoration of historic overland flow patterns. The Selected Plan reasonably maximizes restoration benefits compared to costs, is cost effective and a best buy, and provides opportunities to reduce the decision critical uncertainties necessary to plan and evaluate the Biscayne Bay Coastal Wetland features. The Selected Plan is consistent with project goals and objectives, is estimated to have a total project first cost of $168,023,000 (does not include sunk PIR costs which total $22,995,500), and annual costs associated with vegetation management, endangered species act monitoring, and project level monitoring have been identified. The amount requested for authorization is **$191,018,000** (includes the first cost and sunk costs).

In addition to the ecosystem benefits, the Selected Plan would provide incidental benefits of improved flood risk management through diversion of canal discharges to the coastal wetland/spreader system. This potentially reduces the capacity demand on the regional flood control system while providing more natural and historic overland flows through the rehydrated coastal wetlands and producing a more natural and desirable distribution of estuarine salinities within Biscayne Bay.

7.1 DESCRIPTION OF PLAN COMPONENTS

Alternative O Phase I was identified as the Selected Plan for the Biscayne Bay Coastal Wetlands project through the formulation process described in ***Section 5.0***. The Selected Plan was subsequently refined based on the engineering and design and described below and in ***Appendix A***. The additional engineering and design analysis does not affect the plan formulation, as the cost changes and project refinements would apply to all alternatives. Similarly, the total benefits derived by the plan do not change based on these refinements.

The Selected Plan encompasses a footprint of approximately 3,761 acres and includes features in three of the four sub-components studied: Deering Estate, Cutler Wetlands, and L-31 E Flow Way (***Figure 7-1)***. There are no features in the fourth region, Model Lands.

7.1.1 Deering Estate

This region includes an approximately 500-foot extension of the C-100A Spur Canal through the Power's Addition Parcel (Power's Parcel), construction of a freshwater wetland on the Power's Parcel and delivery of fresh water to the Cutler Creek and ultimately to coastal wetlands along Biscayne Bay. The wetland will be created using a pump station, S-700, to withdraw water from C-100A Spur Canal (100 cfs), 538 linear feet of 60" pipe south of the new pump station running under Old Cutler Road to Outlet, and a spreader structure on the east side of Old Cutler Road to discharge to coastal wetlands in Deering Estate. See ***Table 7-1*** and ***Figure 7-2***.

7.1.2 Cutler Wetlands

Features in this region includes a pump station on C-1 Canal (400 cfs), 7000 +/- linear feet of lined conveyance canal, 13,160 linear feet of spreader canal, box culverts under SW 97 Ave, SW 87 Ave and L-31E, and mosquito control ditch plugs (2,500 linear feet) to discourage the unnatural channelization of the water delivered to the area by the spreader canals (***Table 7-1*** and ***Figure 7-3)***.

The pump station, located on C-1, will deliver water to a 7000 +/- linear feet lined conveyance canal that will run under SW 97th Avenue, SW 87th Avenue (L-31E Levee), and across the L-31E Borrow Canal via concrete box culverts and deliver water to the spreader canal located in the saltwater wetlands. This spreader canal is divided into four segments.

7.1.3 L-31 East Flow Way

Features in this region include a pump station (50 cfs) with outlet spreader to deliver water to saltwater wetlands, pump station (100 cfs) to discharge south to L-31E Borrow Canal, inverted siphon to isolate Military Canal from L-31E, 10 riser structures with flap gated culverts to discharge from L-31E to saltwater wetlands east of L-31E, pump station (40 cfs) to discharge from C-103 north into L-31E, pump station (40 cfs) and spreader canal to deliver water to freshwater wetlands south of C-103, and a pump station (40 cfs) and spreader structure to deliver water to freshwater wetlands south of C-103.

Features in this region will isolate the L-31E Canal from the major discharge canals (C-102, Military Canal and C-103) and to promote freshwater flow through the L-31E Levee into the saltwater wetlands. Gated culverts and inverted siphon structures will isolate L-31E Levee from these canals, allowing the L-31E Borrow Canal to maintain higher water levels. Two pump stations and a series of culverts will move fresh water directly to the saltwater wetlands east of L-31E Levee. Two more pump stations and a spreader canal will deliver water to the freshwater wetlands south of C-103 (***Table 7-1, Figure 7-4***, and ***Figure 7-5***).

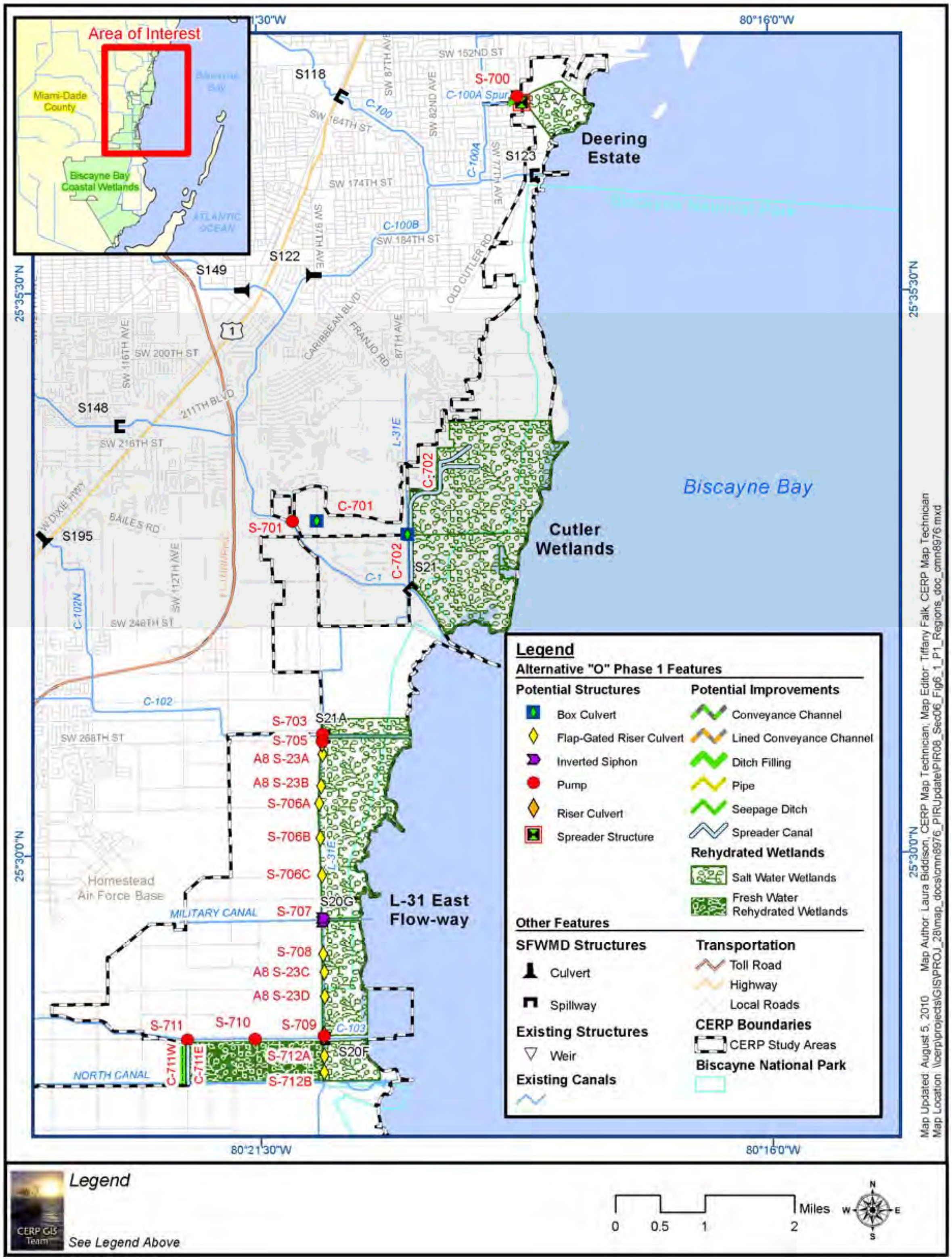

FIGURE 7-1: THE SELECTED PLAN-ALTERNATIVE O PHASE I

TABLE 7-1: SUMMARY OF ALTERNATIVE O PHASE 1 STRUCTURES

Structure Number	Structure Type	Design Capacity (cfs)	Location	Tech Specs & Notes
DEERING ESTATE				
S-700	Pump Station	100	East of C-100A Spur Canal, Power's Addition Parcel	Delivers water from C-100A Spur Canal to historic flow way on Deering Estate, Culvert from pump station under Old Cutler road, including outlet spreader structure
C-100A	Canal Extension	100	Extension of Existing C-100A Spur Canal Power's Addition Parcel	Delivers water to historic flow way on Deering Estate
Pipe	60" pipe	100	South of new pump station running under Old Cutler Road to Outlet	Delivers water from pump station to Spreader canal
Deering Estate Spreader Structure	Spreader Canal	100	East side of Old Cutler Road	Delivers water to coastal wetlands in Deering Estate
CUTLER WETLANDS				
S-701	Pump Station	400	On C-1 Canal	Delivers water from C-1 to C-701 and eventually to C-702 (Spreader Canal)
C-701	Lined Canal	400	Lennar Property	Delivers water from S-701 Pump Station to the Cutler Spreader Canal (C-702)
C-702	Spreader Canal	400	Cutler Wetlands	Delivers water to the saltwater wetlands via overland sheetflow
L-31 EAST				
S-703	Pump Station	50	On L-31 E Canal, just north of C-102	Delivers water to the saltwater wetlands, utilizes an outlet spreader structure
S-705	Pump Station	100	On L-31 E Canal, just south of C-102 intersection	Delivers water from C-102 to southern reach of L-31 E Borrow Canal
S-706A, B, C	Culvert	Varies	L-31E Levee	Delivers water from L-31 E Canal to saltwater wetlands to the east
S-708	Culvert	Varies	L-31 E Levee	Delivers water from L-31 E Canal to saltwater wetlands to the east
S-23 A, B, C, D	Culvert	Varies	L-31 E Levee	Delivers water from L-31 E Canal to saltwater wetlands to the east
S-707	Inverted Siphon	Varies	Intersection of L-31 E Canal and Military Canal	Will connect L-31 E Canal on the north and south sides of Military Canal while isolating flows from Military Canal
S-709	Pump Station	40	On L-31 E Canal, just north of C-103 intersection	Delivers water from C-103 north to L-31 E Canal
S-710	Pump Station	40	Approximately 0.7 miles west of L-31 E Canal on south bank of C-103	Delivers water from C-103 to the freshwater wetland (between C-103 and North Canal, west of L-31 E Canal) via a spreader structure

Structure Number	Structure Type	Design Capacity (cfs)	Location	Tech Specs & Notes
S-711	Pump Station	40	Approximately 1.4 miles west of L-31 E Canal on south bank of C-103	Delivers water from C-103 to the freshwater wetland (between C-103 and North Canal, west of L-31 E Canal) via a spreader canal (C-711)
C-711E	Spreader Canal	40	Approximately 1.4 miles west of L-31 E Canal, between C-103 and North Canal	Delivers water from S-711 Pump Station to the freshwater wetland via overland sheetflow
C-711W	Seepage Collection Ditch	Varies	Approximately 1.4 miles west of L-31 E Canal, between C-103 and North Canal	Collects seepage from C-711E spreader canal and delivers it back to C-103
S-712A&B	Culvert	Varies	L-31 E Levee	Delivers water from L-31 E Canal to saltwater wetlands to the east

Key: cfs =cubic feet per second

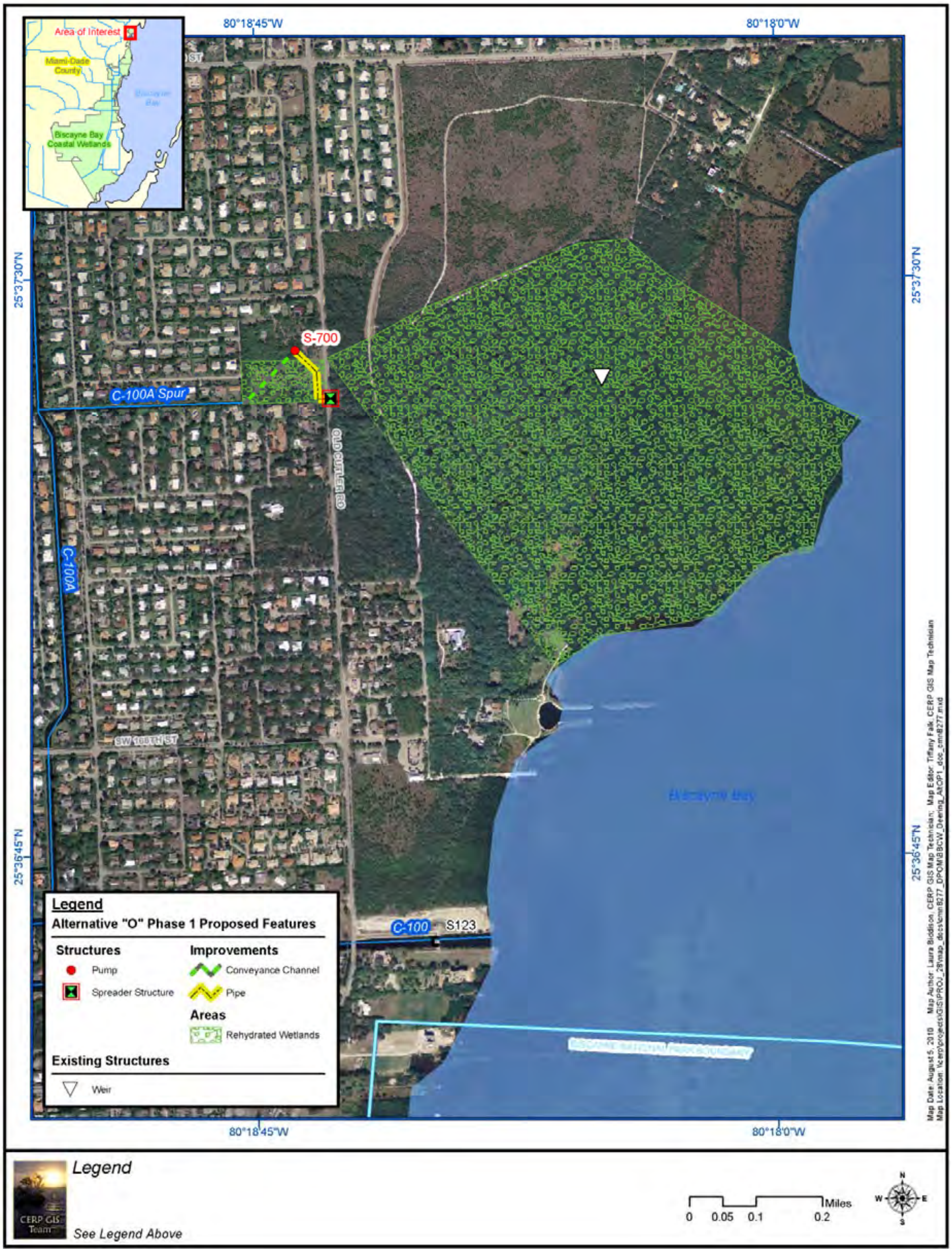

FIGURE 7-2: DEERING ESTATE PROJECT FEATURES

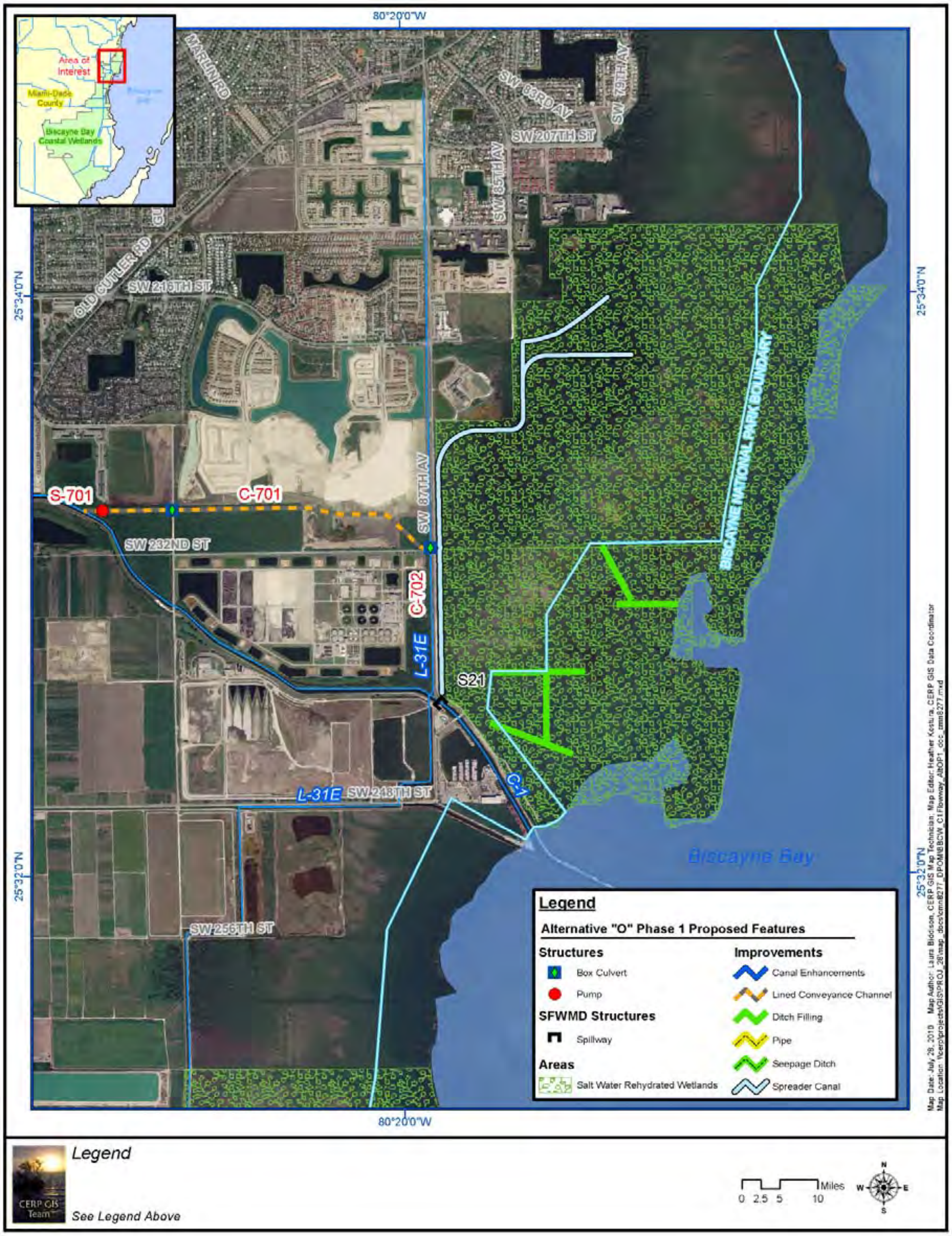

FIGURE 7-3: CUTLER WETLANDS PROJECT FEATURES

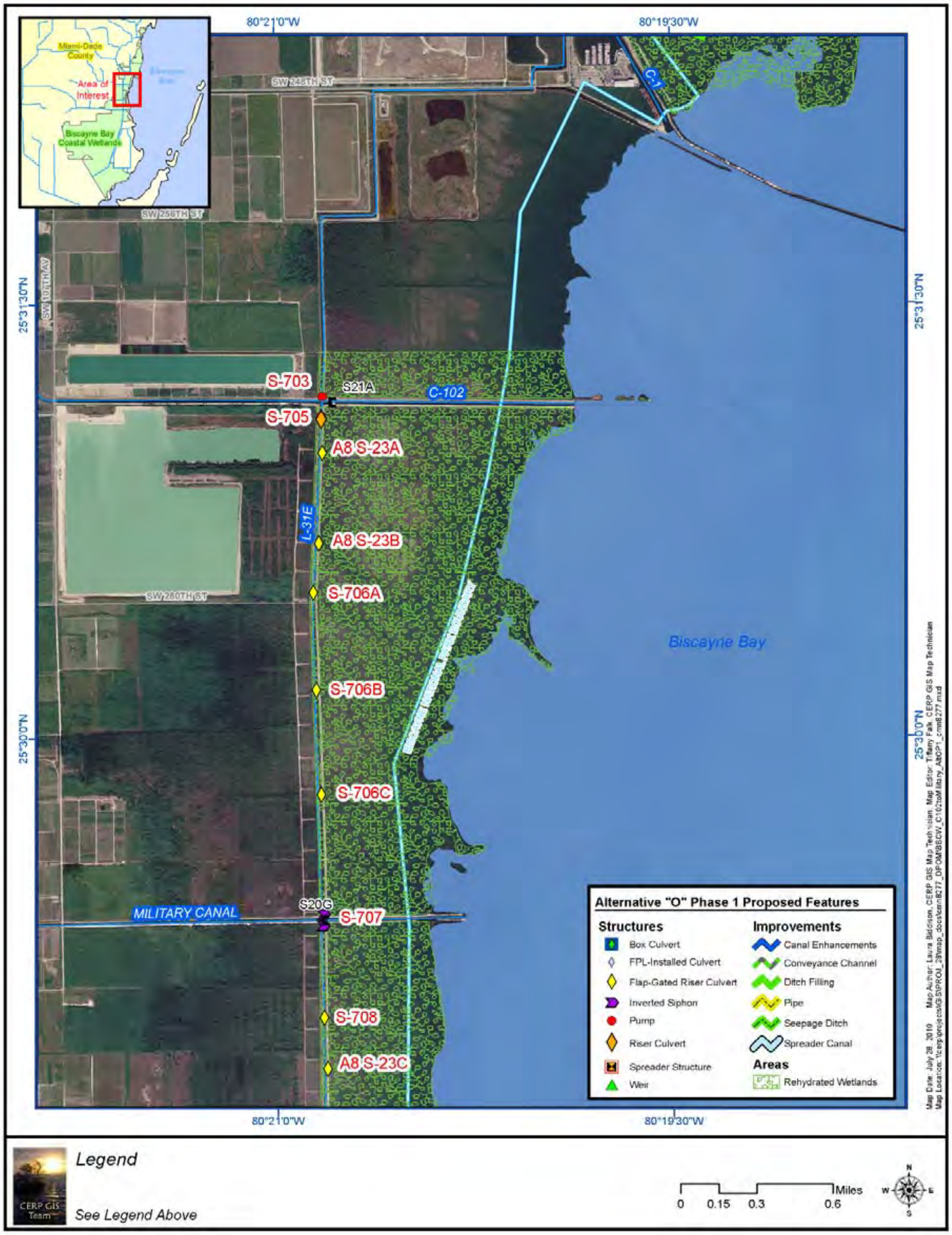

FIGURE 7-4: NORTHERN L-31 EAST FLOW WAY PROJECT FEATURES

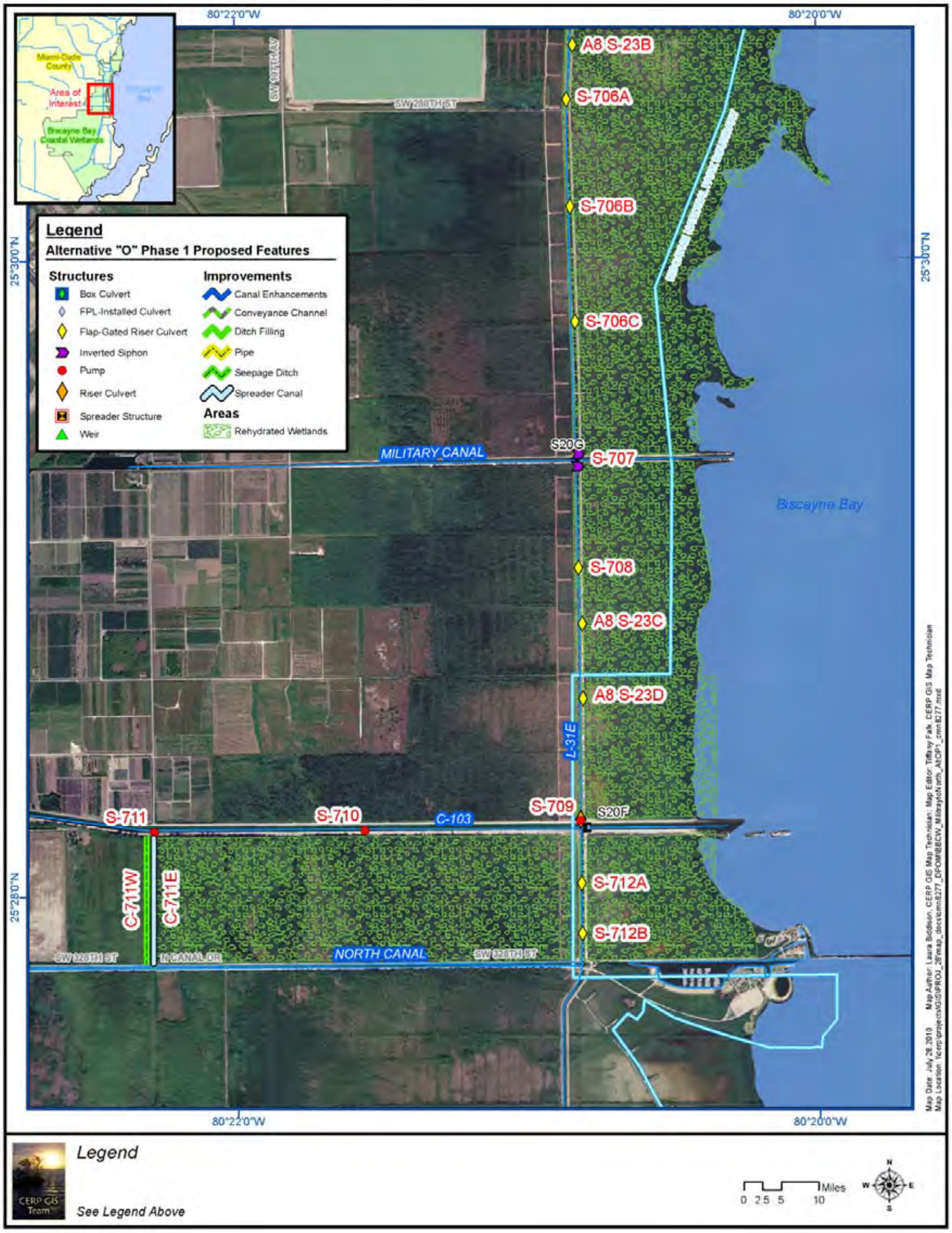

FIGURE 7-5: SOUTHERN L-31 EAST FLOW WAY PROJECT FEATURES

7.2 PROJECT MONITORING PLAN

A three part, Project Level Monitoring Plan (PLMP) has been included as **Annex E Parts I through Parts III**. Part I, Hydrometeorological Monitoring, largely describes the measurement of surface and/or groundwater levels needed to operate the project features, understand flow distributions, and monitor hydroperiods. Although described in detail in **Annex E Part I**, this type of monitoring will generally be limited to upstream and downstream of proposed structures, and to a lesser degree the receiving marshes. In addition to supporting day-to-day decision making regarding feature operations, the hydrometeorological monitoring data will also be used to help implement the adaptive management measures needed to maximize restoration, and will likely be required by permit. It is estimated that the costs associated with implementation of this monitoring will total approximately $864,950.

Part II, Water Quality Monitoring, describes the water quality parameters needed to demonstrate compliance with applicable regulatory requirements, and to necessary to evaluate project feature performance. Similar to the hydrometeorological monitoring, water quality monitoring will generally be limited to upstream and downstream of proposed structures, and is intended to identify water quality status and trends, assess compliance with federal and state water quality statutes, acts, and agreements, aid in determining nutrient removal rates, and guide resource management decisions. Because this plan is intended to address regulatory permitting requirements, the duration of this monitoring shall be as required by applicable permits. In addition to being required by permit, the water quality monitoring data will also be used to help implement the adaptive management measures needed to maximize restoration. Water Quality Monitoring cost estimates were prepared by the SFWMD in conjunction with the USACE, the annual cost is approximately $119,100 with the five-year cost estimated to be approximately $595,000.

Part III, Ecological Monitoring, describes the parameters needed to be measured in order to evaluate the project's performance in meeting restoration goals and to facilitate effective, science based management decisions concerning project design and operation. Specifically, the recommended ecological monitoring will determine if restoring beneficial patterns of freshwater flow, salinity, and water quality to nearshore waters and adjacent wetlands of southwestern Biscayne Bay will achieve the expected community structure, distribution, abundance, and viability of oyster bars, submerged aquatic vegetation (SAV), wetland vegetation, and associated biota. Geographically, the monitoring will cover the nearshore habitat, submerged aquatic vegetation, estuary, and freshwater wetlands in and around the project features. For purposes of estimating costs, it has been assumed that the monitoring will continue for ten years. It is estimated that the costs associated with implementation of this monitoring will total approximately $1,917,000. This estimate assumes that the system wide Monitoring and Assessment Plan (MAP) will continue to receive funding at its current levels. It is also important to note that a significant portion of these costs are related to installation of equipment, and other start up costs.

In summary, the combined three monitoring efforts comprising the Project Monitoring Plan are estimated to cost a total of $3,377,000.

7.3 ADAPTIVE MANAGEMENT PLAN

An Adaptive Management (AM) Plan has been included as Annex E Part IV. The Biscayne Bay Coastal Wetlands Adaptive Management plan has been designed to utilize project-level and system-wide Ecological Monitoring data to determine what changes or additions to management measures and operations are required to attain the project's intended restoration goals and objectives. Specifically, the suggested adaptive management measures should help ensure the restoration of beneficial patterns of freshwater flow, salinity, and water quality to nearshore waters and adjacent wetlands of southwestern Biscayne Bay to achieve the desired community structure, distribution, abundance, and viability of oyster bars, submerged aquatic vegetation, wetland vegetation, and associated biota. This plan facilitates the National Research Council's recent (2006) recommendation for the Incremental Adaptive Restoration approach for Comprehensive Everglades Restoration Plan.

The decision-framework provided within the AM Plan are intended to help link performance measures to monitoring, targets, and potential management options to ensure the Biscayne Bay Coastal Wetlands goals and objectives are reached. While not the only possible management action, the management actions provided within the plan are meant to serve as an initial set of actions which are likely to help reach the intended goal and/or objective, and have therefore been included as a cost of plan implementation. Because neither the scale, nor scope, of AM can be fully defined prior to the project becoming fully operational, the estimated cost of AM implementation has been presented as a range. It is estimated that the costs associated with implementation of Adaptive Management will range between $486,000 and $727,000. Because these measures should not be implemented until after the features have become fully operational, it is recommended that these costs be fully cost shared under OMRR&R.

7.3.1 Incremental Adaptive Restoration

The recent programmatic review of CERP and recommendations of the National Research Council (NRC) of the National Academy of Sciences contained in the report: **Progress Toward Restoring the Everglades: The Third Biennial**

Review - 2010 were utilized in the formulation and planning process for determination of the Selected Plan for BBCW. Biennial evaluations are expected to continue for the duration of the CERP. The NRC recognizes that Everglades' restoration is a complex undertaking with many scientific uncertainties, which can slow the rate of progress. The NRC concluded that if the construction of a restoration project is delayed until all scientific uncertainties are eliminated, there will be many negative consequences including: continued decline of the Everglades ecosystem, lagging public support, and increased project costs.

The NRC identified an approach referred to as Incremental Adaptive Restoration where an incremental approach using steps that are large enough to provide some restoration benefits now, while addressing critical scientific uncertainties and taking actions to promote learning that can guide the remainder of the project design. Constructing projects using a phased approach will enable assessments of benefits and impacts to the environment as each phase is constructed. Remaining phases will then be adapted to optimize performance based on actual findings from the earlier phases. Consistent with the NCR recommendation, the Biscayne Bay Coastal Wetlands project is proposed for implementation in a phased approach. Alternative O Phase-I will utilize the available water in the most beneficial and efficient manner, while also utilizing the lands currently in public ownership.

The Biscayne Bay Coastal Wetlands project was specifically reviewed and addressed in the Third Biennial Review. The report's CONCLUSIONS AND RECOMMENDATIONS states: "**During the past two years the restoration program has made tangible progress, and four CERP project are now under construction. Continued federal commitment is especially important at this time.** The Everglades restoration program has completed the arduous federal planning and authorization processes for three projects and is now moving forward with construction of the Picayune Strand project with federal funding, Additionally, despite budget challenges, the state of Florida continues to expedite the construction of C-111 Spreader Canal, Biscayne Bay Coastal Wetlands, and Lakeside Ranch STA. After years of delay, it is critically important to maintain this momentum to minimize further degradation of the system during CERP implementation."

The Third Biennial Report also states that: "**Given the slower than anticipated pace of implementation and unreliable funding schedule, projects should be scheduled with the aim of achieving substantial restoration benefits as soon as possible"**. The SFWMD under the Acceller-8 program has nearly completed construction of some of the features in the Recommended Plan and monitoring of those features are presently on-going.

Project Scheduling and implementation of project options is discussed in Section 8.1.

7.4 NUISANCE AND EXOTIC VEGETATION CONTROL PLAN

In addition to the Project Level Monitoring Plan, a nuisance and exotic vegetation control plan has been developed in conjunction with USACE policy. This policy compliments the National Invasive Species Act and strives to either prevent or reduce establishment of invasive and non-native species at project sites. The primary objectives of this effort for the BBCW project is to establish favorable conditions suitable for the long-term maintenance control of non-native species, and the re-establishment of native flora. To achieve these goals, this plan proposes to complete both initial and long-term invasive plant control efforts necessary to achieve maintenance control levels of invasive vegetation within the project area.

Recognizing that anticipated costs could escalate or be reduced due to unanticipated spread of exotic and/or nuisance species, increased labor costs, or an increase chemical applications; it is estimated that the initial control effort will take five years at a total cost of approximately $1,090,360, or $218,072 per year. After the first five years, it is estimated that the annual maintenance costs will be $190,000/year.

Specifics of the nuisance and exotic vegetation control plan are contained in ***Annex E, Part V***.

7.5 DRAFT PROJECT OPERATING MANUAL

A Draft Project Operating Manual (DPOM) was developed to control day-to-day water management functions of the Biscayne Bay Coastal Wetlands project. The DPOM encompasses all foreseeable conditions that may be encountered during project operation. The project will be operated in accordance with the DPOM to achieve the goals, purposes, and benefits outlined in the Project Implementation Report (PIR), including the improvement of the quantity, timing, and distribution of water in the natural system. All costs associated with the physical operation of the project will be funded through O&M.

It is important to note that the project is currently in the PIR/Environmental Impact Statement (EIS) Phase, and there is a high probability that modifications and/or revisions to the Project Operating Manual (POM) will occur during subsequent project phases. Report preparation is pursuant to Engineering Regulation (ER) 1110-2-240, and is in accordance with guidance contained in

Engineering Manual (EM) 1110-2-3600, ER 1110-2-8156, and the Programmatic Regulations Guidance Manual Number 5.

7.6 RECREATION FEATURES

The recreation activities proposed for the Selected Plan include: biking/walking trails, environmental interpretation, canoeing/kayaking, bank fishing, tent camping, and nature study. Proposed facilities include: interpretive signage and shade shelter, handicapped accessible waterless restrooms, handicapped parking, tent platforms, pedestrian bridge, benches, bike rack, trash receptacles, park security gate, trail signage, potable water source and a bird watching platform. Recreational features will be constructed on lands owned or acquired in fee by the SFWMD, therefore there are no real estate costs associated with the recreation features.

The construction costs for proposed recreation features were estimated to be $2,316,000.

The justification for incurring additional costs for recreation features is derived by utilizing a benefit to cost ratio. The tangible economic justification of the proposed project can be determined by comparing the equivalent average annual costs with the estimate of the equivalent average annual benefits, which would be realized over the period of analysis. These average annual recreation benefits and costs are summarized in ***Table 7-2***. The conceptual recreation plan is illustrated in ***Figure 7-6***. The benefit to cost ratio for the proposed recreation features is approximately 1.4 to 1. ***Appendix H*** describes in greater detail the recreation plan and associated benefits and costs.

TABLE 7-2: SUMMARY OF RECREATION COSTS AND BENEFITS (FY 11 PRICE LEVELS)

Annual Costs	
Total Recreation Costs	$2,316,000
Interest During Construction	$134,000
Total Investment Cost (rounded)	$2,450,000
Amortized Investment Cost	$127,000
OMRR&R	$25,000
Total Annual Cost	$152,000
Annual Benefits	
Unit Day Value	$7.17
Daily Use	80
Annual Use	29,200
Average Annual Benefit	$210,000
Benefit to Cost	1.4
Net Annual Benefits	$58,000

IDC interest during construction
OMRR&R operation, maintenance, repair, replacement, and rehabilitation
PED pre-construction, engineering and design
S&A supervision and administration

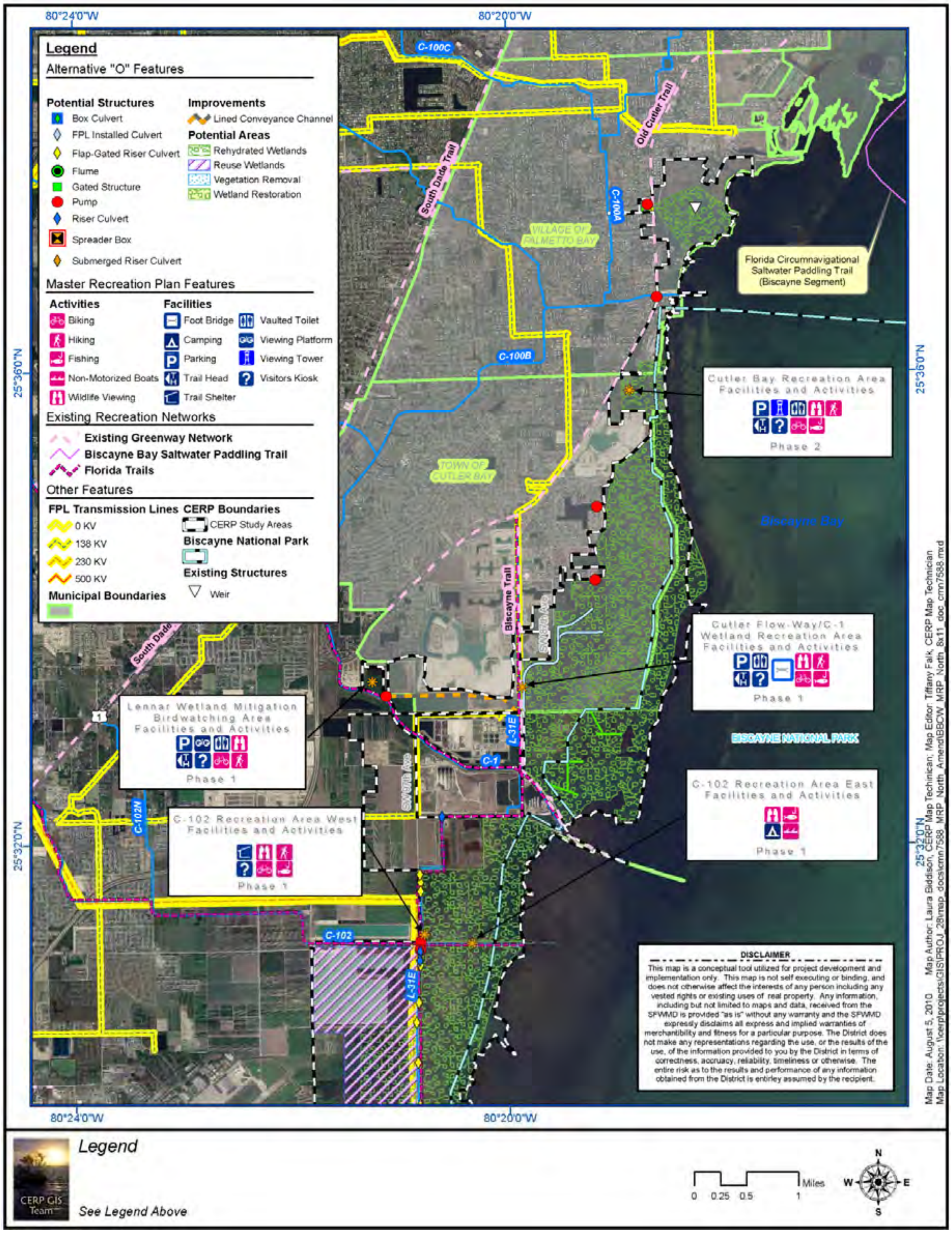

FIGURE 7-6: CONCEPTUAL RECREATION PLAN

7.7 ECOSYSTEM RESTORATION COST ESTIMATES

Table 7-3 includes a breakdown of the estimated cost of the Biscayne Bay Coastal Wetlands project formatted by construction and non-construction costs. Non-construction costs include LERR (lands, easements, rights-of-way and relocations), PED and S&A costs. Costs are estimated at FY 2011 price levels and are rounded to the nearest $1,000. Included in the table are IDC, operations and maintenance (O&M) and annualized costs. The Federal discount rate of 4.125% was utilized to amortize the costs.

TABLE 7-3: BISCAYNE BAY COASTAL WETLANDS INVESTMENT COSTS

Construction Item	Cost
Lands & Damages	80,985,000
Elements	
06 Fish and Wildlife Facilities	4,164,000
09 Channels & Canals	14,797,000
13 Pumping Plant	33,321,000
15 Floodwall Control Diversion Structure	6,272,000
Sub-Total	**$139,540,000**
Planning, Engineering, and Design (PED, E&D)[1]	9,955,000
Construction Management (S&A)	16,212,000
Total First Cost	**$165,707,000**
Investment Costs	
Interest During Construction	
--Construction	$4,890,000
--Real Estate	$10,440,000
Total Investment Cost	**$181,040,000**
Average Annual Costs	
Interest and Amortization of Initial Investment	**$9,320,000**
OMRR&R[2]	**1,873,000**
Monitoring	**193,000**
Total Average Annual Costs	**$11,386,000**

1- PED costs do not include sunk PIR costs of $22,995,000
2- OMRR&R costs do not include $25,000 for recreation OMRR&R
S&A Supervision and Administration
PED Planning, Engineering & Design
LERR Lands, Easements, Rights-of-Ways, and Relocations

Based on the engineering and design of the Selected Plan for this study, the average annual cost for the Selected Plan (Alternative O Phase 1), is $11,386,000

7.7.1 Apportionment of Federal and Non-Federal Costs

Responsibilities for implementing the Selected Plan would be shared by USACE, on behalf of the Federal government, and the non-Federal sponsor, SFWMD. The USACE and SFWMD would cost-share equally in the design, construction and O&M of the restoration projects resulting from this plan. The SFWMD would acquire the necessary LERR. Construction contracts to build the projects would be managed by either USACE or SFWMD to maintain as close to a 50/50 cost share as possible to meet the overall CERP program goal of a 50/50 federal/non-federal cost share.

Rules, which determine how project responsibilities are shared, are established in federal law and the administration's implementing policies. Section 601 of WRDA 2000 provides in-kind cost sharing credit to the non-federal sponsor for design, construction, and O&M, and for treatment of credit between projects to maintain a 50/50 cost share. The PIR recommends crediting the non-Federal sponsor for work completed under the State Expedited Construction program in advance of approval and authorization of the federal project. ***Table 7-4*** includes an apportionment of the costs of the Selected Plan.

Since recreational opportunities are one of the original CERP objectives, planning, design, and construction of recreation features are cost-shared equally by the Federal government and the non-Federal sponsor; however, O&M of the recreation features is a non-Federal responsibility. No additional LERR costs would be required for the recreational features, since they would be constructed within the restoration project footprint. Costs associated with HTRW will be borne 100 percent by the SFWMD except where these costs would have occurred in the absence of contamination. For more detail regarding HTRW cost apportionment see **Section 7.9.3**.

TABLE 7-4: COST APPORTIONMENT OF THE SELECTED PLAN

Item	Federal Cost	Non-Federal Cost	Total
Ecosystem Restoration (ER)			
PED[1]	$ 27,690,000	$ 5,260,000	$ 32,950,000
Construction Management	$ 8,106,000	$ 8,106,000	$ 16,212,000
LER&R		$ 80,985,000	$ 80,985,000
Ecosystem Restoration Construction Cost[2]	$ 58,555,000		$ 58,555,000
ER Subtotal	$ 94,351,000	$ 94,351,000	$ 188,702,000
Recreation (Rec)	$ 1,158,000	$ 1,158,000	$ 2,316,000
Total Project Cost	$ 95,509,000	$ 95,509,000	$ 191,018,000
Total Project Level Monitoring Costs	$ 958,500	$ 958,500	$ 1,917,000
Annual OMRR&R	$ 936,500	$ 961,500	$ 1,898,000
OMRR&R (vegetation management)[3]	$ 96,500	$ 96,500	$ 193,000
OMRR&R (non-recreation)	$ 840,000	$ 840,000	$ 1,680,000
OMRR&R (recreation)		$ 25,000	$ 25,000

[1]PED estimates for non-recreation components are derived directly from the MCACES. PED includes development of the PIR and sunk costs of $22,995,000.
[2]The ecosystem restoration construction cost and PED cost are not detailed as being shared equally due to the non-Federal Sponsor's land costs. The Federal shares were changed to bring the total project cost to a 50/50 share basis.
[3]OMRR&R for vegetation management annual costs are greater during the first 5 years ($218,000). After the first 5 years of OMRR&R for vegetation management the costs of continued vegetation management decreases ($190,000).

7.7.2 Description of the Federal and non-Federal Implementation Responsibilities

Responsibilities for implementing the Selected Plan would be shared by USACE, on behalf of the Federal government, and the non-Federal sponsor, SFWMD. USACE and SFWMD would cost share equally in the design of the projects resulting from this plan. SFWMD has acquired the necessary LERR and would O&M the completed project. Construction contracts to build the projects would be managed by either USACE or SFWMD to maintain a 50/50 cost. Rules which determine how project responsibilities are shared are established in Federal law and related implementing policies. Section 601 of WRDA 2000 provides in-kind cost sharing credit to the non-Federal sponsor for design, construction, and O&M and for treatment of credit between projects to maintain a 50/50 cost share. The PIR would include recommendations to credit the non-Federal sponsor for work completed under the State Expedited Construction program in advance of approval and authorization of the Federal project. At this time, the Selected Plan includes SFWMD's State Expedited Construction program for the BBCW project.

Detailed design of the State Expedited Construction program would be accomplished by SFWMD with coordination and review by USACE under the State Expedited Construction program. All project features would be designed in accordance with USACE regulations and standards. Construction activities for the State Expedited Construction program project would be in accordance with the State Expedited Construction program and would be the responsibility of SFWMD. Crediting for work performed by SFWMD would be subject to project authorization and adherence to USACE design standards and regulations.

7.7.3 Project Implementation Schedule

The project schedule is included in Appendix B Cost Estimates.

7.7.4 Pre-Construction Engineering and Design Activities

PED activities would be in accordance with USACE construction standards. Preliminary design activities, which include survey and geotechnical investigations as well as cultural resources compliance, commenced in early 2005. Under the State Expedited Construction program, SFWMD has prepared a Basis of Design Report (BODR) for the BBCW State Expedited Construction program. The BODR presents approximately 30 percent level of design, and includes all engineering assumptions and conceptual designs for the State Expedited Construction program features. Upon final approval of the BODR, SFWMD would prepare initial, intermediate and final plans and specifications for construction contract award. All design work would be coordinated and reviewed with USACE to ensure that the work to be constructed as part of the State Expedited Construction program would meet USACE standards and regulations.

7.7.5 Implementation of Project Operations

The Draft Project Operating Manual for the BBCW Phase I Project would be modified and revised, as necessary, through several project phases. During the Detailed Design and Plans and Specifications Phase, the Draft Project Operating Manual would be modified as needed to define temporary operations to be used during construction. These temporary operations are known as Interim

Operations during Construction. As construction of the project nears completion, the Draft Project Operating Manual would be further modified to focus on operations during the Operational Testing and Monitoring Phase. Knowledge gained from the Operational Testing and Monitoring Phase would then be incorporated into a revision of the Draft Project Operating Manual, which would be coordinated with SFWMD and the USACE South Atlantic Division (SAD), and would supersede all other iterations of the Draft Operating Manual. The final version of the Project Operating Manual would be used by SFWMD when the SFWMD accepts responsibility for long-term operations of the project.

7.8 DESIGN AND CONSTRUCTION CONSIDERATIONS

7.8.1 Engineering and Design

Planning, engineering and design activities would be in accordance with USACE and SFWMD requirements. Preliminary design activities, which include survey and geotechnical investigations as well as cultural resources compliance, commenced in early 2005. Under the State's Expedited Construction program, the SFWMD prepared a Basis of Design Report (BODR). The BODR includes all engineering assumptions and conceptual designs for each of the project features. Upon reviewing the BODR, the SFWMD prepared initial, intermediate and final plans and specifications for construction contract award. All design work has been coordinated and reviewed with USACE to meet USACE standards and regulations.

Alternative O Phase 1 includes more than just the State's Expedited Construction program features. Some project features have not yet been fully designed. The design of these features, which lack detailed survey and geotechnical investigations, will be completed by USACE after the PIR document has been approved.

7.8.2 Construction and Implementation of the Plan

The non-Federal sponsor is exploring alternative project delivery methods to expedite implementation of a portion of the project through the State's Expedited Construction program. The remainder of the Selected Plan would be implemented by standard USACE processes. The following are lists of construction features to be constructed by the SFWMD and USACE:

SFWMD constructed features (under the State's Expedited Construction program):

- S-700 (includes all Deering Estate features)
- S-701

- C-701
- C-702 (sections a, b, and c)
- S-23 A, B, C, and D

USACE constructed features:

- C-702 (section d)
- C-711 E and W
- S-703
- S-705
- S-706 A, B, and C
- S-707
- S-708
- S-709
- S-710
- S-711
- S-712 A and B

7.8.3 Outstanding Design Issues

Further investigations regarding the function of several existing culverts will need to be completed during the Advance Planning Phase of the project which precedes Preliminary Design. These culverts are located on the western side of the L-31E Borrow Canal, between C-102 and C-103, and may continue to serve privately owned lands west of L-31E.

As described in the Draft Project Operating Manual (Annex D), the project will be adaptively managed to ensure no adverse impacts to existing levels of flood protection until one (or more) of the following events has occurred; 1) Detailed engineering studies performed during the Advance Planning Phase confirm that pumping into the reach of L-31E between C-102 and C-103 will not adversely affect existing levels of flood protection provided to privately owned lands west of L-31E; 2) privately owned lands west of L-31E are provided equivalent flood protection through alternative means; and/or 3) affected lands are acquired in support of the project.

The siphon, S-707, that is proposed to be installed underneath Military Canal, will require a large open work area. There are existing constraints at the site which cannot be impacted but could hamper construction. To the east of the confluence of the L-31E Canal with Military Canal is the spillway structure S-20G and the associated control building used for its operation. To the west are several parallel 230,000 volt power lines operated by Florida Power and Light (FPL) which need a clear perimeter maintained.

7.9 LANDS, EASEMENTS, RIGHTS-OF-WAY AND RELOCATIONS CONSIDERATIONS

Section 601 of the WRDA 2000 and USACE policy requires that the non-Federal sponsor obtain and provide certification of all lands, easements, rights-of-way and relocations (LERRs) necessary for project implementation.

7.9.1 Real Estate Requirements

The lands required for the Selected Plan are based on the benefits assessment modeling and on the analysis of the lands needed for construction, and operation, maintenance, repair, replacement and rehabilitation (OMRR&R) of the project. ***Table 7-5*** shows the total land requirement and estimated functional lift for the three area based performance metrics. The net freshwater wetland lift shown in this table was computed using PM #4 "Wetlands With Sufficient Water". The complete results for this performance metric are included in **Table C-4 of Appendix C.** The net saltwater wetland lift in ***Table 7-5*** was estimated using the results from PM #2, "Acres of Saltwater Wetland Meeting 0-20 psu Criterion". A summary of PM #2 results are included in **Table C-6 of Appendix C.** Note that the saltwater wetland lift estimate exceeds the project lands acreage because some of the lift occurs to lands that are subject to navigational servitude (located within the mean tide zone). The net nearshore salinity lift was computed using PM #1, "Acres of Bay Bottom within 500 Meters of Shore Meeting 20 psu Criterion". The results from PM #1 are included in **Table C-13 of Appendix C**. There are no land requirements for the nearshore salinity functional lift component of the project since these benefits occur in Biscayne Bay which is subject to navigational servitude. (Note that the total "habitat lift" estimates from CBEEM for each ecozone are aggregates of several PMs and are not reported as acres. For this reason, ***Table 7-5*** uses the results from the three performance measures that are reported in units of acres of habitat lift as a comparison with the land use requirements for the project.)

Figure 7-7 through ***Figure 7-11*** show the geographic relationship between the lands required for Alternative O Phase I and the aerial coverage of each benefit ecozone. These maps include polygons identified as "BBCW Zones of Potential Habitat Lift". For the saltwater wetlands and freshwater wetlands, the zones of potential habitat lift were sized based on a target of maximum restoration. However, the lands required for each alternative are less than the maximum restoration acreage because none of the alternatives affect all of the land within the zones of potential habitat lift. In other words, the wetland acreage required by a given alternative can be a sub-set of the maximum restoration lift acreage. These lands are those within the zones of potential habitat lift that are directly impacted by a given alternative. This is illustrated in ***Figure 7-7*** through ***Figure 7-11*** which show that the "rehydrated wetland" lands required for

Alternative O, Phase 1, (those lands hydrologically impacted), are much less extensive than the acreage identified within the zones of potential habitat lift. While the lands identified for inclusion in Alternative O, Phase I will protect the associated project benefits, this project will not preserve the potential for future benefits on lands within the zones of potential habitat lift but outside of the Alternative O, Phase I project footprint.

A comparison of the land requirements and the freshwater habitat benefits computed for each alternative generally indicates that land requirements for freshwater wetland restoration are greater than acres of habitat lift. This is because acres of improved wetland habitat are computed by multiplying the increase in functionality by the total acreage affected by the feature or project. For example, if a feature targets a 1,000 acre parcel of degraded freshwater wetlands for restoration and the feature will improve the functionality by 50 to 90%, then the total habitat lift is 400 acres of lift; however, the required footprint is 1,000 acres. For the freshwater wetlands, the lands required to achieve the associated benefits for a given alternative were determined by the actual footprint of the targeted wetlands. For instance, the freshwater wetland land requirements identified for Alternative O, Phase 1 are the 400 plus acres targeted for rehydration by the S-709, S-710, and S-711 pumps. The areal extent of rehydration in this area is constrained by the C-103 canal on the north, North Canal on the south, L-31E Borrow Canal on the east, and the seepage collector canal (C-711 Canal) on the west. Lands adjacent but outside of these boundaries will not be rehydrated as a result of the groundwater stage control provided by the boundary canals. For the saltwater wetlands, the area estimated to be rehydrated or flooded was generally determined to be those lands lying between the water distribution features (L-31E Culverts, Cutler Spreader Canal) of a given alternative and the shoreline to the east. (In the Shoal Point area, the topography of the remnant tidal creek resulted in project lands boundaries that generally follow elevation contours rather than run east-west.) Though benefits to significant acres of nearshore habitat acreage will result from the implementation of Alternative O Phase I, no land purchase, in fee or otherwise, is required to protect these benefits since subject lands are submerged.

The real estate component of the Selected Plan is tentative in nature and intended for planning purposes only. Total estimated cost of real estate is $80,985,000. Both the final real property acquisition lines and the real estate cost estimates provided herein and in ***Appendix D*** are subject to change. More detail on the real estate requirements for the Selected Plan is discussed in ***Section 7.9.2*** below and ***Appendix D***.

TABLE 7-5: PROJECT ACREAGES AND FUNCTIONAL LIFT BY BENEFIT ZONE

Land Requirements and Functional Lift Summary			
	Total Area by Ecozone	Project Lands Area	Net Functional Lift
	(acres)	(acres)	(acres of habitat lift)
Freshwater Wetlands	9,638	473.61	283
SaltwaterWetlands	21,035	3,287.59	6,396
Nearshore Salinity	8,585	0	2,950

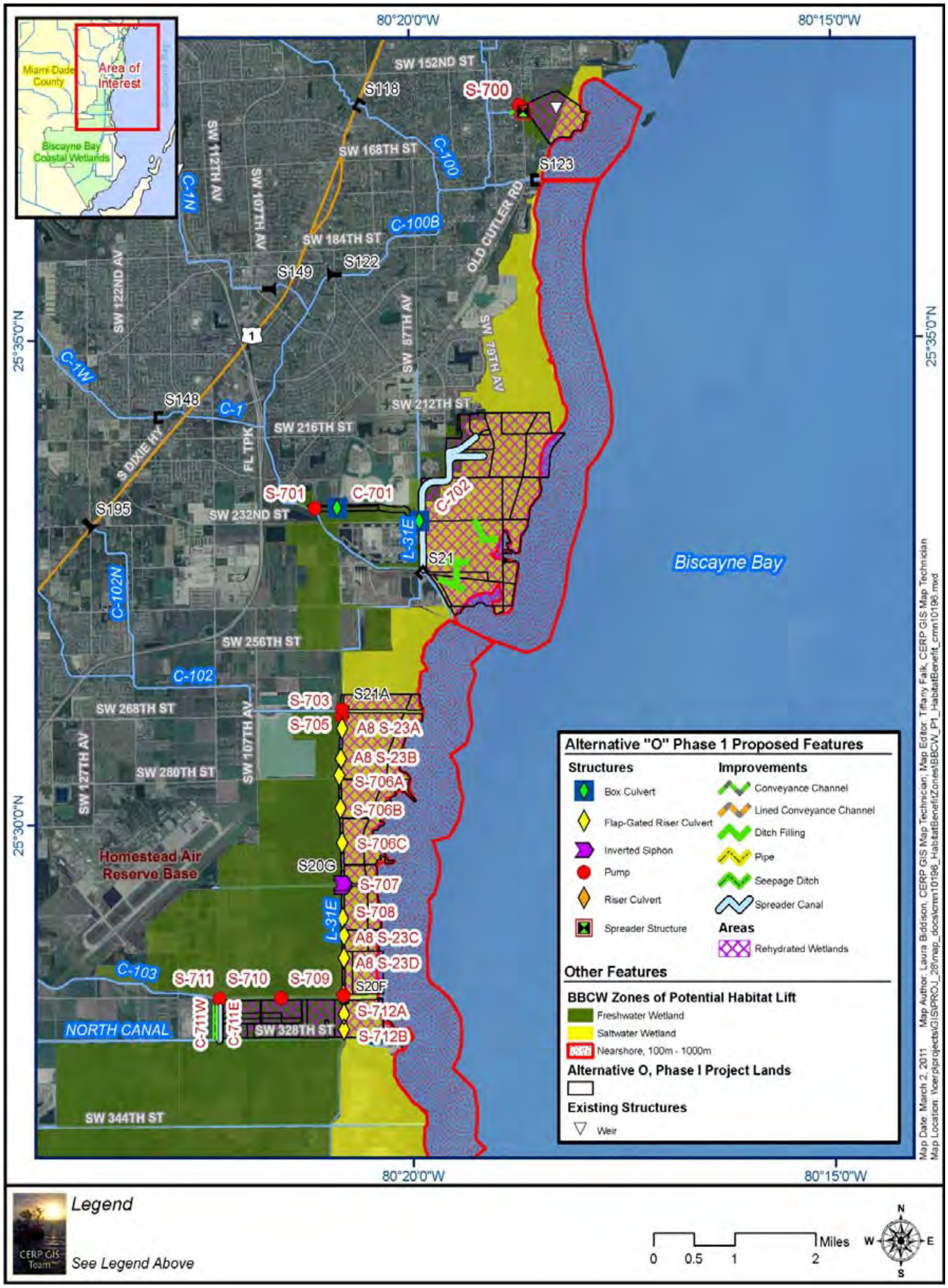

FIGURE 7-7: HABITAT BENEFIT ZONES - ALTERNATIVE O PHASE I

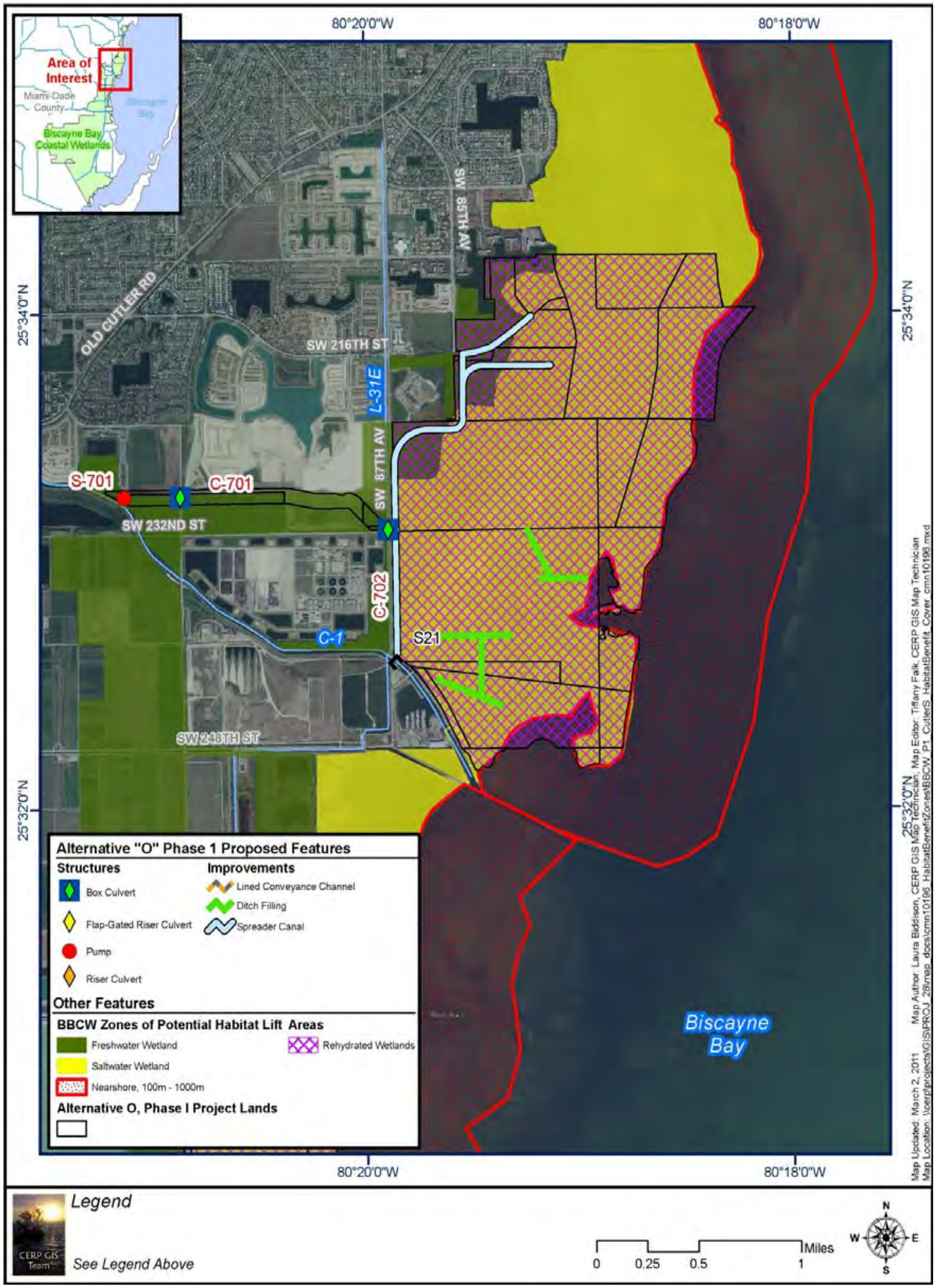

FIGURE 7-8: HABITAT BENEFIT ZONES - LENNAR FLOWWAY AND CUTLER SOUTH - ALTERNATIVE O PHASE I

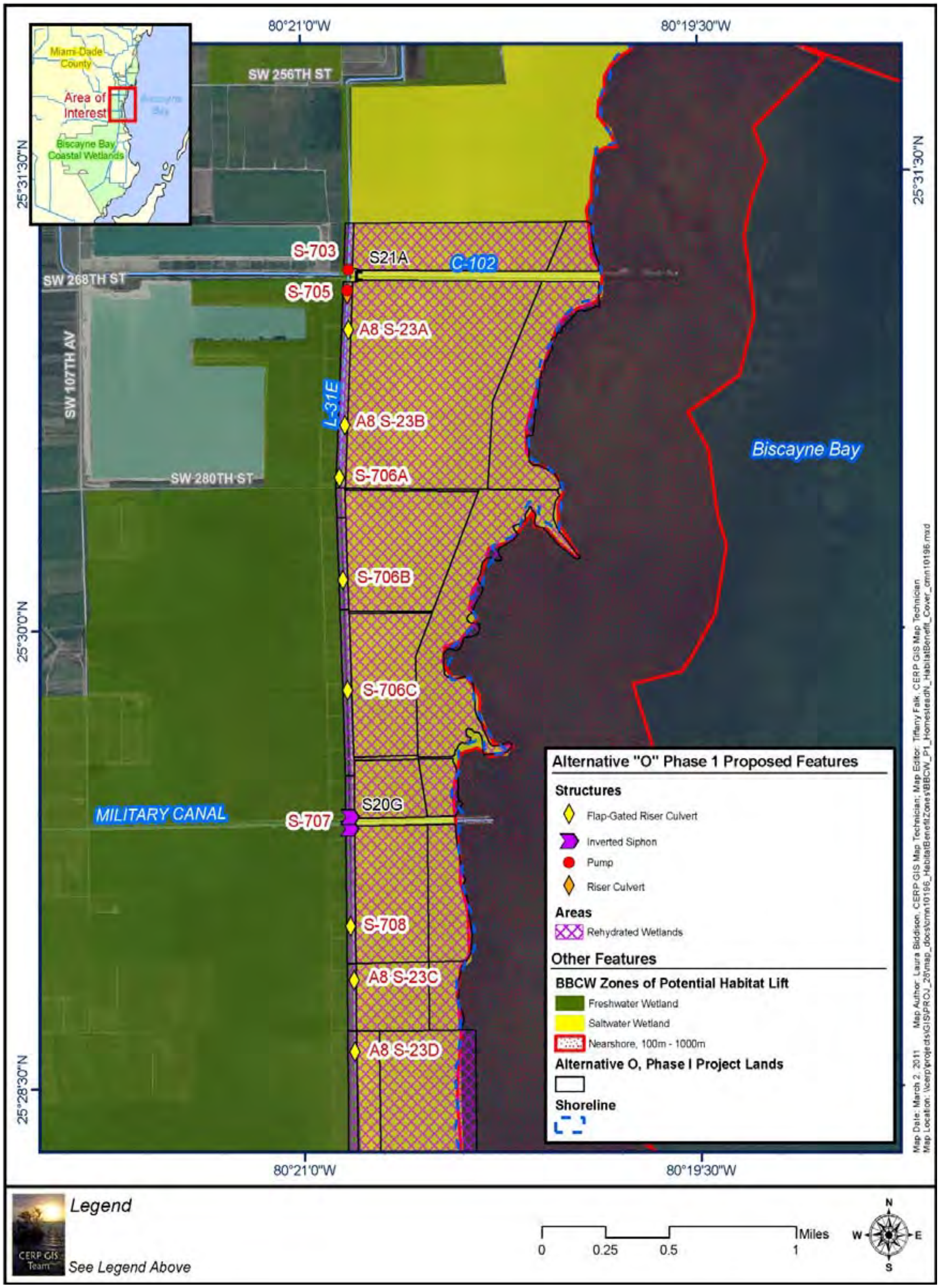

FIGURE 7-9: HABITAT BENEFIT ZONES – HOMESTEAD NORTH – ALTERNATIVE O PHASE I

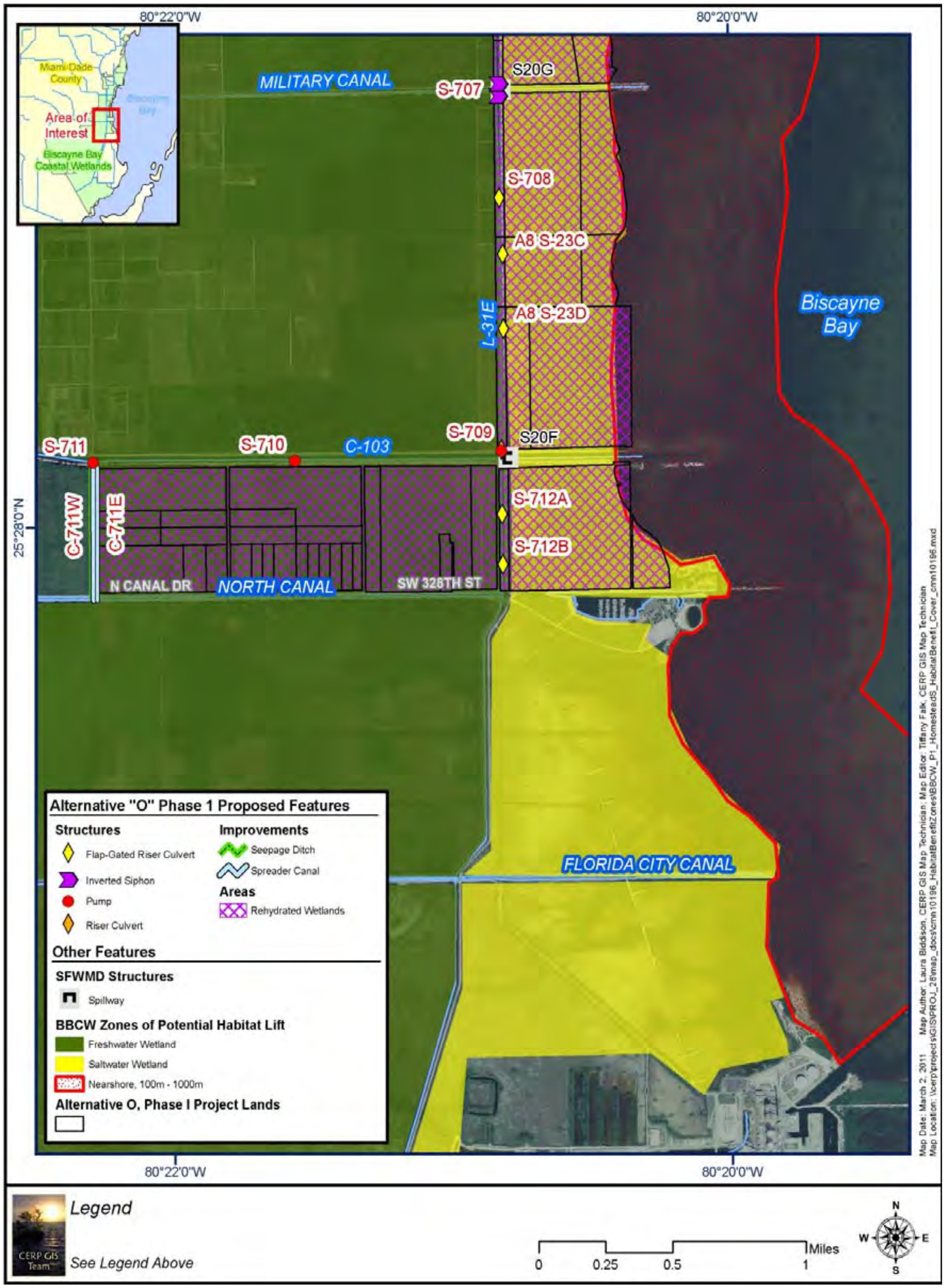

FIGURE 7-10: HABITAT BENEFIT ZONES - HOMESTEAD SOUTH - ALTERNATIVE O PHASE I

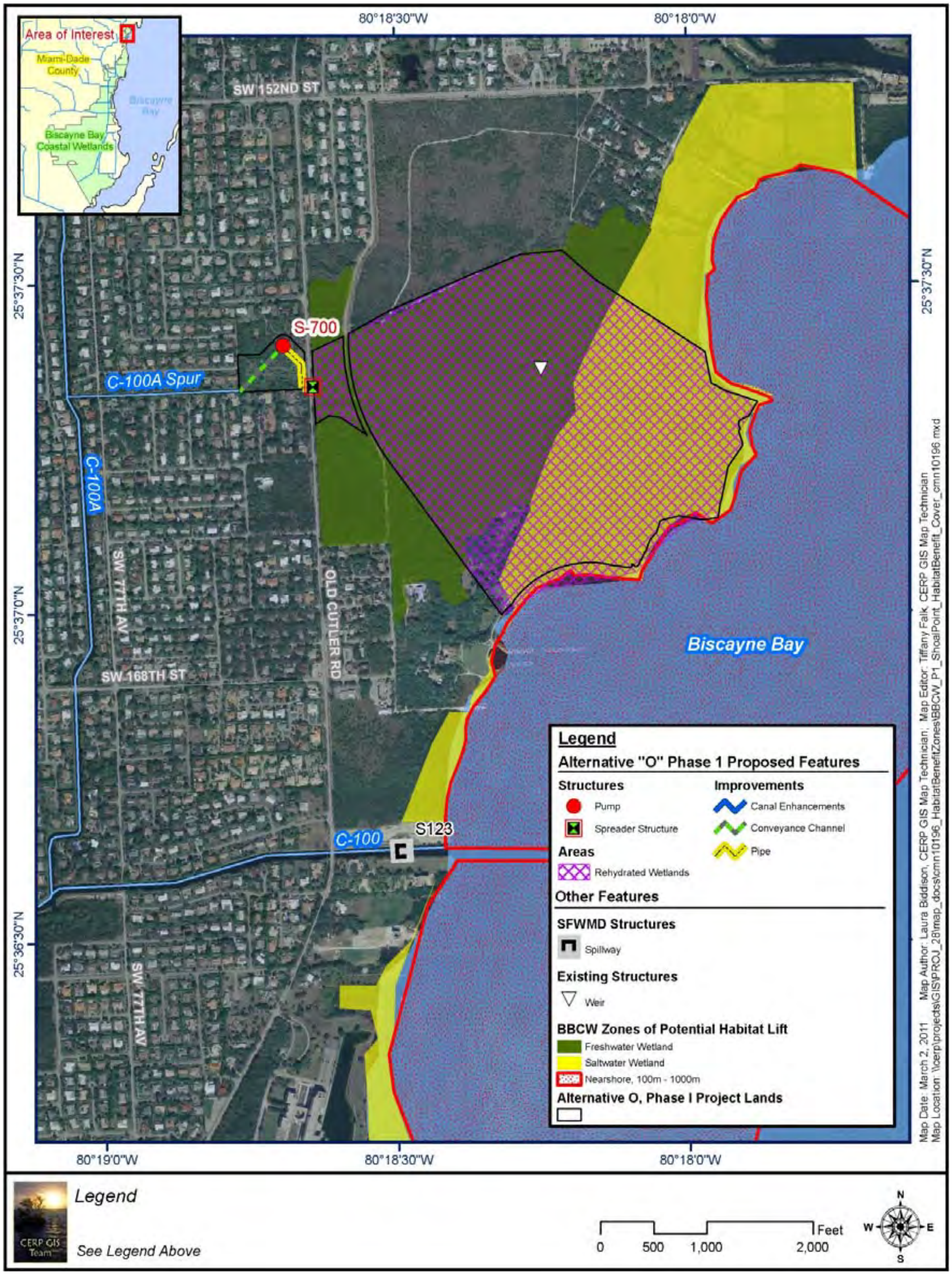

FIGURE 7-11: HABITAT BENEFIT ZONES - SHOAL POINT – ALTERNATIVE O PHASE I

7.9.2 Land Acquisition

Within the Biscayne Bay Coastal Wetlands project, there are approximately 3,761 acres required for the project. The SFWMD owns approximately 934.14 acres within the footprint of the project with an additional approximately 414.83 acres to be acquired from private landowners. These acres would be provided in fee. Florida Power and Light (FPL) owns approximately 148.90 acres within the footprint of the project and will convey a perpetual flowage easement to the SFWMD for the project. The United States of America, National Park Service owns approximately 937.27 acres which will be provided by Letter Agreement or Memorandum of Agreement.

The Trustees of the Internal Improvement Trust Fund (TIIF), State of Florida, owns fee title to approximately 111.06 acres within the project footprint. The State will convey a perpetual easement to the SFWMD or execute a Supplemental Agreement which will contain language sufficient to ensure that TIIF and SFWMD provide the interest held by TIIF to the project indefinitely unless and until the project is deauthorized by Congress .

Miami-Dade County Water and Sewer Department owns approximately 403.4 acres and Miami-Dade Parks and Recreation owns approximately 198.55 acres within the project footprint. Miami-Dade County regulations prohibit the conveyance of a fee interest to the SFWMD, without an exchange for other suitable lands. Miami-Dade County DERM owns or controls approximately 612.90 acres within the Alternative O, Phase 1 portion of the project footprint. These Miami-Dade County governmental entities will execute Supplemental Agreements with SFWMD which will contain language sufficient to ensure that the interest required for will be provided unless and until the project is deauthorized by Congress.

Pursuant to the terms and conditions of the Master Agreement, the SFWMD is responsible for providing all lands, easements, right-of-ways, and relocations.

Refer to the ***Real Estate Appendix***, ***Appendix D***, Paragraph D.17 for the Estate Analysis. Refer to ***Appendix D***, Paragraph D.18 for the Proposed Estates Analysis.

7.9.2.1 Land Assessment and Land Requirements for Alternative O, Phase 1

After identification of Alternative O, Phase 1 as the Tentatively Selected Plan, the PDT determined the acreage required for construction features in each component of the alternative and then evaluated what acres were required for project operations in each component. The lands required for project operation were determined by reviewing the magnitude of project induced hydrologic impact together with potential risk to the project benefits if the lands were not acquired. The PDT also considered the existing condition of the properties and the current use. Land risk assessment tables were developed for each of the component areas.

Activities included in the OMRR&R which relate not only to areas where permanent construction facilities will be located but also to lands required for continued operational purposes. These are outlined below:

- Pump and facility maintenance which are per manufacturer's recommendations and schedules. (Permanent facilities).
- Erosion control to make sure banks and areas around culverts and other structures are not compromised by weather, plant or animal forces. (Permanent facilities).
- Mowing to ensure there are no maintenance issues being hidden by high grass vegetation. Mowing also reduces the ability of woody plants to gain a foothold and lead to larger issues. (Permanent facilities)
- All monitoring required under the Terms and Conditions contained in the USFWS Biological Opinion. Specifically for the BBCW project, this monitoring consists of observations for the presence and avoidance of indigo snakes during project construction. Temporary access would be required to all areas of construction. (Permanent facilities)
- Invasive, exotic, native, and nuisance vegetation control. Vegetation control will be performed both to control underwater infestations and surface infestations. Invasive plants can prevent correct project function and can damage vital structural components if allowed to grow unchecked. Exotic vegetation removal will be conducted by herbicidal spraying during the first year of construction, and then repeated infrequently, as needed. Controlled burning, another methodology often employed to keep exotic species in check, may be required in the limited uplands and freshwater wetland habitats west of L-31, but not utilized in the extensive mangrove forests that dominate the coastal wetland communities north of Turkey Point and east of L-31. Temporary access would be required in both the freshwater and coastal wetlands within the project area. See Annex E, Part 5 for specific details on the nuisance and exotic vegetation control plan. (Permanent facilities)
- Adaptive Management (AM) measures needed to ensure project benefits and restoration goals are achieved; or to avoid violating one or more project constraints. Once the project is operational and freshwater is redirected from canal point source discharges to more of an overland flow rehydrating the coastal wetlands, the specific types and locations for adaptive management actions can be determined. Some of these actions could include operational adjustments to ensure desirable freshwater flow patterns; plugging, filling and/or removing woody vegetation in existing mosquito and drainage ditches to obtain desirable freshwater distribution;

along with oyster spat and larval stocking to ensure reproduction success. Access would be potentially required along the major drainage ditches, primarily in the Cutler Wetlands and areas adjacent to the C-1, C-102, C-103 and Military canals. Lands within the L-31E component of the project area, just east of the L-31E Borrow Canal, also have mosquito and drainage ditches as these are abandoned farm lands. Filling the mosquito and drainage ditches would change the flow patterns of fresh water across adjacent properties; therefore, access to these areas may be required. See Annex E, Part 4 for specific details on the adaptive management plan.

Project-level monitoring includes water quality, hydrologic and ecological monitoring activities to ensure that the intended purposes of the project would be achieved through long-term operations.

All proposed monitoring parameters are described in detail in ***Annex E*** (Project Monitoring Plan). Water quality monitoring involves sample collection and analysis for baseline, startup, and operational phases of the project. Access to the sampling stations have already been obtained since most are being sampled as part of an existing monitoring network(s) maintained by SFWMD and Miami-Dade County DERM. However, five new stations will be added: pumps S-700 (Deering Estate), and S-701 (Cutler Flow-way), at the mouth of Cutler Creek (CC01), in the L-31E borrow canal north of C-102 and in the L-31E borrow canal south of C-103.

Hydrologic monitoring includes measurements of stage and elevation (groundwater) and flow at water control structures. The majority of the monitoring sites will be located at existing or proposed structures, such as pumps, water control structures or weirs. There are a few additional water level monitoring locations in canals or wetlands. Much of the hydrometerological monitoring will be supported by the existing monitoring network. A total of fifteen (15) new surface water level monitoring sites are proposed to be installed. With exception of upstream of S-703, S-705, and S-709, new surface water level monitoring sites will be established upstream and downstream of each of proposed six new pump stations. Three (3) new surface monitoring sites will also be established within wetlands. ***Table E-1*** to ***E-3*** in ***Annex E*** provides the location coordinates for each of the monitoring locations, as well as the monitoring parameters and data collection frequency. The locations of the monitoring sites are depicted on ***Figure E-3*** to ***E-5*** in ***Annex E***. Access to these locations will be required.

The project-specific ecological monitoring plan proposes a continuation of the existing long-term monitoring efforts presently being conducted through the Monitoring Assessment Plan of RECOVER. This monitoring program focuses on estuarine performance measures that include oysters, submerged aquatic vegetation (SAV), estuarine fishes, juvenile crocodiles, nearshore salinity, wetland vegetation and wetland algae. This long-term monitoring program has resulted in a comprehensive database by which project effects can be quantified. Since this monitoring was initiated prior to CERP, access to all monitoring sites has already been established. See Annex E, Part 3 for specific details and station locations for each monitoring parameter.

MAGNITUDE OF PROJECT INDUCED HYDROLOGIC IMPACT

In the land assessment tables, the magnitude of hydrologic impact was determined by computing the ratio of acreage to maximum daily pump capacity. For instance, for the 185 acre targeted wetland in Deering Estates, the maximum daily pump capacity is 100 cfs or 198 acre-ft per day. Given these values, the average depth of inundation during maximum pumping at Deering Estates is 1.07 ft per day. For Cutler Wetlands, the average depth of inundation in the targeted wetlands area is approximately 0.50 ft per day during maximum pumping. For L-31E North, the average depth of inundation in the targeted wetland area is approximately 0.25 ft/day. For L-31E South – Freshwater wetlands, the average depth of inundation in the targeted freshwater wetland area is approximately 0.40 ft/day. For L-31E South – Tidal area, the average depth of inundation in the targeted freshwater wetland area is approximately 0.20 ft/day.

POTENTIAL RISK TO BENEFITS W/O LAND INTERESTS

The “Potential Risk to Benefits w/o Land Interests” column in the land assessment tables was assessed by considering the location of the parcel relative to the source of diverted water and relative to the coastline. Parcels with degraded freshwater wetlands that are located directly adjacent to a source of diverted water were considered to present a high risk to project success if land interests could not or were not acquired. The reasoning for this is that these lands are where the greatest wetland habitat lift is expected to occur and where the potential for development exists given that much of this acreage has been farmed in the past. These “high risk” lands are where access for monitoring, backfilling of smaller drainage ditches, and/or periodic exotic vegetation control is required to ensure project success. Also these lands are critically located between the water diversion structure and the bay coastline where nearshore salinity benefits are expected to occur. Implementation of the nuisance and exotic vegetation control plan is critical in controlling the spread of exotic species, and necessary in reducing competition with the native flora; an essential component of re-establishing pre-drainage wetland habitat. Applying adaptive management strategies after assessing ecological responses will allow for the necessary management actions to ensure that maximum restoration goals are achieved.

Parcels located directly adjacent to the bay were considered to present a moderate risk to project success if lands interests are not secured. The reasoning for this is that these lands have extensive mangrove forest so the lands are not considered to be readily developable. Thus, the risk that the landowner will convert the lands to a use that is adverse to the project success is not as likely as it is for areas without mangroves that have been farmed in the past. Though these are "moderate risk" lands, they are part of the critical path from the diversion structures to the nearshore bay zone where significant salinity benefits are expected from this project. If some action in the future limits the use of these lands as part of the flow path, not only are the expected tidal wetland benefits potentially compromised, the adjacent nearshore salinity benefits are at risk.

For the areas east of the L-31East Levee, the modeling data was insufficient to show hydrologic changes to these areas. The models used to determine the project benefits, WASH123 and TABS as well as the MODBranch model cannot predict the changes in either groundwater or surface water hydrology. Therefore the following is an analysis of how the project operations will potentially impact the various areas. ***Table 7-6*** shows the lands in the Deering Estate determined to be required for the Project, with a total of approximately 196.5 acres required. Of that approximately 25.85 acres are required for construction. The remaining approximately 170.65 acres will be impacted by Project hydrologic impacts approximately 1.1 foot per day when the pumps are discharging. It was determined that this is a Moderate to Significant impact on these lands. ***Table 7-7*** shows the lands in the Cutler Ridge portion of the project with approximately 1,733.93 acres required. Of that approximately 109.86 acres are required for construction of project features. For the remaining 1,624.07 acres hydrologic impacts are considered Moderate to Significant with approximately 0.5 feet of freshwater being discharged onto the area on a daily basis. ***Table 7-8*** shows the L-31E Culverts-Homestead North area comprised of approximately 962.66 acres, with only approximately 5.3 acres required for construction. For the remaining 957.36 acres, impacts are considered moderate with approximately 0.25 feet of freshwater flow across the lands on a daily basis. ***Table 7-9*** shows the L-31E Culverts Homestead South Tidal Wetlands totaling approximately 432.55 acres with only 2.16 acres required for construction. For the remaining 430.39 acres, impacts are considered moderate with approximately 0.20 feet of freshwater being discharged onto the area on a daily basis. ***Table 7-10*** shows the L-31E Culverts Homestead South Freshwater Wetlands totaling approximately 435.46 acres with 10.95 acres required for construction. For the remaining 424.51 acres hydrologic impacts are considered Moderate with approximately 0.4 feet of freshwater being discharged onto the area on a daily basis.

TABLE 7-6: DEERING ESTATE LAND ASSESSMENT EVALUATION

Deering Estate										
Tract/ Parcel	Current Property Ownership	# Acres	Existing Condition of Property (hydrology)	Current Use	Required for Construction (est. acres)	Operational Use Requirement (est. acres)	Magnitude of Project Induced Hydrologic Impact	Estate	Potential Risk to Benefits w/o Land Interests	Remarks
1a	Miami-Dade (DERM)	185.65	Degraded FW Wetlands	Park (passive recreation)	15		NA	Fee/SA	High	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land to be provided Fee thru exchange with SFWMD or by Supplemental Agreement pursuant to Master Agreement.
1b			Freshwater to Tidal Wetlands transition	Park (passive recreation)		170.65	≈1.1 ft/day when discharging Significant to Moderate	Esmt / SA	High to Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land to be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities compromises benefits used to justify project. Infrequent access to wetlands east of L-31 E will be necessary to conduct exotic vegetation removal and control. Additionally, as part of the adaptive management protocol, periodic access may be required to fill existing mosquito and/or drainage ditches east of the L-31 levee.
2	Miami-Dade (Parks & Rec)	10.85	Uplands	Abandoned Farm	10.85		NA	Fee/SA	High	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land to be provided Fee thru exchange with SFWMD or by Supplemental Agreement pursuant to Master Agreement.
Acreage Totals		196.5			25.85	170.65				

TABLE 7-7: CUTLER RIDGE LAND ASSESSMENT EVALUATION

Cutler Ridge										
Tract/ Parcel	Current Property Ownership	# Acres	Existing Condition of Property (hydrology)	Current Use	Required for Construction (est. acres)	Operational Use Requirement (est. acres)	Magnitude of Project Induced Hydrologic Impact	Estate	Potential Risk to Benefits w/o Land Interests	Remarks
1a	SFWMD	29.86	Degraded FW Wetlands	Abandoned Farm	29.86		NA	Fee	High	Land required for construction of project features.
1b		651.67	Degraded Tidal wetland	Abandoned Farm	20		NA	Fee	High	Land required for construction of project features.
1c			Degraded Tidal wetland	Abandoned Farm		631.67	≈0.5 ft/day Significant	Fee	High	Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.
2	NPS	308.04	Degraded Tidal wetland	Park		308.04	≈0.5 ft/day Moderate	Esmt / MOA	Moderate	Land required to flow water only. Loss of ability to flow water, and perform other activities compromises benefits used to justify project. Provided by Memorandum of Agreement (MoA).
3a	Private	32.25	Degraded FW Wetlands	Abandoned Farm		32.25	≈0.5 ft/day Moderate	Fee	High	Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.
4	State	111.06	Degraded FW Wetlands	Abandoned Farm		111.06	≈0.5 ft/day Significant	Esmt / SA	High	State law prohibits conveyance of Fee. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project.
5a	Miami-Dade (Water/Sewer)	403.4	Degraded Tidal wetland	Abandoned Farm	20		NA	Fee/SA	High to Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided in Fee thru exchange with SFWMD or by Supplemental Agreement pursuant to Master Agreement

5b			Degraded Tidal wetland	Abandoned Farm		383.4	≈0.5 ft/day Significant	Esmt / SA	High to Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project. Infrequent access to wetlands east of L-31 E will be necessary to conduct exotic vegetation removal and control. Additionally, as part of the adaptive management protocol, periodic access may be required to fill existing mosquito and/or drainage ditches east of the L-31 levee.
6a	M-D P&R	79.6	Degraded FW Wetlands	Abandoned Farm	20		NA	Fee/SA	Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided in Fee thru exchange of land with SFWMD or by Supplemental Agreement pursuant to Master Agreement
6b			Degraded FW Wetlands	Abandoned Farm		59.6	≈0.5 ft/day Significant	Esmt / SA	Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided in easement by deed or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project.
7a	M-D DERM	118.05	Degraded FW Wetlands	Abandoned Farm	20		NA	Fee/SA	Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided in Fee thru exchange with SFWMD or by Supplemental Agreement

										pursuant to Master Agreement
7b			Degraded FW Wetlands	Abandoned Farm		98.05	≈0.5 ft/day Moderate	Esmt / SA	Moderate	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project.
Acreage Totals		1733.9			109.86	1624.07				

TABLE 7-8: L-31E CULVERTS-HOMESTEAD NORTH LAND ASSESSMENT EVALUATION

L-31E CULVERTS - HOMESTEAD NORTH										
Tract/ Parcel	Current Property Ownership	# Acres	Existing Condition of Property (hydrology)	Current Use	Required for Construction (est. acres)	Operational Use Requirement (est. acres)	Magnitude of Project Induced Hydrologic Impact	Estate	Potential Risk to Benefits w/o Land Interests	Remarks
1a	Miami-Dade (Parks & Rec)	92.58	Degraded Tidal wetland	Abandoned Farm	2.5		NA	Fee/SA	High	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided in Fee thru exchange with SFWMD or by Supplemental Agreement pursuant to Master Agreement
1b			Degraded Tidal wetland	Abandoned Farm		90.08	≈0.25 ft/day Moderate	Esmt / SA	High	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project.
2	NPS	308.05	Degraded Tidal wetland	Park		308.05	≈0.25 ft/day Moderate	Esmt / MoA	High	Land required to flow water only. Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project. Land to be provided by Memorandum of Agreement (MoA).
3a	Private	252.83	Degraded Tidal wetland	Abandoned Farm	2.8		NA	Fee	High	Land required for construction of project features.
3b			Degraded Tidal wetland	Abandoned Farm		250.03	≈0.25 ft/day Moderate	Fee	High	Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.
4	Miami-Dade DERM	309.2	Degraded Tidal wetland	Abandoned Farm		309.2	≈0.25 ft/day Moderate	Esmt / SA	High	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises

										benefits used to justify project. Infrequent access to wetlands east of L-31 E will be necessary to conduct exotic vegetation removal and control. Additionally, as part of the adaptive management protocol, periodic access may be required to fill existing mosquito and/or drainage ditches east of the L-31 levee.
Acreage Totals		962.66			5.3	957.36				

TABLE 7-9: L-31E CULVERTS-HOMESTEAD SOUTH LAND ASSESSMENT EVALUATION

L-31 E Culverts - Homestead South Tidal Wetlands										
Tract/ Parcel	Current Property Ownership	# Acres	Existing Condition of Property (hydrology)	Current Use	Required for Construction (est. acres)	Operational Use Requirement (est. acres)	Magnitude of Project Induced Hydrologic Impact	Estate	Potential Risk to Benefits w/o Land Interests	Remarks
1a	Private	94.8	Degraded FW Wetlands	Abandoned Farm	2.16		≈0.20 ft/day Moderate	Fee	High	Land required for construction of project features.
1b			Degraded Tidal wetland	Abandoned Farm		92.64	NA	Fee	High	Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.
2	Miami-Dade (Parks & Rec)	16.52	Degraded Tidal wetland	Abandoned Farm		16.52	≈0.20 ft/day Moderate	Esmt / SA	High	Miami-Dade Ordinances prohibit conveyance of Fee without exchange. Land will be provided by easement or by Supplemental Agreement pursuant to Master Agreement. Loss of ability to flow water, conduct monitoring, prohibit uses, and perform other activities on land compromises benefits used to justify project. Infrequent access to wetlands east of L-31 E will be necessary to conduct exotic vegetation removal and control. Additionally, as part of the adaptive management protocol, periodic access may be required to fill existing mosquito and/or drainage ditches east of the L-31 levee.
4	NPS	321.23	Degraded Tidal wetland	Park		321.23	≈0.20 ft/day Moderate	Esmt / MoA	High	Land required to flow water only. Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project. Land to be provided by Memorandum of Agreement (MoA).
Acreage Totals		432.55			2.16	430.39				

TABLE 7-10: HOMESTEAD SOUTH FRESHWATER WETLAND LAND ASSESSMENT EVALUATION

L-31 E Culverts - Homestead South Freshwater Wetlands										
Tract/ Parcel	Current Property Ownership	# Acres	Existing Condition of Property (hydrology)	Current Use	Required for Construction (est. acres)	Operational Use Requirement (est. acres)	Magnitude of Project Induced Hydrologic Impact	Estate	Potential Risk to Benefits w/o Land Interests	Remarks
1a	SFWMD	251.61	Degraded FW Wetlands	Abandoned Farm	7.2			Fee	High	Land required for construction of project features.
1b			Degraded FW Wetlands	Abandoned Farm		244.41	≈0.40 ft/day Moderate	Fee	High	Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.
2a	FPL	148.9	Degraded FW Wetlands	Abandoned Farm	1.75		NA	Esmt	High	Land required for construction of project features. FPL required by SFWMD, Miami-Dade DERM and USACE to provide easement for CERP BBCW project pursuant to terms of regulatory permits.
2b			Degraded FW Wetlands	Abandoned Farm		147.15	≈0.40 ft/day Moderate	Esmt	High	Land required for operation of project features. FPL required by SFWMD, Miami-Dade DERM and USACE to provide easement for CERP BBCW project pursuant to terms of regulatory permits.
3a	Private	34.95	Degraded FW Wetlands	Abandoned Farm	2		NA	Fee	High	Land required for construction of project features.
3b			Degraded Tidal wetland	Abandoned Farm		32.95	≈0.40 ft/day Moderate	Fee	High	Loss of ability to flow water, and perform other activities on land compromises benefits used to justify project.
Acreage Totals		435.46			10.95	424.51				
Grand Total Acreage		3761.1			154.12	3606.98				

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 guidelines set forth in the referenced Section. The Section provides: "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." There are requirements to verify the appropriateness of fee simple acquisition or less than fee acquisition set forth (more detail is provided in Appendix D-Real Estate paragraph D-17). The analysis was conducted and while it was determined that fee title should be provided for the project, it was also determined that lesser estates could be recommended based on the language of the CERP Master Agreement; therefore the following estates were recommended to be required for the project. For lands owned by the U.S. Department of Interior, National Park Service, the right to flow water over and across the lands is required. These lands will be provided by a Memorandum of Agreement (MOA) to the SFWMD that allows the flow of water from the project across the lands of the Biscayne National Park. For lands owned by Florida Power and Light (FP&L), as part of its proposed Nuclear Reactors at FP&L's Turkey Point Site, FP&L had to get approval from Miami-Dade County and the permit condition required FP&L to convey perpetual flowage easements to Miami-Dade County Department of Environmental Resources Management for review. For lands owned by Miami-Dade County (Parks & Recreation Dept, DERM, or Sewer and Water Authority), Miami-Dade County ordinances prohibit the conveyance of fee title without an exchange of lands. For those lands required for project construction owned by Miami-Dade County, SFWMD will exchange properties to insure SFWMD has fee title to these lands. For other lands owned by Miami-Dade County required for project operation, SFWMD and Miami-Dade County will execute a Supplemental Agreement (SA) in conformity with the CERP Master Agreement to provide a perpetual flowage/conservation easement sufficient to operate the project. For lands owned by the State of Florida, Board of Trustees of the Internal Improvement Fund as State law prohibits the conveyance of fee, the State will execute a Supplemental Agreement to provide a perpetual flowage/conservation easement over these lands or will execute a perpetual flowage/conservation easement over these lands. For lands owned by SFWMD as of the date of the PIR, these lands will be provided in fee. For lands owned by private landowners, these lands will also be provided in fee. All this analysis is set forth in more detail in Paragraph D-17.

Wetland Descriptions Pertaining to the BBCW Project Area

Wetlands

Wetlands are areas that hold water for significant periods during the year and are characterized by anaerobic (low oxygen) conditions favoring the growth of specific plant species and the formation of specific soil types. These habitats are inundated or saturated with surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Freshwater Wetlands

Devoid of saltwater, freshwater wetlands in the project area are comprised of various freshwater wetland vegetation types, including sawgrass (*Cladium jamaicense*), cattail (*Typha* spp.), and coastal plain willow (*Salix caroliniana*). This habitat type is found mostly south of the C-103, and includes extensive areas of the Model Lands Basin. These vegetative types can be found as monocultures, but more often occur as mixed species. Even cattail, which is known for its ability to crowd out other plant species when conditions are favorable, is found mixed with species such as water hyssop (*Bacopa* spp.), mermaid weed (*Proserpinaca* spp.), willows (*Salix* spp.), and sawgrass. A variety of other freshwater wetland plant species, including periphyton species, occur in this vegetation type. Areas dominated by willow generally indicate freshwater areas that have been disturbed.

Degraded Freshwater Wetlands

This describes formerly productive wetlands that have been scraped, drained, leveled, and converted to agriculture farm lands or pasture lands. Although technically still wetlands, the functional capacity and overall productivity has been significantly reduced. In some areas where the availability and distribution of fresh water and disruption of natural sheet flow from discontinuities in hydrology due to levees, roads, and canals, the vegetative types are transitioning into more salt tolerant species. A primary goal of the project is to re-distribute freshwater canal discharges across a wider spatial area of wetlands. If successful, this rehydration effort will reduce hypersalinity and re-establish true estuarine conditions, while allowing a more natural transition of vegetative types.

Freshwater to Tidal Wetlands Transition

Also referred to as saline herbaceous/emergent wetlands or estuarine wetlands, this habitat type lies between mean sea level and the mean high water level, and therefore, is continuously flooded only during the annual water level peak that occurs in the fall. The vegetation is generally dominated by herbaceous, halophytic species such as sea oxeye (*Borrichia frutescens*), cordgrass (*Spartina* spp.), saltgrass (*Distichlis spicata*), and common rush (*Juncus* spp.) and sometimes spike rush (*Eleocharis* spp.). There is often a mixture of succulent herbaceous species such as saltwort (*Batis maritima*) and glasswort (*Salicornia virginica*) with scattered black mangrove.

Tidal Wetlands

Tidal wetlands are distinguished by their flood regime: wetlands flooded at least once per day are considered “low marsh” and those flooded less than once per day are considered “high marsh.” High marshes are typically flooded by high spring or storm tides. Also referred to as coastal wetlands or saltwater wetlands this wetland community along the mainland shore of the project area is dominated by mangrove forest. Mangroves are shoreline trees that live in the intertidal zone and form an extensive forest of emergent shoreline vegetation. Four species of trees are considered to comprise the mangrove community in south Florida: red mangrove (*Rhizophora mangle*), white mangrove (*Laguncularia racemosa*), black mangrove (*Avicennia germinans*), and buttonwood (*Conocarpus erectus*). The majority of this mangrove forest is contiguous, forming a habitat corridor for coastal wildlife.

Most of the mangrove habitat in the project area can be subdivided into four forest types. Closest to the bay shoreline is the coastal mangrove forest whose canopy is comprised mainly of black and white mangroves exceeding 30 ft in height and sometimes reaching 45 ft. The understory is mostly red mangroves. Landward of this zone is the interior mangrove forest that is dominated by black and white mangroves approximately 15 to 30 ft tall, again with an understory of red mangrove. Brazilian pepper can sometimes occur as an understory species. Adjacent to and landward of the interior mangrove forest is the transitional mangrove forest. This forest type is dominated by white mangroves approximately 7 to15 ft high, but red and black mangroves and buttonwood can be 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 ft in stature.

Degraded Tidal Wetlands

This area has been disturbed by the creation of mosquito ditches and interruption of freshwater sheetflow to the shoreline resulting in the expansion of salt tolerant plant species. Additionally, the reduction of freshwater flows has contributed to the extension of the dry season thus creating prolonged hypersaline conditions that have reduced the productivity and diversity of organisms within this habitat.

Non-Native Dominated Wetlands

There are primarily two types of non-native dominated wetlands in the project area; namely, Australian pine dominated wetlands and Brazilian pepper dominated wetlands. The type of non-native species that dominates a given area is generally related to the topography of the wetland. The majority of the Australian pine dominated wetlands occur in artificially elevated mangrove areas. Often the pines occur as linear features along berms created by the digging of drainage and mosquito ditches. Brazilian pepper dominated wetlands are generally intermediate in elevation, hydroperiod, and function between the native wetland and upland types in the project area. They can occur as dense mono-specific stands that are difficult to penetrate or as stands mixed with willow, buttonwood and other mangrove species.

7.9.3 Hazardous, Toxic and Radioactive Waste

Engineer Regulation (ER) 1165-2-132 states that construction of civil works projects in HTRW contaminated areas should be avoided where practicable. Compliance with the requirements of ER 1165-2-132 for the planning phase is demonstrated in this report. The USACE and SFWMD will continue to document HTRW conditions on the project lands such that the project will be in compliance with the ER and other applicable HTRW policy.

During the plan formulation phase of the study, the project delivery team developed and/or modified project alternatives in an effort to minimize and avoid lands that were likely to contain HTRW materials. However, none of the planning alternatives evaluated is likely to be completely free of HTRW materials because every alternative included former agricultural lands that likely have residual agricultural chemicals present in the cultivated soils. The development of an alternative that does not include former agricultural lands was not possible within this study area. The Selected Plan avoids HTRW to the extent possible by limiting the use of more intensely farmed acreage west of L-31E and elimination of a freshwater wetland rehydration feature located at Cutler west of the L-31E Levee. The Jacksonville District has worked with the SFWMD to ensure that human health concerns and ecological risks are evaluated for lands required for the BBCW project. As a first step towards satisfying the requirements of ER 1165-2-132, Alternative O, Phase 1 was formulated to minimize the potential for risks associated with HTRW. Second, Phase I Environmental Site Assessments (ESAs) were performed on each parcel owned by the SFWMD. The typical Phase I ESA scope of work is consistent with the Reconnaissance Phase requirements outlined in Section 7 of the USACE ER 1165-2-132 – Hazardous Toxic and Radioactive Waste (HTRW) Guidance for Civil Works Projects, dated June 26, 1992. Third, Phase II site investigations were conducted when warranted. To ensure consistent evaluations of lands to be used for Everglades restoration, the FDEP, USFWS, and SFWMD jointly developed a protocol, entitled “Protocol for Assessment, Remediation, and Post-remediation Monitoring for Environmental Contaminants on Everglades Restoration Projects" (SFWMD, 2008). The protocol, which is commonly referred to as the Ecological Risk Assessment (ERA) Protocol, is intended to provide guidance on conducting environmental site assessments on agricultural lands proposed for use in projects to be inundated with water, such as for conversion to storm water treatment areas, wetlands, reservoirs, and other aquatic features. Analysis for the Alternative O Phase 1 project followed the ERA Protocol. A copy of the ERA Protocol is provided in ***Appendix C.4***.

The ERA Protocol requires that relevant data collected during the Phase II ESA initially be compared to the human health Soil Cleanup Target Levels (SCTLs) from 62-777 F.A.C. and the ecological risk Soil Quality Assessment Guideline (SQAG) thresholds. While the SCTL's are promulgated standards under Florida law, the SQAG guidelines are not standards as defined in Section 403.803, F.S. Where the results exceed the SCTLs, a risk-based approach is used by the regulator to determine if corrective action is required or if an alternative target level is appropriate based on projected exposure. Where the results exceed the SQAG screening criteria, a Screening Level Ecological Risk Assessment (SLERA) is performed as part of the Phase II ESA. The purpose of the SLERA is to evaluate potential ecological risks to benthic invertebrates and higher trophic species, particularly USFWS trust species protected under the Endangered Species Act or the Migratory Bird Treaty Act, associated with exposure to the chemicals present in the soils, after the project is constructed and the property is inundated.

7.9.3.1 Project Lands Environmental Site Assessment Summary

Phase 1 and 2 environmental site assessments (ESAs) have been completed by the SFWMD on approximately 2,900 acres out of 3,700 acres of project lands included in the proposed BBCW selected plan. The summary Phase I/II audit reports with more than 500 pages of information are included in **Appendix A Part II.** The "Summary of Environmental Conditions" report in **Appendix C.3** includes information on Phase 1 / 2 audits that have been completed or contemplated for parcels that total 5,500 acres not all of which will be included in the project lands. **Table 1 in the Summary Report located in Appendix C** includes a parcel by parcel summary of the audits conducted to date. The short summary provided here describes the available site investigations as they pertain to human health and the ecological risks associated with the soils that contain concentrations of chemicals above human health regulatory criteria as defined by Florida Administrative Code 62-777, and/or an ecological guideline established by the Florida Department of Environmental Protection (FDEP) or the U.S. Fish and Wildlife Service (USFWS).

The Phase II ESA activities conducted to date have identified 27 CERCLA regulated substances in the surficial soil/sediment across the recommended plan's (Alt O Phase I) project area that exceed either human health criteria or ecological guidelines. ***Table 7-11*** is a summary of the chemicals found above applicable criteria. Of the detected substances, 26 exceeded ecological screening criteria [Sediment Quality Assessment Guidelines (SQAGs)], which in most cases (with the exception of arsenic) are significantly lower than the human health based Soil Cleanup Target Levels (SCTLs). A screening level ecological risk assessment (SLERA) was performed to further evaluate risk associated with those chemicals exceeding the SQAGs. This SLERA was reviewed by the FDEP and USFWS and they have indicated that the exceedances found to date pose limited risk to human health and ecosystem resources under pre- or post-project land use conditions. Where limited risk was indicated, the SFWMD worked with the FDEP and USFWS to mitigate for these risks (See **Section 7.16** for details).

TABLE 7-11: RANGE OF CONCENTRATIONS MEASURED VS REGULATORY REQUIREMENTS AND ECOLOGICAL GUIDELINES; BBCW ALT O, PHASE 1 CONFIGURATION

Parameter	CAS #'s[1]	CERCLA[2] Regulated (Y/N)	Site Wide	EPA Limits[4] (mg/kg)	Human Health and Ecological Guidelines (mg/kg)					
			Range[3] Observed (mg/kg)		SCTL-CDE[5]	SCTL-RDE[6]	SCTL-LGW[7]	SCTL-LSW[8]	SQAG-PEC[9]	SQAG-TEC[10]
Dieldrin	60-57-1	Y	0.0000079 - 0.0050	0.11	0.3	0.060	0.002	0.0001	0.062	0.0032
4,4-DDT	50-29-3	Y	<0.000014 - 1.0	7.0	15	2.9	11	0.06	0.063	0.0042
4,4-DDD	72-54-8	Y	<0.0023 - 0.89	7.2	22	4.2	5.8	0.01	0.028	0.0049
4,4-DDE	72-55-9	Y	<0.0000091 -1.24	5.1	15	2.9	18	0.04	0.031	0.0032
beta-BHC	319-85-7	Y	<0.0000092 - 0.0016	0.96	2.4	0.5	0.001	0.003	N/A	N/A
delta-BHC	319-86-8	Y	<0.000012 - 0.00059	N/A	490	24	0.2	N/A	N/A	N/A
Total Chlordane	54-74-9	Y	<0.0021 - 0.480	6.5	14	2.8	9.6	0.003	0.018	0.0032
Dimethoate	60-51-5	Y	<0.0405 - 0.16	120	170	13	0.006	0.0004	N/A	N/A
Arsenic	7440-38-2	Y	0.63 - 33	1.6	12	2.1	SPLP	SPLP	33	9.8
Copper	7440-50-8	Y	0.2 - 594	41,000	89,000	150	SPLP	N/A	150	32/85[11]
Chromium	7440-47-3	Y	.132 - 62.8	N/A	470	210	38	4.2	110	43
Lead	7439-92-1	Y	ND - 64.8	800	1400	400	SPLP	N/A	130	36
Barium	7440-39-3	N	ND - 48	190,000	130,000	120	1,600	N/A	60	20
Selenium	7782-49-2	Y	<0.0942 - 1.22	5,100	11,000	440	5.2	0.5	N/A	1
Silver	7440-22-4	Y	ND- 1.43	5,100	8,200	410	17	0.01	2.2	1
Cadmium	7440-43-9	Y	<0.07 - 6.8	1,000	1,700	82	7.5	N/A	5	1
Mercury	7439-97-6	Y	<0.014 - 0.2	34	17	3	2.1	0.01	1.1	0.18
Acenaphthene	83-32-9	Y	<0.00083 - 0.4	33,000	20,000	2,400	2.1	0.3	0.089	0.0067
Anthracene	120-12-7	Y	<0.00059 - 0.32	170,000	300,000	21,000	2500	0.4	0.85	0.0057
Benzo (a) anthracene	56-55-3	Y	<0.0015 - 1.1	2	N/A	N/A	0.8	N/A	1.1	0.11
Benzo (a) pyrene	50-32-8	Y	<0.0016 - 0.14	0.21	0.7	0.1	8	N/A	1.5	0.15
Chrysene	218-01-9	Y	<0.0013 - 0.78	210	N/A	N/A	77	N/A	1.3	0.17
Fluoranthene	206-44-0	Y	<0.0013 - 1.4	22,000	59,000	3,200	1,200	1.3	2.2	0.42
Fluorene	86-73-7	Y	<0.00098 - 0.084	22,000	33,000	2,600	160	17	0.54	0.077
Phenanthrene	85-01-8	Y	<0.0012 - 0.59	N/A	36,000	2,200	250	N/A	1.2	0.2
Pyrene	129-00-0	Y	<0.0065 - 1.5	17,000	45,000	2,400	880	1.3	1.5	0.2
Total PAH	NOCAS	N	0.01 - 5.1	N/A	N/A	N/A	N/A	N/A	23	1.6
TPH	NOCAS	N	<18.3 - 553	N/A	2,700	460	340	340	N/A	N/A

Notes:

mg/kg - milligrams per kilogram
[1]CAS Registry Number (CAS#'s) - unique numeric identifier which designates one substance and has no chemical significance
[2]40 Code of Federal Regulations (CFR) 302.4, Designation of Hazardous Substances - Comprehensive Environmental Response, Compensation, Liability Act
[3]Range of chemical concentrations observed in all the samples collected within the BBCW Project Area
[4]USEPA Region 9 PRGs - RSL Table – Industrial
[5]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure - Commercial / Industrial
[6]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, Direct Exposure – Residential
[7]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, and Leachability based on Groundwater Criteria
[8]Chapter 62-777, FAC, Table 2 - Technical Background Document, SCTLs, and Leachability based on Freshwater Surface Water Criteria
[9]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Probable Effects Concentration
[10]Development and Evaluation of Sediment Quality Assessment Guidelines, Volumes 1-4 (MacDonald, 2000), Sediment Quality Assessment Guidelines-Threshold Effects Concentration
[11]Interim Screening Criteria for protection of the Everglades Snail Kite

Arsenic is the contaminant that was most frequently detected on project lands. The source of much of the arsenic on project lands is likely to be from past farming activities since it is often coincident with other residual farm chemicals such as copper, lead, DDT, and chlordane. However, it is possible that some of the arsenic is naturally occurring given the presence of marl soils on these lands. There is a good deal of variation in mean arsenic concentrations within South Florida. The geometric mean concentration of arsenic in South Florida is 0.60 mg/Kg while in Everglades National Park marl soils that have no history of agricultural use is 5.4 mg/Kg with background arsenic levels exceeding 12 mg/Kg in some areas. (Chen and Ma,1999). Given the past farming activity and the level of chemicals found on the project lands it is more probable that the arsenic in the farmed areas is largely present as a result of past application of farm chemicals. Maps of with arsenic in soils coincident with project features are shown in ***Figure 7-12 ,Figure 7-13. Figure 7-14. and Figure 7-15..*** ***Figure 7-12*** shows the project features of the Deering component of the Selected Plan prior to the construction on this site in 2010 and 2011. This material is expected to be used during the construction of the Cutler features. ***Figure 7-13*** shows the project features of the Cutler Flow-Way. ***Figure 7-14*** shows the lined channel and pump station on the western portion of the Cutler component. ***Figure 7-15*** shows the project features in the L-31E component of the selected plan. The acreage with soils containing arsenic shown on these maps are based upon parcel boundaries, anticipated project construction footprints in some cases, and the highest observed arsenic concentration for the parcel. The maps do not depict the definitive delineation of acreage with arsenic contamination which, in many cases, is likely smaller than the parcel size. For instance, a given parcel where 10 or more samples have been collected may be identified as having arsenic on these maps based upon a single sample exceeding a relevant threshold while the remaining 9 samples showed no evidence of arsenic. On ten parcels totaling 1097 acres, the highest concentration of collected samples indicate arsenic concentrations exceed 2.1 mg/Kg which is the Florida residential (human health) direct exposure criteria for arsenic (SCTL-RDE). The highest sampled arsenic concentrations were observed on three parcels totaling 366 acres. Samples indicate arsenic concentrations exceed 12.0 mg/Kg which is the Florida commercial/industrial (human health) direct exposure criteria for arsenic (SCTL-CDE). Samples from one 50 acre grid cell, located east of the L-31E Levee and not within the construction footprint, exceed 33 mg/Kg which is the Florida ecological impact criteria for arsenic in sediments (SQAG). The USFWS reviewed the data from this 50 acre cell and determined that the areal extent of this concentration of arsenic did not pose an unacceptable risk to fish and wildlife resources.

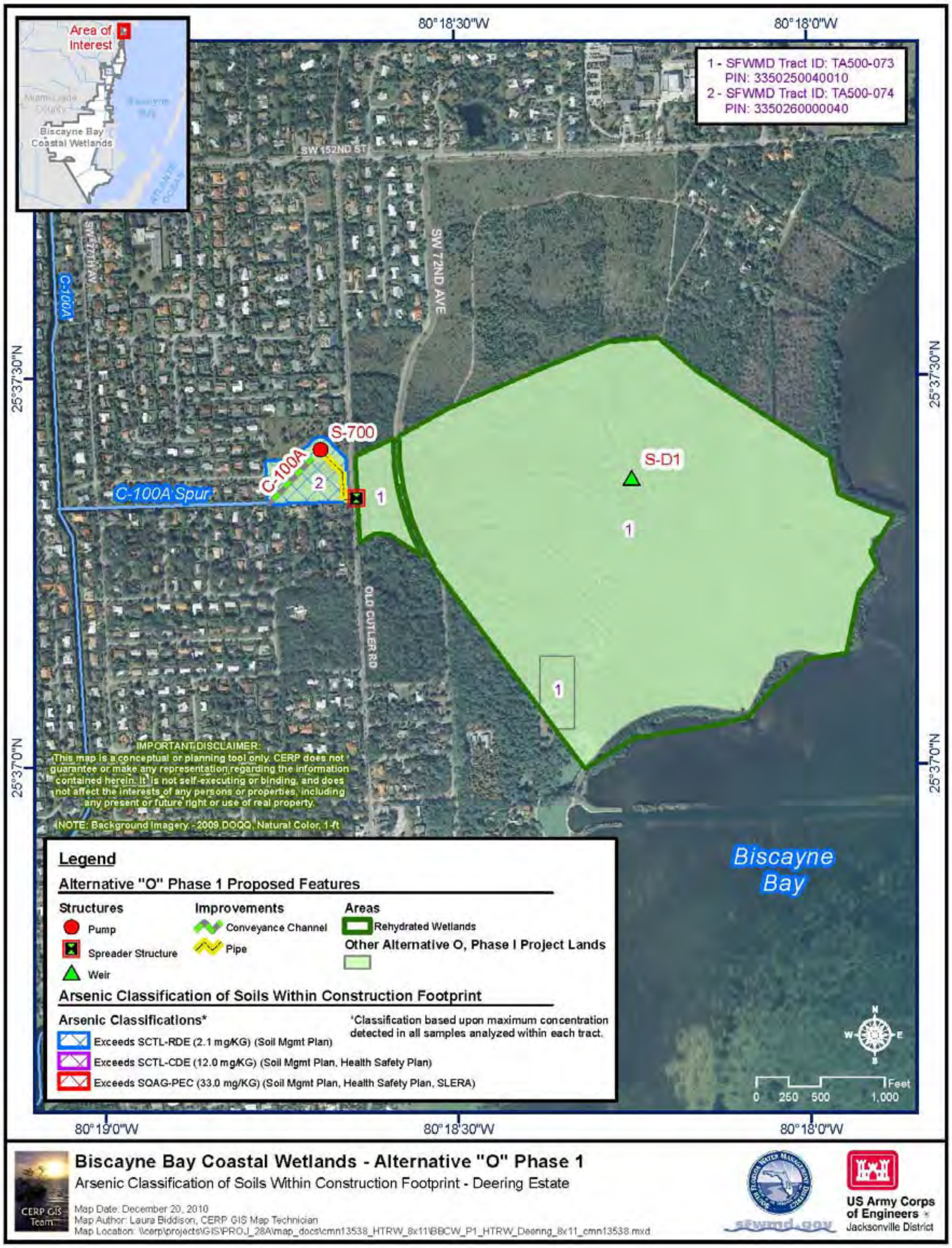

FIGURE 7-12: REGION 1, DEERING ESTATE FEATURES COINCIDENT WITH ARSENIC IMPACTED SOILS

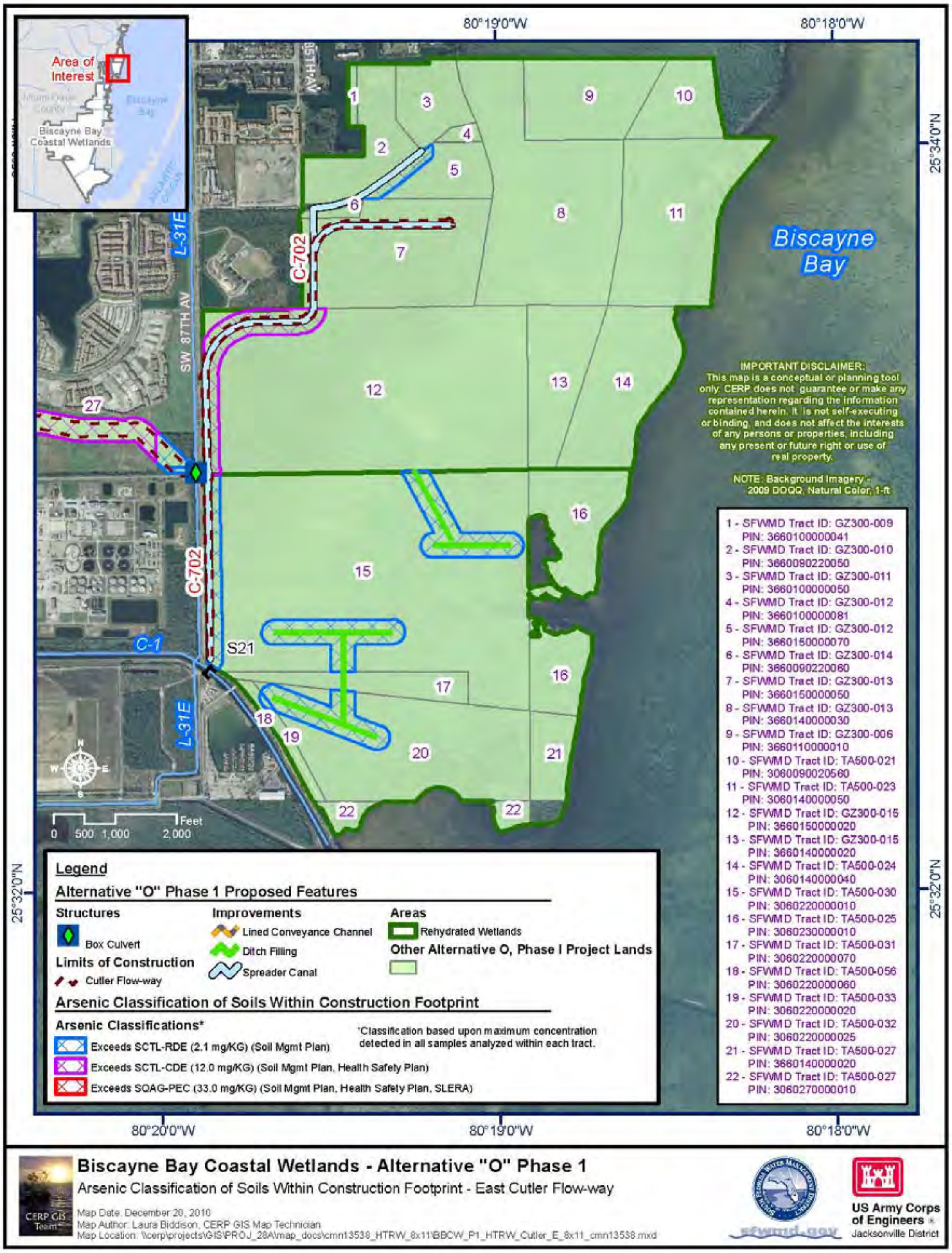

FIGURE 7-13: REGION 2, CUTLER EAST FEATURES COINCIDENT WITH ARSENIC IMPACTED SOILS

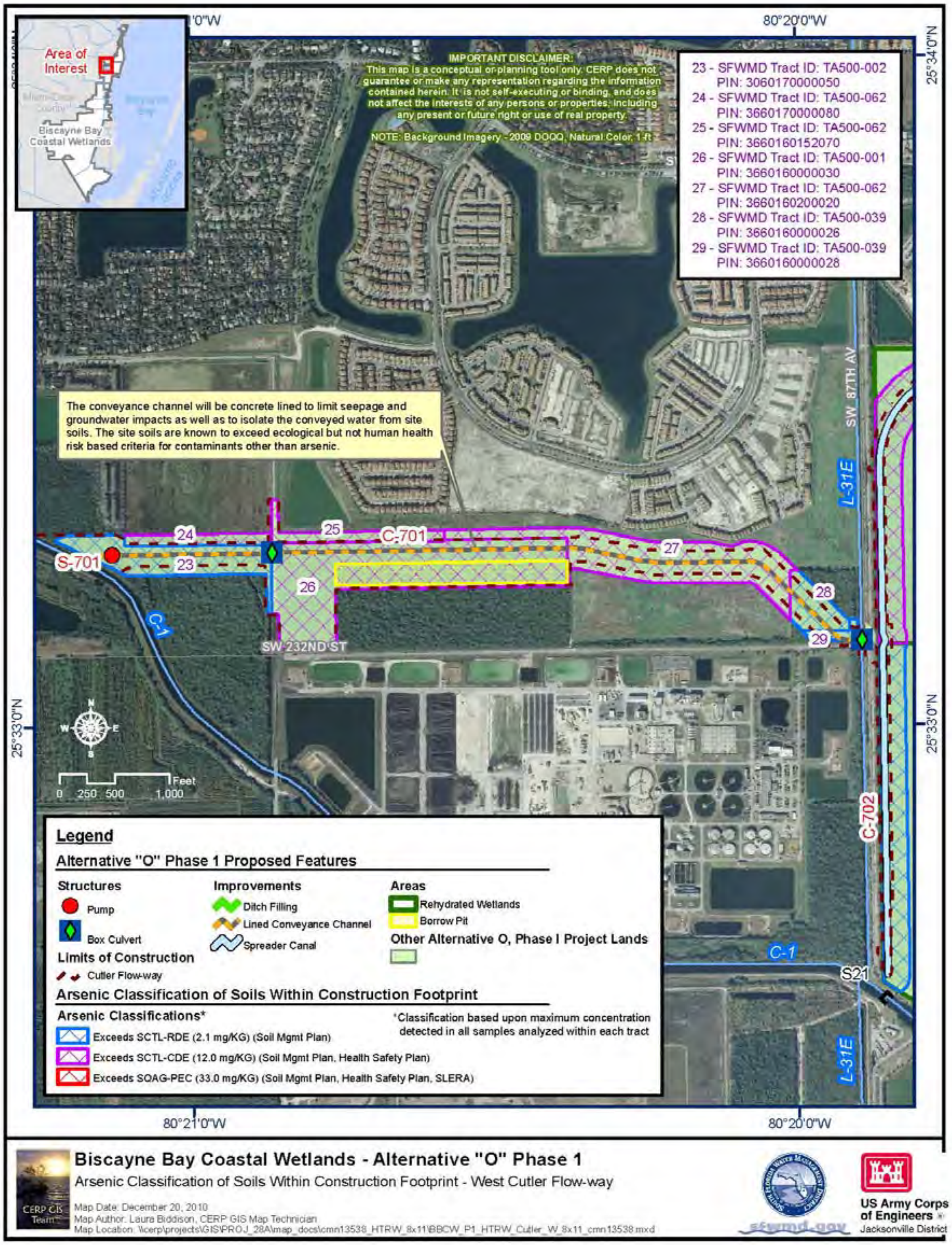

FIGURE 7-14: REGION 2, CUTLER WEST FEATURES COINCIDENT WITH ARSENIC IMPACTED SOILS

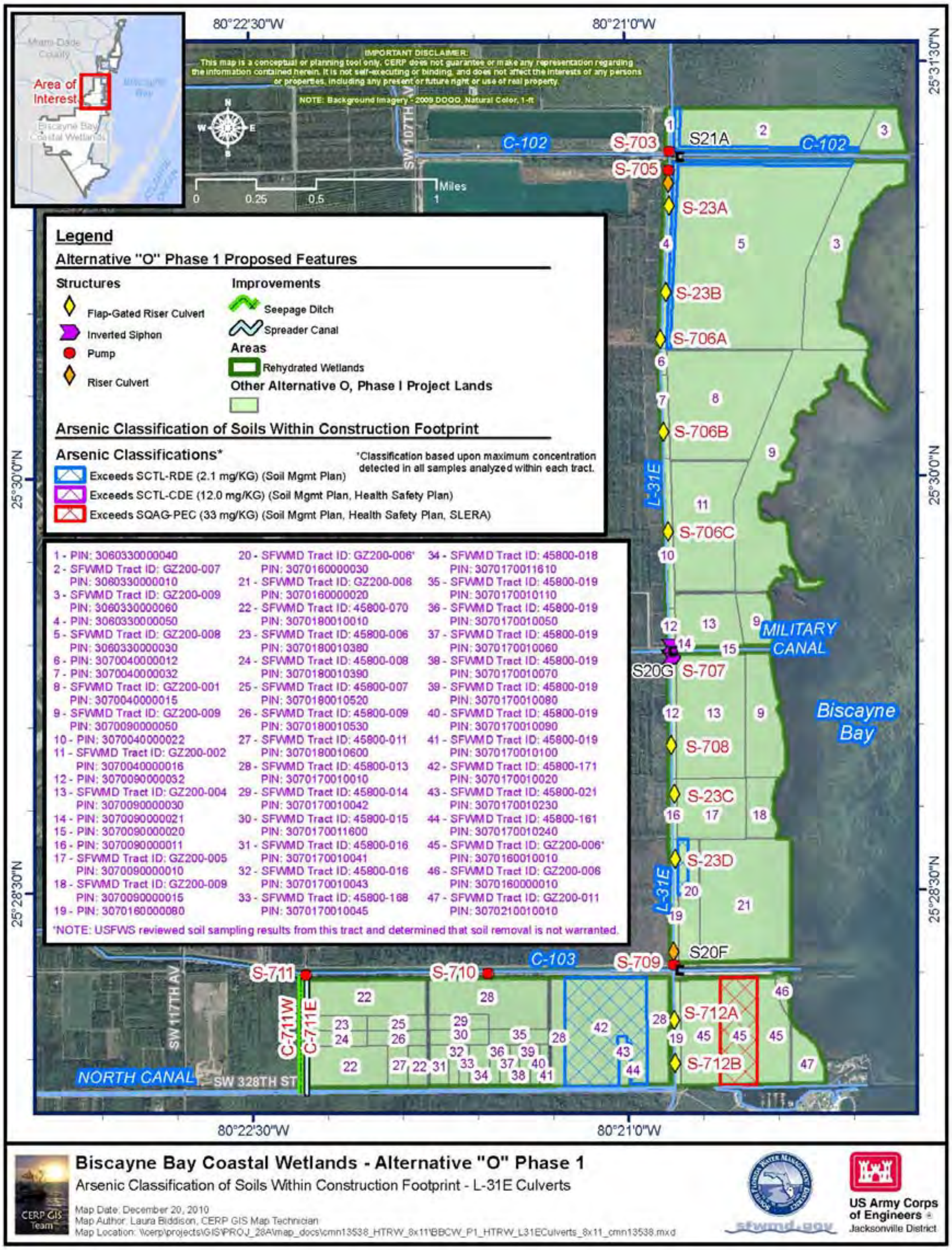

FIGURE 7-15: REGION 3 (L-31 EAST) FEATURES COINCIDENT WITH ARSENIC IMPACTED SOILS

During planning of the Cutler Wetland pump station on C-1, the project delivery team considered locating the pump station at the intersection of SW87th Ave and the C-1 canal or locating the pump station northwest of the intersection of the C-1 canal and SW 232nd Street. The SW 87th avenue/C-1 location is closer to the South Dade landfill at Black Point where a landfill-related groundwater plume of ammonia intersects with the C-1 canal. The project team decided that the location northwest of SW 232nd Street would be more suitable since there would be no possibility of entraining ammonia impacted groundwater into water pumped from the C-1 canal.

A construction debris landfill was located just south of the Cutler Wetlands Flow-way alignment on Tract TA500-062 (***Figure 7-15***). Historic aerial photography indicates that this property was used for agriculture prior to its use as a landfill. The property owner, Lennar Homes, has completed removal of the landfill. Because of the local geology that features hard limerock at a depth of 1 to 2 ft below land surface, waste was not buried at this former landfill but was stacked above the normal ground elevation. This fact greatly facilitated the removal of the landfill waste and lowered the likelihood of not removing all of the waste during closure. Constructing the flow-way on land just north of the former landfill site presents a lower risk than typically associated with construction next to an old landfill site given the practice of stacking rather than burying the waste. Quarterly groundwater monitoring was conducted for several years subsequent to the landfill removal. Ammonia, which is a typical degradation byproduct found in groundwater beneath landfills, was found at levels above FDEP's 2.8 mg/L groundwater cleanup target. After several years of quarterly sampling, no more exceedances of groundwater quality standards were observed, due to natural attenuation. The local regulatory authority recently (May 6, 2011) issued a no-further action letter indicating that site cleanup has been completed and groundwater monitoring was no longer necessary. The no-further action letter is included in Appendix C and the closure report will be reviewed by USACE prior to construction. It is possible that the construction of the flow-way on lands directly adjacent to the former landfill site might result in the disturbance of residual landfill pollutants in the groundwater that might have migrated off of the former landfill site. The USACE will evaluate related issues associated with constructing in the vicinity of the former landfill site. After project completion, the flow-way will not have a significant impact on soil and groundwater conditions at the former landfill site since the planned flow-way will be lined with 6" of concrete to limit seepage losses into the groundwater.

West of the former landfill site at Cutler Wetlands, a soil sample collected from Tract TA500-062, Property Identification Number 3660170000080 found high concentrations of DDE, chlordane, and pyrene at concentrations indicating a "hot spot" rather than a legal application of an agricultural chemical. At no cost to the Federal Government, the SFWMD instructed its contractor to perform a hot spot removal action to remove the soils from this site for off-site disposal. Follow-up testing indicated that all soils with elevated concentrations of these chemicals were removed. In the L-31E Wetlands component, two parcels (PINs 3070180010390, 3070180010380 shown in ***Figure 7-16***) have a history of prior agricultural use; however, evidence of illegal solid waste disposal was found on these two parcels which comprise approximately 20 acres. Prior to lands certification, the SFWMD will remove the solid waste from these parcels and conduct additional soil / groundwater testing at 100 percent sponsor cost to confirm their removal.

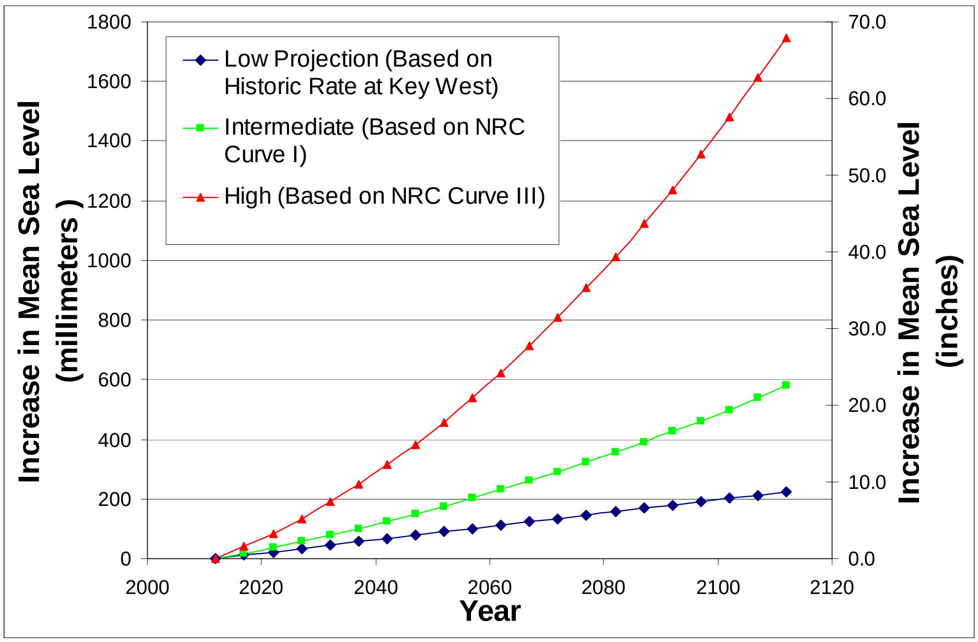

FIGURE 7-16: PROJECTED RELATIVE SEA LEVEL RISE AT BBCW PROJECT FEATURES (ASSUMES CONSTRUCTION COMPLETED IN 2012).

With the exception of the sites discussed in the two paragraphs above, the chemicals found in the soils of the majority of the project sites are likely the result of former legal application of agricultural chemicals. Absent the conversion of the project lands to an aquatic restoration purpose, no response actions would be required on these lands. Two parcels (PINs 3070180010390, 3070180010380) within the L-31E Flow-way freshwater wetlands component contain illegally dumped solid waste materials which require removal at no cost to the government prior to land certification. A single soil sample taken from Tract 45800-171 also within the L-31E Flow-way Freshwater Wetland has elevated concentrations of lead, arsenic, and copper that exceeds the Florida SQAG-PEC (Soil Quality Assessment Guideline-Probable Effects Concentration) in the case of arsenic and lead or the USFWS interim Snail Kite probable effects exposure concentration for copper. This site requires further investigation.

All Phase I/II studies and remedial activities completed to date have been coordinated with the Florida Department of Environmental Protection (FDEP) and the United States Fish and Wildlife Service (USFWS). The FDEP is EPA's delegated RCRA authority in Florida so regulatory review has been and will continue to be coordinated through the FDEP rather than through the USEPA. The Phase I/II reports have been reviewed by the USFWS to assess potential impacts to fish and wildlife resources. For the project lands evaluated to date, limited risks to ecological receptors as a result of the arsenic and other residual agricultural chemicals have been identified for the proposed project by either the USFWS or the FDEP. Where limited risk was indicated, the SFWMD worked with the FDEP and USFWS to mitigate for these risks (See **Section 7.16** for details).

Table 7-12 is a summary of environmental audits yet to be performed on project lands. Of the remaining 800 or so acres of land not yet acquired, the SFWMD and the USACE expect that the audits conducted on approximately 400 acres that lie east of the L-31E Levee are not likely to result in any requirements from FDEP to conduct RCRA response actions. Aerial photography of the remaining 400 or so acres of un-surveyed land that lies west of the L-31E Levee shows that approximately half of this land probably has some history of farming. It is probable that some chemicals will be found at concentrations above human health or ecological thresholds on these lands and that some limited RCRA response actions may be required.

Parcel specific summaries of the environmental audit findings are included in ***Tables 7-12, 7-13, and 7-14***.

TABLE 7-12: SUMMARY OF OUTSTANDING ENVIRONMENTAL AUDITS YET TO BE PERFORMED.

Parcel No.	Parcel Size (Acres)	Area within Alt O Footprint (Acres)	Phase I ESA or ESA Update Recommended	Phase II ESA Recommended
Deering Estate				
TA500-073	341.78	186.73	no	yes
Regional Total	**341.78**	**186.73**		
Cutler Wetlands				
Cutler Flow-Way				
TA500-021	105.6	35.60	yes	no
TA500-001	61.7	16.90	no	yes
Regional Total	**111.8**	**52.49**		
L-31 East Flow-Way Wetlands				
L-31E Freshwater Wetlands				
45800-006	9.67	9.67	no	yes
45800-007	9.69	9.69	no	yes
45800-008	10.18	10.18	no	yes
45800-009	10.17	10.17	no	yes
45800-011	9.09	9.09	no	yes
45800-014	9.85	9.85	no	yes
45800-015	9.99	9.99	no	yes
45800-016	4.51	4.51	no	yes
45800-018	9.01	9.01	no	yes
45800-019	36.57	36.54	no	yes
45800-021	5.93	5.93	no	yes
45800-013	319.28	101.57	yes	yes
45800-016	8.37	8.37	no	yes
45800-070	92.44	92.44	yes	yes
45800-161	0.58	0.58	no	yes
45800-168	4.53	4.53	no	yes
Subreagional Total	549.86	332.11		
L-31E Tidal Wetlands				
GZ200-002	91.22	91.22	yes	no
GZ200-004	132.18	132.18	yes	no
GZ200-011	259.52	16.11	yes	no
Sub-regional Total	482.92	239.51		
Regional Total	1032.78	571.62		
Grand Total	1486.35	810.84		

The SFMWD has addressed, at no Federal Government expense, most of the RCRA response actions identified in the Phase I/II audits conducted to date. These audits also identified areas where residual agricultural chemicals were present in the soils. The discussion of how soils containing low levels of agrichemicals will be managed as part of non-RCRA response actions is included in **Section 7.16.**

7.9.4 Relocation Assistance

In accordance with the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, as amended (Public Law [PL] 91-646), relocation assistance must be provided to affected residents and businesses. Information provided by the SFWMD would indicate that relocation assistance is not required. Upon certification of the LERR, the SFWMD would be required to demonstrate compliance with the requirements of PL 91-646 including that landowners have been properly advised of their rights under the program and that which evidence appropriate benefit determinations. To include:

- Number of persons, farms and businesses displaced
- Estimate of all PL 91-646, Title II costs and contingencies
- Discuss/describe availability of replacement housing and any need for last resort housing benefits

Based on current information, it appears that there are no relocation assistance payments made or required.

7.10 OPERATIONS AND MAINTENANCE CONSIDERATIONS

The major considerations for the O&M of the Biscayne Bay Coastal Wetlands are to maximize project benefits while maintaining existing flood protection levels, maintaining existing levels of service for legal users, minimizing operations and maintenance costs, and monitoring project impacts.

7.10.1 Flood Risk Management and Water Supply

None of the features included in the Biscayne Bay Coastal Wetlands project is intended to enhance flood risk management or alter water supply to any existing legal user. However, the project features must be operated in accordance with the Savings Clause (Section 601 (h)(5) of WRDA 2000) which requires that existing levels of flood risk management to agricultural and urban lands be maintained and that the level of service to existing legal users be maintained. The Savings Clause analysis which discusses flood risk management and level of service is found in ***Annex C.*** The draft operations plan in ***Annex D*** provides details on how the project will be operated to minimize changes in flood risk management and water supply.

7.10.2 Operations and Maintenance Costs

Annual O&M costs were estimated for the construction features of the Selected Plan for the Biscayne Bay Coastal Wetlands project. The O&M costs were determined by extrapolation from operational costs histories supplied by the SFWMD, USACE operational history and by using industry standard cost data and data from past and projected cost trends. O&M activities include such items as mowing, erosion control, pump maintenance, levee road maintenance, invasive species control and building maintenance. Annual O&M costs for project monitoring and vegetation includes hydrometeorological monitoring, ecological monitoring, water quality monitoring, and endangered species monitoring. Vegetation management is the management and control of exotic and nuisance vegetation. The total annual (OMRR&R) costs are estimated to be $1,873,000.

Annual O&M costs for recreation are estimated at $25,000 for trash pick-up and recreation facility repair, rehabilitation and replacement.

7.11 PLAN ACCOMPLISHMENTS

The project will divert an average of 59 percent of the annual coastal structure discharge (from structures S-123, S-21, S-21A, S-20F) into freshwater and saltwater wetlands instead of direct discharges into Biscayne Bay. This diversion will reduce the future nitrate load to Biscayne Bay by 162 metric tons of nitrogen per year which is approximately 50 percent of the projected future nitrate load to Biscayne Bay. The diversion will also reduce peak total phosphorus loading to the bay by approximately 50 percent over the future without-project condition.

Of the 473.61 acres (approximate) of freshwater wetlands acquired for this project, the Selected Plan (Alternative O Phase 1) will provide a total of 283 acres of freshwater wetland rehydration benefit. This is an increase of approximately 7.1 percent over the estimated 3,977 acres of existing functional freshwater wetland acreage within the project area.

Out of the total available saltwater wetland acreage of 22,500, this project will increase saltwater wetland function from 1,002 habitat units to 7,398 habitat units (net 6,396 acres of functionality). This increase in functionality will be the result of hydrating these wetlands and reducing the salinity of the water in these areas to less than 20 psu. Increasing the hydroperiod in the saltwater wetlands should result in improved habitat for the endangered American Crocodile which requires mesohaline salinity conditions to maximize juvenile survival. This is an increase from approximately 5 percent to 32 percent habitat functionality.

This project will also benefit the nearshore area of Biscayne Bay, defined as the zone within 0 to 500 meters from the shoreline, by improving the probability that the water in this zone will meet a desired salinity concentration of less than 20 psu. The target concentration for this zone is optimal for nursery habitat for pink shrimp, better meets the requirements for estuarine species which should benefit from this project. Out of a total possible nearshore acreage of 8,585 acres, the project will provide an average of 2,950 acre of lift of nearshore habitat. This is an increase from 1,673 habitat units to 4,624 habitat units of nearshore acreage. This is an increase of approximately 30 percent over the existing nearshore habitat functionality. This increase in habitat suitability comes from improved salinity conditions and improvement in water quality due to diversion of water through the saltwater wetlands.

The benefits to recreation in the project area result in an average annual net benefit of $58,000.

This project results in a total of 9,629 net habitat units (HUs). This total is comprised of 283 HUs in freshwater wetlands, 6,396 HUs in saltwater wetlands, and 2,950 HUs in the nearshore area of Biscayne Bay.

7.12 NEXT ADDED INCREMENT ANALYSIS

Section 385.26 of the CERP Programmatic Regulations required the development of a series of programmatic Guidance Memoranda (GM) that includes guidance for performing plan formulation and evaluation process and NAI justification. Next-added increment (NAI) is defined in the CERP Programmatic regulations as "the next project to be added to a system of projects that includes only those projects that have been approved according to general provision of law or specific authorization of Congress and likely to be implemented by the time the project being evaluated is completed." The NAI analysis evaluates the effects, or outputs, of the TSP as the next project to be added to the group of already approved CERP projects. This analysis helps illuminate the amount of benefits the selected alternative plan contributes without regard to future CERP projects. It also helps to ascertain whether sufficient benefits would accrue to the selected alternative plan to justify the cost if no additional CERP projects (other than those already existing or authorized) were implemented. In the case of the Biscayne Bay Coastal Wetlands Project NAI analysis, no other CERP projects are assumed to exist.

7.12.1.1 Ecological Analysis–Next Added Increment

A system analysis was conducted to determine the system habitat benefits for the CE/ICA and assist in the selection of the selected plan. All of the with-project alternatives considered in the TSP alternative evaluation included the project features and the rest of CERP. During the initial development of the Restudy final plan, the planners observed that the selected Alternative D13R resulted in a change in flow to southern Biscayne Bay. The most significant changes were that C-103 flows were decreased by approximately 50 percent while C-1 flows increased by 100 percent. The net change in flow to the bay was a reduction of approximately 120,000 acre-feet/year. To replace this lost water, the South Dade Wastewater Reuse project was added to the Restudy program's final project array.

The NAI analysis was conducted to justify and describe the benefits of the BBCW as a stand-alone project without the system wide benefits attributed to other CERP projects. The difference between the average annual HU lift for the system-wide analysis and the NAI was calculated to demonstrate the change in benefits if the rest of CERP is not constructed. The NAI analysis utilized the same performance measures as were used for the system-wide analysis, and was conducted using the combined HUs scores.

The following table (***Table 7-13***) includes results of the HU analysis for the NAI analysis for each of the alternatives.

TABLE 7-13: NEXT ADDED INCREMENT HABITAT UNIT SUMMARY

	Existing Condition	Future Without	Alternative O, P1	Alternative O-P1, NAI
Nearshore Indices	0.09	0.19	0.54	0.52
Acres	8,585	8,585	8,585	8,585
Habitat Units	**732**	**1,673**	**4,624**	**4,475**
2050 HU Lift	**NA**	**0**	**2,950**	**2,802**
Saltwater Indices	0.04	0.04	0.33	0.30
Acres	22,550	22,550	22,550	22,550
Habitat Units	**973**	**1,002**	**7,398**	**6,836**
2050 HU Lift	**NA**	**0**	**6,396**	**5,834**
Freshwater Indices	.414	.414	.444	.442
Acres	9638	9638	9638	9638
Habitat Units	3997	**3997**	**4280**	**4261**
2050 HU Lift		**0**	**283**	**264**
Total Habitat Units		**0**	**9,629**	**8,900**

In comparing the NAI benefits with the system-wide analysis, ***Table 7-13*** shows that there is a slight, but measurable difference between benefit calculations. Both analyses used the same CBEEM methodology for calculating benefits, and the conclusion can be drawn that much of the benefits of the Biscayne Bay Coastal Wetlands TSP could be achieved with little correlation to the remainder of the CERP being constructed. The next added increment results are lower for the equivalent alternatives due to the lack of supplemental water provided by the CERP wastewater reuse project planned for South Miami-Dade County.

The analysis shows that the NAI analysis for Alternative O-P1 provides benefits of 8,900 HUs across the three ecological zones. The system-wide analysis for Alternative O-P1 accounted for 9,629 total HU's across the three ecological zones. As a stand-alone project, the BBCW restoration nearly doubles the spatial extent of the wetlands expected to exist in the future. Also, there is only a reduction of 8 percent in HUs within the study area created as compared to the system-wide analysis of all CERP components including BBCW. It is reasonable to expect that the system-wide project benefits would be very similar to the NAI benefits given that the reuse project mostly replaces water lost to other CERP projects; however, benefit calculations reflect the fact that the constant flow of reuse water flow provides more potential benefits as compared to highly variable canal flows. One explanation for the limited difference between the predicted system-wide benefits and the NAI benefits is that the system-wide analysis does not capture most of the benefits that are being provided outside of the Biscayne Bay Coastal Wetlands study area by other CERP components. Due to the nature of the available models and uncertainty in the independent CERP features included in the system-wide analysis, it was not practical to characterize all of the system benefits. If all of the benefits to the other conceptual CERP features were characterized, it is fully expected that the cumulative system-wide benefit analysis would greatly exceed the cumulative NAI benefits of the stand alone Biscayne Bay Coastal Wetlands project. It is important to note that the BBCW project study area is furthest downstream of the CERP components. As such, this project has little to no impact on the achievement of CERP system-wide benefits that occur upstream of the BBCW study area. That is to say, that upstream benefits are not dependent upon the BBCW project; though, the achievability of BBCW benefits is dependent on CERP induced hydrologic changes that occur upstream. Fortunately, the CERP "Savings Clause" requirements of Section 601(h)(5) of WRDA 2000 requires that equivalent replacement water must be identified and available prior to the transfer or elimination of water supplies from any legal user within the CERP implementation area. This requirement should protect the Biscayne Bay project area from future potential CERP related water supply reductions that might threaten the benefits expected for the BBCW project.

Overall, the project design is consistent with attaining project goals and objectives. Operational flexibility would lead to increased benefits by further minimizing potential high flows to the estuary as well as by minimizing discharges and associated sediment loads, and preserve the opportunity to construct remaining features of Alternative O in a future effort. Both the system formulation and the NAI evaluations of Alternative O Phase 1 (the TSP) demonstrate significant ecological benefits due to implementation of the Biscayne Bay Coastal Wetlands project.

7.13 CONTRIBUTION TO ACHIEVEMENT OF INTERIM GOALS AND INTERIM TARGETS

Section 601(h)(3)(C)(III) of the WRDA 2000 (PL 106-541) required the CERP Programmatic Regulations to include the "establishment of interim goals to provide a means by which the restoration success of the Plan may be evaluated throughout the implementation process." Section 385.38 of the CERP Programmatic Regulations (33 CFR Part 385) further described the intent and the underlying principles for establishing interim goals, and a process for developing them. Section 385.39 of the CERP Programmatic Regulations established the requirement to develop interim targets to measure progress toward meeting the other water-related needs of the south Florida region, and described the intent, underlying principles, and the process for establishing interim targets.

Consistent with the Programmatic Regulations, the RECOVER team, using the best science and information available at the time (2003), developed recommendations for interim goals and targets and provided these recommendations to USACE, Department of Interior, and SFWMD for their consideration prior to executing the Intergovernmental Agreements (Agreements) to establish interim goals and interim targets for the CERP. The RECOVER recommendations, along with associated documentation and appendices, provide greater detail on the interim goals and interim targets and are contained in a document entitled *RECOVER Team's Recommendations for Interim Goals and Targets for the Comprehensive Everglades Plan* dated 2 March 2007. The RECOVER recommendations organize the interim goals by ecosystem indicator within specified regions of the Everglades. Determinations for meeting specific interim goals were evaluated by anticipated project effects.

As a result, the Biscayne Bay Coastal Wetlands Phase 1 project is expected to make progress toward 11 of the 29 interim goals of restoration (***Table 7-14***); however, because the project is not designed to increase flood control, increase water supply, nor contain water storage features, none of the interim targets are applicable. Since the project is located along the southeast coast, the effects are contained within the southeastern glades area and Biscayne Bay.

TABLE 7-14: EXPECTED PROJECT EFFECTS FOR CERP INTERIM GOALS

Indicator	***Interim Goals and Predictions***	***Summary of Project Effects***
3.2 Sheet Flow	Establish more historic magnitudes and directions of sheetflow in the natural areas of the Everglades	Fresh water would be diverted out of canals using pumps and culverts restoring overland flow to about 3,000 acres of wetlands, and create more natural gradients of flow into Biscayne Bay.
3.3 Hydropattern	Restore the natural timing and pattern of inundation throughout the ecological communities of South Florida, including sawgrass plains, ridge and slough and marl marshes.	Natural timing and pattern of inundation are expected to improve within freshwater wetlands within the project area. Hydropatterns may also be improved in un-impounded wetlands.
3.4 System-wide Spatial Extent of Natural Habitat	Increase spatial extent of natural habitat.	The spatial extent of higher quality wetlands would increase due to control on non-native species through improved hydroperiods and other means, if necessary (mechanical or chemical removal).
3.6 Periphyton Mat Cover, Structure, and Composition	Restore periphyton mat cover, structure and composition that were characteristic of the spatially distinct hydroperiods (short and long) and low nutrient conditions in the greater Everglades wetland communities.	Periphyton cover and persistence is expected to increase in wetlands that are not salt intruded.
3.9 Aquatic Fauna Regional Populations in Everglades Wetlands	Increase the abundance of fish to levels that approximate those predicted for pre-drainage conditions.	The abundance and diversity of aquatic fauna is expected to improve in the freshwater impoundments as a result of improved

		hydroperiods.
3.10 American Alligator	Restore more natural numbers and distribution patterns for alligators across South Florida's major freshwater and estuarine landscapes.	Maintaining deeper water on average within the impounded wetlands should increase alligator foraging habitat.
4.1 Salinity Patterns in Florida Bay and Biscayne Bay	Reduce the intensity, duration, frequency and spatial extent of high salinity events, re-establish low salinity conditions in mainland nearshore areas, and reduce the frequency of and rapidity of salinity fluctuations resulting from pulse releases of fresh water from canals.	The nearshore salinity pattern would improve by an increased linear extent of lower salinity, and salinity patterns within the saltwater wetlands are expected to provide salinity gradients that support important ecotones.
4.2 Submerged Aquatic Vegetation in Southern Estuaries	Re-establish a diverse seagrass community with moderate plant densities and more natural seasonality, and increase the percentage of Florida Bay having suitable habitat for seagrass growth.	The diversity of seagrasses in the nearshore zone should increase with a greater abundance of estuarine species such as shoal (*Halodule wrightii*) and wigeon (*Ruppia maritima*) grasses.
4.3 Juvenile Shrimp Densities in Florida Bay and Biscayne Bay	Increase densities of juvenile shrimp within the various basins of Florida Bay and Biscayne Bay.	An increased abundance of shoal grass and more stable nearshore salinity patterns would increase the preferred habitat of juvenile pink shrimp (*Farfantepenaeus duorarum*).
4.4 American Crocodile	Increase the frequency of salinities less than 20 parts per thousand in Florida Bay to foster optimal growth and survival of juvenile crocodiles.	Reduced salinity within saltwater wetlands along the shoreline would improve habitat for juvenile crocodiles (*Crocodylus acutus*).

5.1 Quantity of Fresh water Lost to Tide	Reduce the quantity of freshwater lost to tide.	Water currently discharged through canals is redirected through wetlands.

In addition to the indicators listed in ***Table 7-14***, the project is expected to improve the spatial extent and abundance of Eastern oysters along the shoreline of the project area, and create a more suitable habitat for estuarine finfish such as spotted seatrout and yellowfin mojarra, which are indicative of a restored estuary.

7.14 DISCUSSION OF MAJOR RISK AND UNCERTAINTY

The major uncertainties associated with implementing this project are primarily related to the accuracy of the project costs and benefits. A short summary of these risks and uncertainties is included below.

7.14.1 Cost Risk and Uncertainty

Cost risk analysis is the process of determining the probability of cost and schedule overruns and assigning a studied growth potential to contract costs as a percentage of a value applied as a contingency. It is a formal process that includes involvement of the project delivery team, utilizing nationally-recognized software based on the Monte Carlo principles. When considerable uncertainties are identified, cost risk analysis can pinpoint areas of high cost uncertainty and provide valuable information about that uncertainty. This gives the management team an effective additional tool to assist in the decision making process. Recent USACE guidance requires that a formal cost risk analysis be prepared for all Civil Works decision documents requiring Congressional authorization for projects exceeding $40 million. See ***Appendix B*** for a discussion on Risk and Uncertainty Analysis.

7.14.2 Benefit Risk and Uncertainty

The key assumptions regarding project benefits are the availability of water, future land use conditions, and the magnitude of sea level rise (SLR). The risk and uncertainty associated with each of these assumptions is discussed below.

7.14.2.1 Water Availability

Benefits associated with rehydration of wetlands as well as improved salinity conditions in the nearshore are directly related to the amount of water available to divert and redistribute from the south Miami-Dade conveyance canals. The largest water demands come from urban/agricultural users and the natural system. The projected 2050 urban/agricultural water demands were incorporated into project modeling efforts. Though there is a risk that the 2050 water use projections will be exceeded, recently this became less likely since the local water consumptive use permitting agency (SFWMD) has limited the major urban water user (Miami-Dade County Water and Sewer Department) to existing groundwater withdrawals from the Biscayne aquifer, and must seek alternative sources for any future demands. The distribution of water supplies within the natural system will be altered as a result of the full implementation of CERP or other restoration projects. The original Restudy indicated that under with-project conditions Biscayne Bay will receive less water. However, Section 385.36 of the Programmatic Regulations requires that PIRs determine if existing legal sources of water are to be eliminated or transferred as a result of project implementation ("existing legal users" includes the natural system). This means that if a CERP project is expected to result in an elimination or transfer of an existing legal source of water, such as Biscayne Bay, the PIR shall include an implementation plan that ensures a new source of water of comparable quantity and quality is available to replace the source that is being transferred or eliminated.

7.14.2.2 Future Land Use Conditions

The benefit assessment methodology included an analysis of the effect of land use changes on project water quality as well as availability of some agricultural lands for use as wetland restoration sites. The benefit assessment assumes that agricultural lands near L-31E Levee will be available for use as wetland restoration sites. These lands are currently outside of the Miami-Dade County Urban Boundary so they are difficult to convert to urban and commercial land uses. The conversion of some of these lands would likely reduce overall project benefits; however, the local regulatory agencies (DERM, FDEP, SFWMD) negotiate with permit applicants within the Biscayne Bay Coastal Wetlands project area to minimize development impacts.

7.14.2.3 Sea Level Rise

An analysis was performed to look at the effect of sea level rise (SLR) on the benefits predicted for the selected Alternative O, Phase 1, per the guidance provided in EC 1165-2-211. This guidance requires that sea level rise impacts be determined at the 20 year, 50 year, and 100 year post-construction timeframes. For the sea level rise analysis, the timing of project construction and benefit accrual is based upon having construction complete by 2012. The results indicate that within the 20-year timeframe, approximately 8 percent of the project ecosystem benefits are likely at risk to SLR. At the end of the 50-year timeframe, the benefits attributed to the Selected Plan will be diminished by approximately 41 percent as determined by comparing the flood prediction maps for 2 ft of SLR (high projection for 50 years) with the benefited area projection.

Limited impacts to project benefits are anticipated at the low and moderate SLR projections at 50-years. Under the high SLR scenario at 100 years, the project benefits will not occur. Given the delayed ecological response to project induced changes, the restoration benefits resulting from this project are expected to ramp up from zero benefits at time of construction to maximum project benefits at 10 years post construction. Taking into account sea level rise, the period of maximal project benefits will occur during the period between 10 and 20 years post construction. After 20 years until the end of the project life 30 years later, project benefits are expected to decrease as a result of SLR. The expected impact of SLR is a reduction of around 17% in average annual benefits estimated over the 50 year life of the project.

The effects of SLR on project benefits that occur after the 40-year period of analysis should be treated the same as benefits that occur after the period of analysis. In other words, effects that occur after the 40 year period of analysis should not be considered for plan selection or determination of project viability.

A qualitative comparison of SLR impacts to benefits accorded other project alternatives was done. This analysis showed that the selected plan will likely experience a greater percent reduction in overall benefits as compared to the alternatives that focus on freshwater wetland rehydration (Alternatives YB and Q); however, these alternatives would not provide as much preservation of the critical oligohaline and mesohaline habitat located east of the L-31E Levee. In comparison to the No Action Alternative, the Selected Plan will provide more protection to oligohaline and mesohaline habitat located east of the L-31E Levee. The Selected Plan should perform the same as the No Action Alternative in terms of effects to freshwater wetland habitat west of the levee.

As with the predictions of future rates of SLR, there is uncertainty in the estimation of effects to project related ecosystem benefits due to the accuracy and reliability of the datasets used in this analysis. The MSL flood prediction maps are based upon topographic data that is known to be accurate to within plus or minus 0.5 ft. The land elevation is assumed to be static over the 20, 50, and 100 year periods; however, topographic change is likely to occur in the saltwater wetland areas as a result of SLR and other natural processes. Despite these limitations and inherent uncertainties, the analysis is presented here since it is the most reliable information available at this time.

EVALUATION OF EFFECT OF SEA LEVEL RISE ON BBCW PROJECT BENEFITS

Prepared February 10, 2010 / Revised September 28, 2011

1) INTRODUCTION

The restoration benefits projected for this project are associated with the rehydration of freshwater wetlands, salinity maintenance in the saltwater wetland area, and moderated salinity conditions in the nearshore area adjacent to the saltwater wetlands that border Biscayne Bay on the west. This will be accomplished by installing pumps, spreader canals, and gated culverts that will take water from the existing canal network and distribute it to wetlands located east and west of the L-31E Levee.

Since the study area elevation varies between +9.0 to –1.0 feet NAVD88, it is apparent that SLR will affect project features and the expected ecological benefits. Corps planning guidance (EC 1165-2-211) calls for evaluating the effects of sea level rise (SLR) under multiple scenarios. The multiple scenarios recommended include analysis of sea level rise at low, intermediate and high levels at 20, 50, and 100 years following the completion of project construction. Relative sea level rise has been calculated by the Jacksonville District for the low, intermediate and high scenarios at 5 year intervals per EC 1165-2-211 guidance and based upon the historic sea level rise as measured at the NOAA Key West tide station. Relative SLR in this part of Florida is equivalent to eustatic SLR since land elevation is generally stable. The results of this analysis are presented in ***Table 7-15*** and ***Figure 7-17 through 7-27***.

TABLE 7-15: RELATIVE SEA LEVEL RISE AT 5 YEAR INTERVALS FOR LOW, INTERMEDIATE, AND HIGH PROJECTIONS.

Year of Analysis	t_2 (years)	Low Projection (Based on Historic Rate at Key West) (mm)	Intermediate (Based on NRC Curve I) (mm)	High (Based on NRC Curve III) (mm)	Low Projection (Based on Historic Rate) (inches)	Intermediate (Based on NRC Curve I) (inches)	High (Based on NRC Curve III) (inches)
2012	26	0	0	0	0.0	0.0	0.0
2017	31	11	18	40	0.4	0.7	1.6
2022	36	22	37	84	0.9	1.4	3.3
2027	41	34	57	134	1.3	2.2	5.3
2032	46	45	78	189	1.8	3.1	7.4
2037	51	56	100	248	2.2	4.0	9.8
2042	56	67	124	313	2.6	4.9	12.3
2047	61	78	149	383	3.1	5.9	15.1
2052	66	90	175	458	3.5	6.9	18.0
2057	71	101	202	538	4.0	8.0	21.2
2062	76	112	230	623	4.4	9.1	24.5
2067	81	123	260	712	4.9	10.2	28.0
2072	86	134	291	807	5.3	11.4	31.8
2077	91	146	322	907	5.7	12.7	35.7
2082	96	157	356	1012	6.2	14.0	39.9
2087	101	168	390	1122	6.6	15.3	44.2
2092	106	179	425	1237	7.1	16.7	48.7
2097	111	190	462	1357	7.5	18.2	53.4
2102	116	202	500	1482	7.9	19.7	58.4
2107	121	213	539	1612	8.4	21.2	63.5
2112	126	224	579	1748	8.8	22.8	68.8

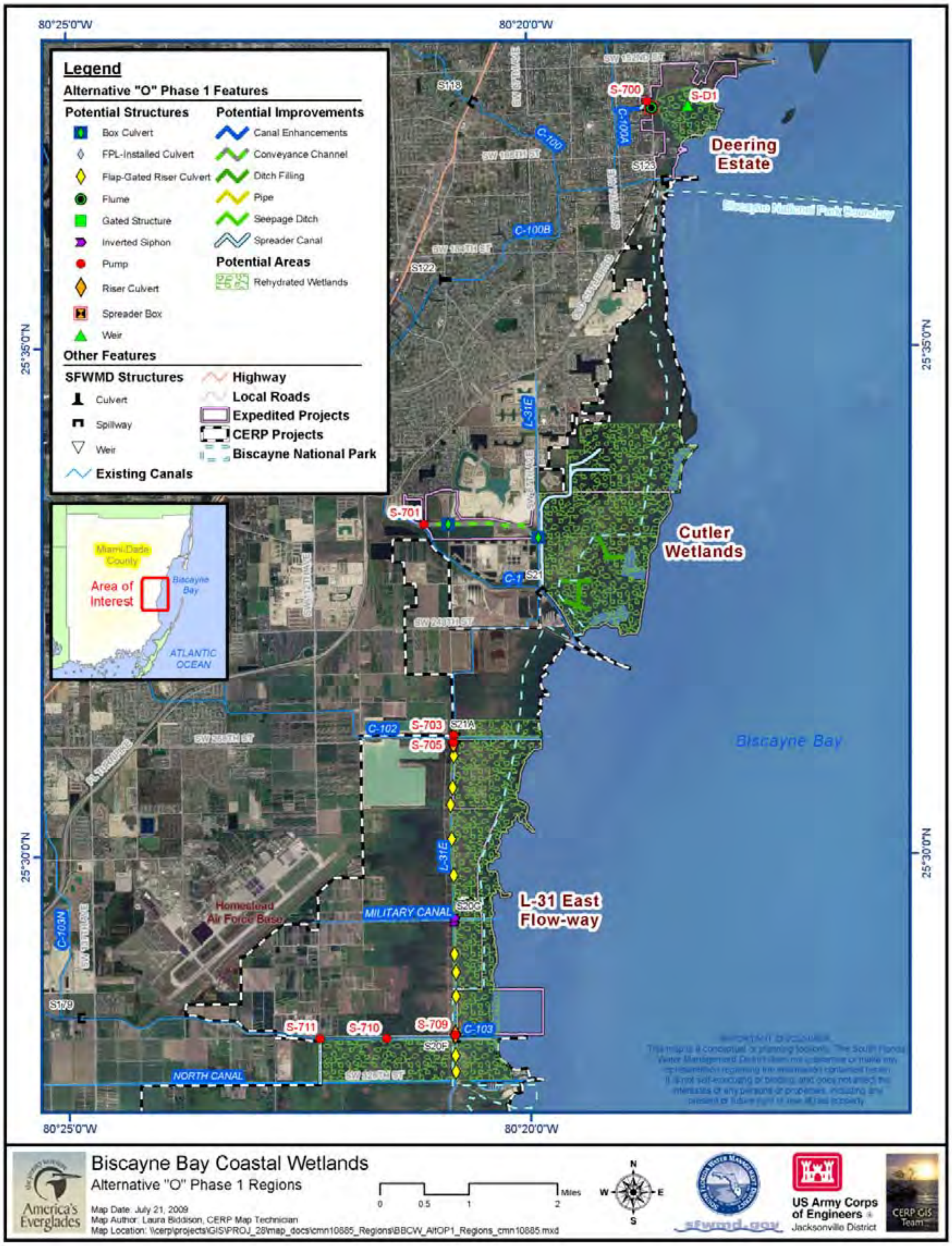

FIGURE 7-17: PROJECT MAP SHOWING AREAS OF EXPECTED BENEFITS

2) GENERAL EFFECTS OF SLR ON SELECTED PLAN

The effect of SLR on Biscayne Bay Coastal Wetlands habitat will vary depending upon the location and elevation of the affected lands. ***Figure 7-18*** shows a map of the project area with the three project components located east of the Homestead portion of the L-31E Levee, in the Cutler Wetlands, and at Deering Estates in the north. The dividing line between the freshwater wetland habitat and the saltwater wetland habitat is generally considered to be the L-31E Levee though some remnant freshwater wetland habitat exists in the Cutler Wetlands east of L-31E. Maps of the L-31E and Cutler Wetlands components as well as elevation cross sections are shown in ***Figures 7-18 through 7-27*** with overlays of mean sea level (MSL), MSL+1 ft SLR, MSL+2 ft SLR, and MSL+3 ft SLR. Based on the topography and sea level conditions shown in these figures, it appears that SLR will impact the saltwater wetland habitat east of the L-31E Levee to the greatest extent. As sea level comes up, the white zone habitat that currently is limited to the very eastern fringe of the saltwater wetland zone will expand westward. Mangrove forest will move westward towards the L-31E Levee alignment. Nearshore shallow estuarine habitat that is targeted for salinity improvement by this project will slowly move west towards the L-31E Levee as MSL comes up. Whatever peat soils exist east of the L-31E Levee will decompose and disappear as saltwater intrudes into remnant grammanoid marsh not previously impacted by tidal flows. At higher sea level conditions, freshwater wetlands west of the L-31E Levee will transition to saltwater wetlands.

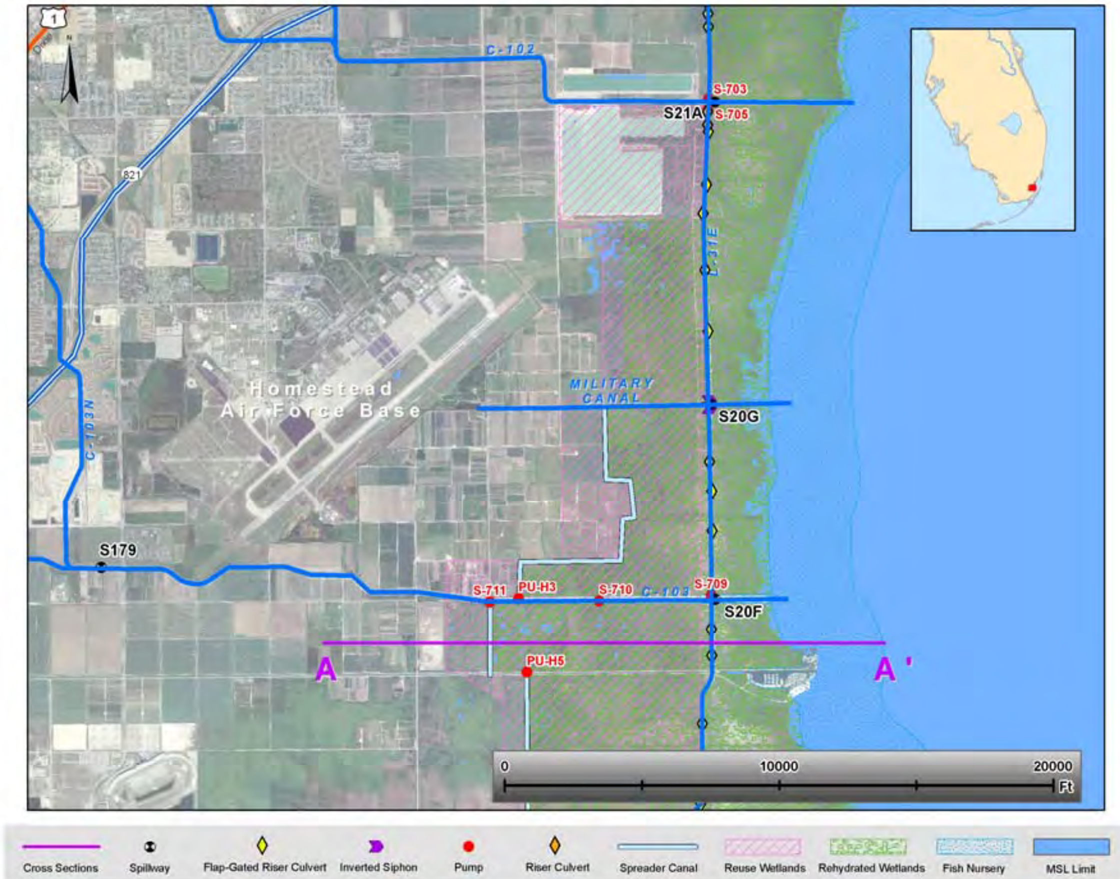

FIGURE 7-18: L-31E WETLAND AREA AS IMPACTED BY MSL.

Many tidal creeks have already disappeared in coastal wetlands as a result of sediments trapped by opportunistic plants that have rooted in the creek beds as water flow has diminished. Restoring water flows through the saltwater wetlands will help maintain open watercourses. Sea level rise is expected to modify the patterns of connectivity through Everglades coastal wetlands and increase sediment loads (Davis et al. 2005). This phenomenon is also likely to occur in Biscayne Bay coastal wetlands. In addition to SLR, climate change may result in more extreme weather events. If SLR is accompanied by an increase in tropical storm intensity and frequency, the rate of soil accumulation may increase and partially offset higher MSL conditions. (Hurricane Wilma resulted in approximately 5 cm accumulation of sediment deposits in the Everglades mangrove zones in 2005 (Whelan, 2009).) Also, increased mean sea level conditions in Biscayne Bay are likely to moderate hyper and hypo salinity events in the nearshore zone since there will be more ocean water available for dilution.

Under higher rates of SLR, the increase in groundwater stages and in surface water depths will result in a loss of flood protection for the area. Changes to the open/close operating criteria at coastal canal structures may be instituted as water managers attempt to counteract the effects of SLR on flood protection and salinity control. The SLR related increase of groundwater stage in the western part of the project area could provide increased hydration to the freshwater wetlands to the extent that the water management practices are not significantly modified in an effort to continue to provide the same level of flood protection west of the L-31E Levee. With no change to water management operations, lands to the west of the L-31E Levee that are still farmland will likely be abandoned and revert to freshwater wetland habitat since farming is likely to be uneconomical in the face of increased flooding. (This is an observed phenomena for lands east of the L-31E Levee where acreage previously farmed in the 1940's to 1960's has reverted to wetlands due to SLR related increased flooding among other factors.) Increased chloride concentrations in surface and groundwater west of the L-31E Levee may also adversely impact farmland productivity.

The ecological benefits associated with this project are related to the enhancement of freshwater wetland hydroperiod, saltwater wetland salinity conditions, and nearshore salinity conditions. To assist in the evaluation of the likely effect of sea level rise on project benefits, the areas where the freshwater and saltwater rehydration benefits are expected to occur were mapped under several sea level predictions. These GIS maps are shown in ***Figure 7-18, and Figures 7-20*** through ***Figure 7-27***. For saltwater wetland related project benefits, the degree to which the flooded area covers the benefitted zone under different MSL plus SLR projections is used as an indication of how benefits are likely to be reduced by sea level rise. The maps of the L-31E Wetlands components show that 24 inches of SLR will result in substantial flooding of the lands between L-31E and Homestead Air Reserve Base. These lands are where most of the freshwater wetland benefits are assumed to occur. Freshwater wetland benefits are assumed to be 50 percent impacted when SLR approaches 24 inches. These freshwater wetlands will begin to transition to saltwater wetland habitat due to an increase in the salinity of surface water and shallow groundwater.

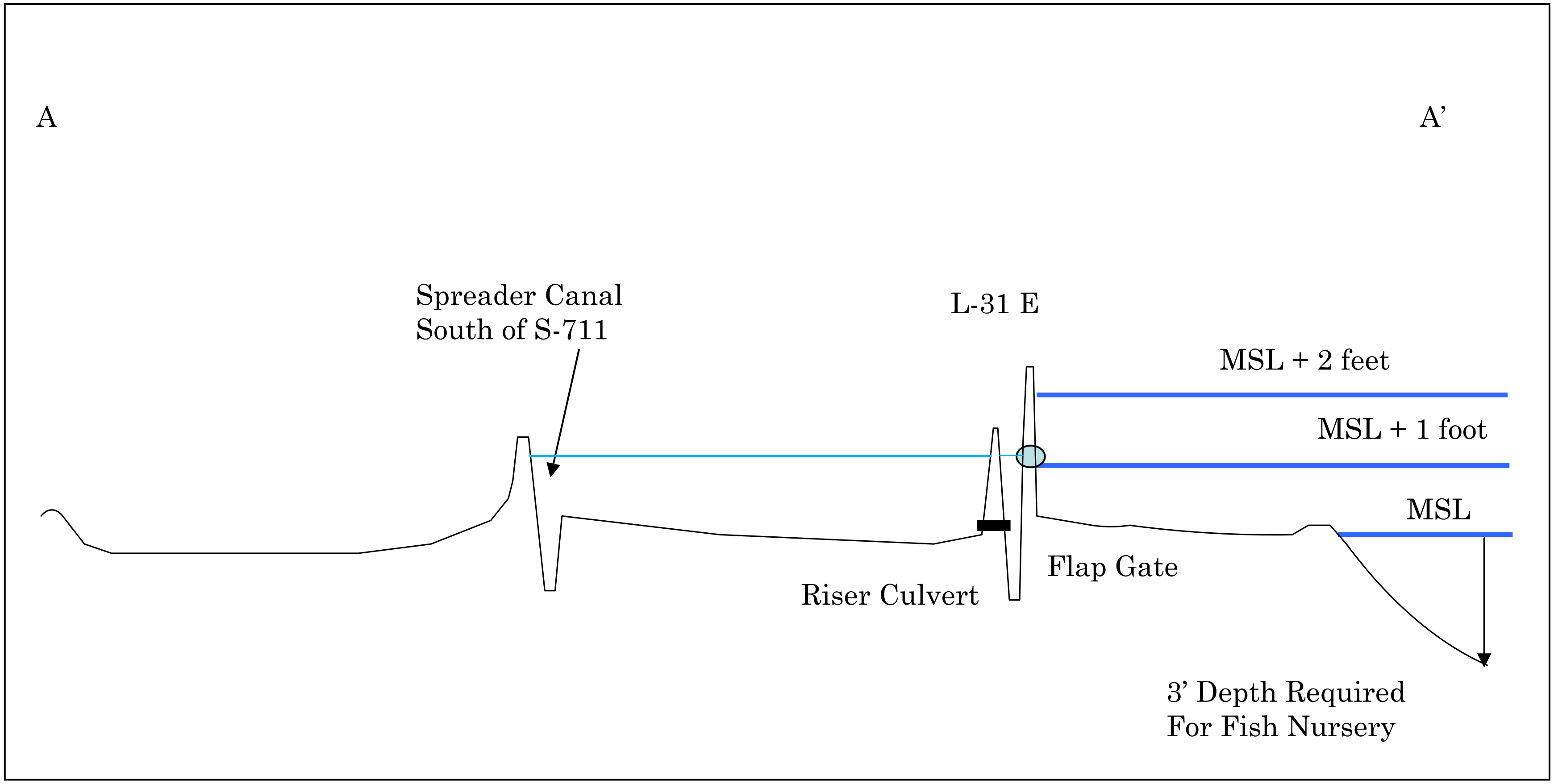

FIGURE 7-19: L-31E WETLANDS: CROSS SECTION A-A'

The estimation of the effect of SLR on the nearshore salinity benefits resulting from this project is less quantitative than that done for the saltwater wetland benefits. Given the gentle slope of the saltwater wetlands east of L-31E, SLR is expected to result in the translocation of estuarine nursery habitat westward as MSL increases. At higher SLR projections, the L-31E Levee may act as a boundary that limits the further translocation of nearshore nursery habitat.

Using the methodology described above, qualitative assessments of the SLR impact to project benefits are discussed for three SLR projections at three different points in time. ***Table 7-16*** shows the distribution of project related restoration benefits across the three component areas and three ecozones. Estimates of the reduction in ecozone benefits were made using the GIS maps and cross sections shown in ***Figure 7-18*** through ***Figure 7-27***. For relative increases in SLR of less than 1 ft, simple interpolation was done to estimate loss of project benefits. Note that GIS maps of the Deering Estates component were not generated for this analysis. The SLR related benefit reductions for the Deering Estates component were estimated to be similar to those expected at Cutler Wetland.

Table 7-17 shows the estimated percentage of benefit lost for each component and ecozone for critical increases in SLR.

TABLE 7-16: APPROXIMATE DISTRIBUTION OF ECOSYSTEM BENEFITS (MEASURED IN HABITAT UNITS) ACROSS THE THREE COMPONENT GROUPS FOR ALTERNATIVE O, PHASE 1.

	Freshwater Ecozone	Saltwater Ecozone	Nearshore Ecozone	Total
Deering	6	191	177	374
Cutler	0	3089	1387	4476
L-31E	277	3116	1387	4779
TOTAL	**283**	**6396**	**2950**	**9629**

TABLE 7-17: PROJECTED REDUCTION IN BENEFITS BY COMPONENT AND ECOZONE UNDER SEVERAL SLR SCENARIOS

Estimated Percent Benefit Reduction at 3" of SLR	Percent Reduction in Freshwater Wetland Benefits	Percent Reduction in Saltwater Wetland Benefits	Percent Reduction in Nearshore Salinity Benefits
Estimated Percent Reduction in Benefits with 3" of SLR *			
Deering	0%	2%	0%
Cutler	0%	2%	0%
L-31E	0%	10%	0%
Estimated Percent Reduction in Benefits with 7" of SLR *			
Deering	0%	4%	0%
Cutler	0%	4%	0%
L-31E	0%	20%	0%
Estimated Percent Reduction in Benefits with 9" of SLR *			
Deering	0%	5%	0%
Cutler	0%	5%	0%
L-31E	0%	30%	0%
Estimated Percent Reduction in Benefits with 24" of SLR			
Deering	100%	10%	0%
Cutler	100%	10%	0%
L-31E	50%	100%	25%
Estimated Percent Reduction in Benefits with at 68" of SLR			
Deering	100%	100%	100%
Cutler	100%	100%	100%
L-31E	100%	100%	100%

* Reduction in benefits for SLR less than 1 ft were estimated by interpolating between the estimated losses at 0 ft of SLR and 1 ft of SLR.

a) Projected Effect of SLR at 20 years Post Construction

The low projection for SLR at 20 years is 1.8 inches, the intermediate projection is 3.1 inches, and the high projection is 7.4 inches. The location of the benefited areas relative to the flood conditions for MSL and MSL+1 foot conditions are shown in ***Figure 7-18*** through ***Figure 7-23*** for the L-31E component and the Cutler Wetlands component. These figures were used to estimate benefit losses and are included here for illustrative purposes so that readers can imagine where each combination of SLR scenario and time period might fall. ***Figure 7-19*** and ***Figure 7-21*** show elevation cross sections in Homestead Wetlands and Cutler Wetlands. A summary of the percentage of benefits available under the three SLR scenarios at 20 years is shown in ***Table 7-18***. After 20 years, the low projection for SLR will have no impact on project benefits. The moderate projection for SLR at 20 years, will result in minimal reduction of project benefits. The high projection for SLR at 20 years (7.4 inches) will likely result in less than 10% reduction in overall project benefits. At 20 years, the saltwater wetland benefits are subject to the most impact from SLR. This is particularly true for the L-31E Homestead saltwater wetlands which are shown to be significantly impacted by one foot of SLR in ***Figure 7-21***. Freshwater wetland benefits are unlikely to be impacted even at the high projection in 20 years. The impact on SLR on salinity benefits in the nearshore zone over the next 20 years is expected to be minimal under all three projections since the zone of optimal salinity conditions will move upland (westward) over time. Under the low SLR projection, it is likely that deposition in the nearshore, mudbank, and mangrove areas will match SLR so that there is minimal change in average embayment depth. Under the moderate to high SLR projections, there may be some change in the total area where salinity conditions are optimal for some mesohaline and oligohaline species. However, given the topography in the saltwater wetland area, particularly in the Cutler Wetland area, it is unlikely that mesohaline and oligohaline areas will be substantially eliminated by SLR under any scenario in 20 years. At the higher SLR estimate, some reduction in the severity and duration of hypersaline conditions in Biscayne Bay proper is likely since the rate of exchange of bay water with ocean water will increase.

TABLE 7-18: EFFECTS ON RESTORATION BENEFITS AFTER 20 YEARS OF SEA LEVEL RISE

20 years of SLR	Freshwater Wetland Benefits	Saltwater Wetland Benefits	Nearshore Salinity	Percent of Project Benefits
Low (1.8 inches)	100%	100%	100%	100%
Intermediate (3.1 inches)	100%	94%	100%	96%
High (7.4 inches)	100%	88%	100%	92%

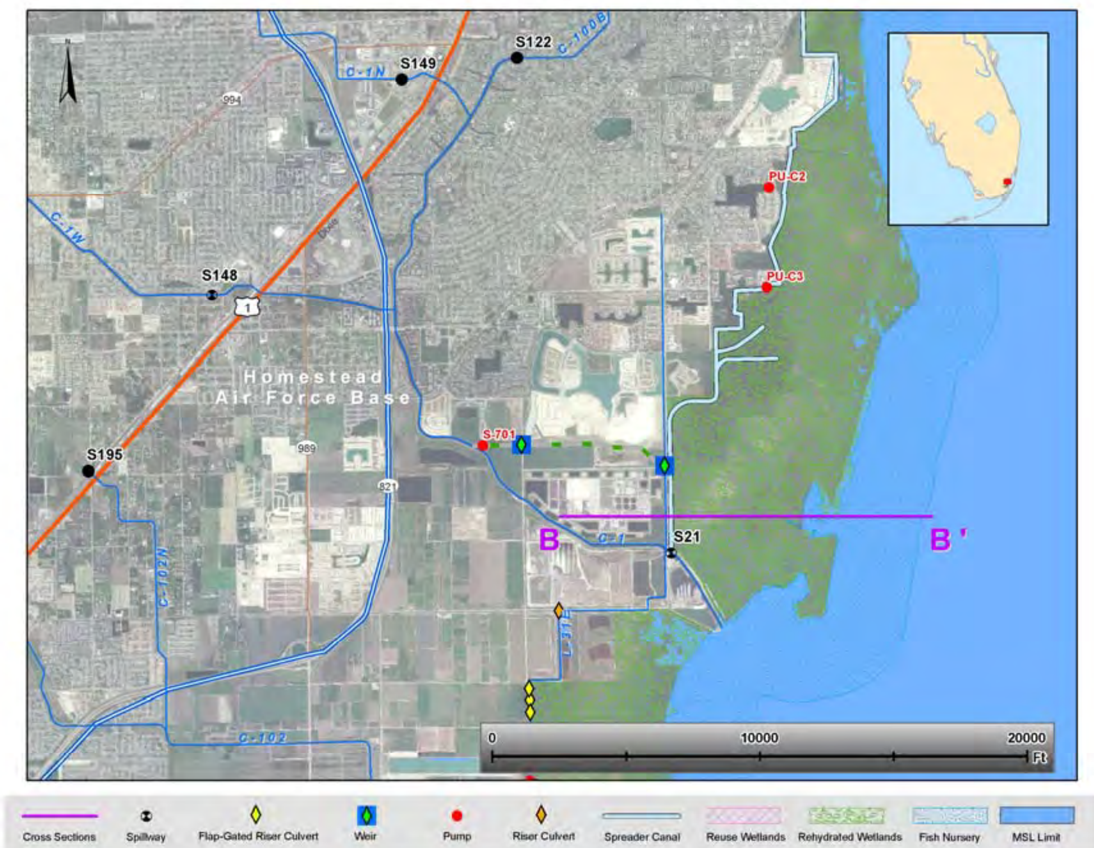

FIGURE 7-20: CUTLER WETLAND AREA AS IMPACTED BY MSL.

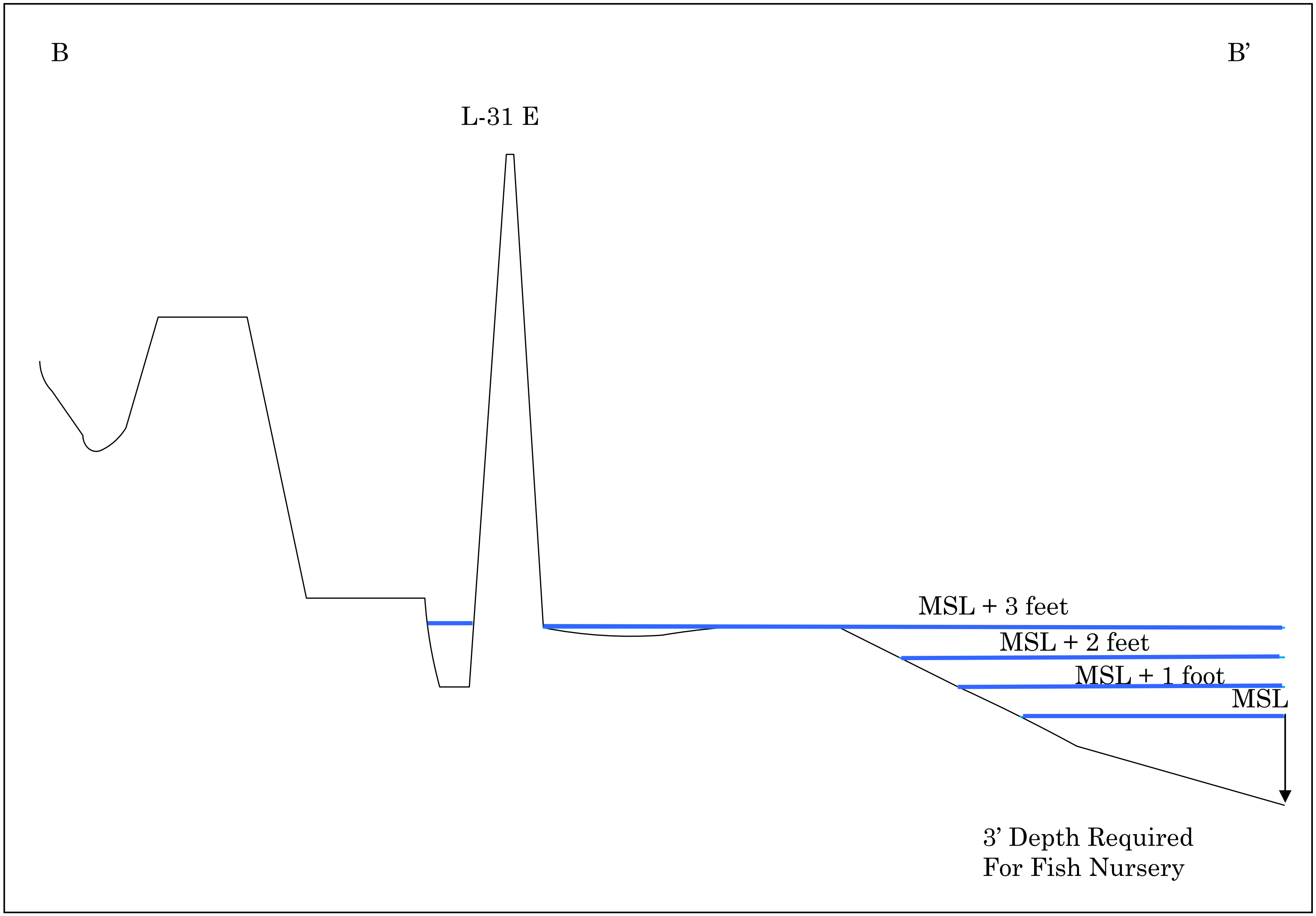

FIGURE 7-21: CUTLER WETLANDS: CROSS SECTION B-B'

b) Projected Effect of SLR for Low, Intermediate, and High at 50 years Post Construction

The low projection for SLR at 50 years is 4.4 inches, the intermediate projection is 9.1 inches, and the high projection is 24.5 inches. The location of the benefited areas relative to the flood lines for MSL+1 and MSL+2 foot conditions are shown in ***Figure 7-22*** through ***Figure 7-25*** for the L-31E component and the Cutler Wetlands component. A summary of the percentage of benefits available under the three SLR scenarios at 50 years is shown in ***Table 7-22***. After 50 years, the low projection for SLR will have minimal impact on project benefits. Under the low SLR projection, it is likely that deposition in the nearshore, mudbank, and mangrove areas will match SLR so that there is minimal change in average embayment depth. The moderate projection for SLR at 50 years, will result in approximately an 1% reduction of project benefits. The high projection for SLR at 50 years (24.5 inches) will likely result in up to a 41% reduction in overall project benefits. At 50 years, the L-31E saltwater wetlands will be severely impacted by two feet of SLR (***Figure 7-24***) though the Cutler Wetlands will not be due to the higher average land elevation of these lands. Under the high scenario at 50 years, the saltwater salinity benefits are assumed to be reduced by 70 percent in the area of Homestead. Freshwater wetland benefits are assumed to be 50 percent impacted at the high projection in 50 years given that approximately ½ of the target wetlands are within 1 mile of the L-31E Levee. Under the moderate to high SLR projections, there may be some change in the total area where salinity conditions are optimal for some mesohaline and oligohaline species.

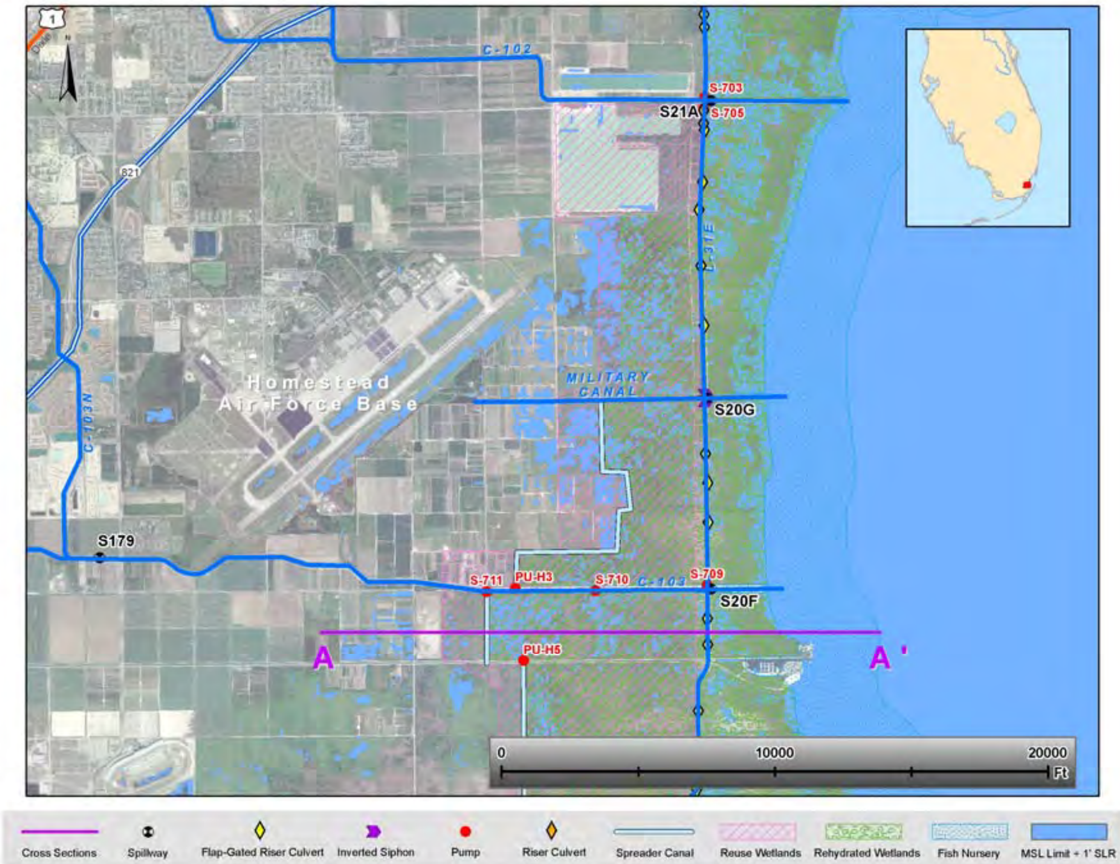

FIGURE 7-22: L-31E WETLAND AREA AS IMPACTED BY MSL+1 FT SLR.

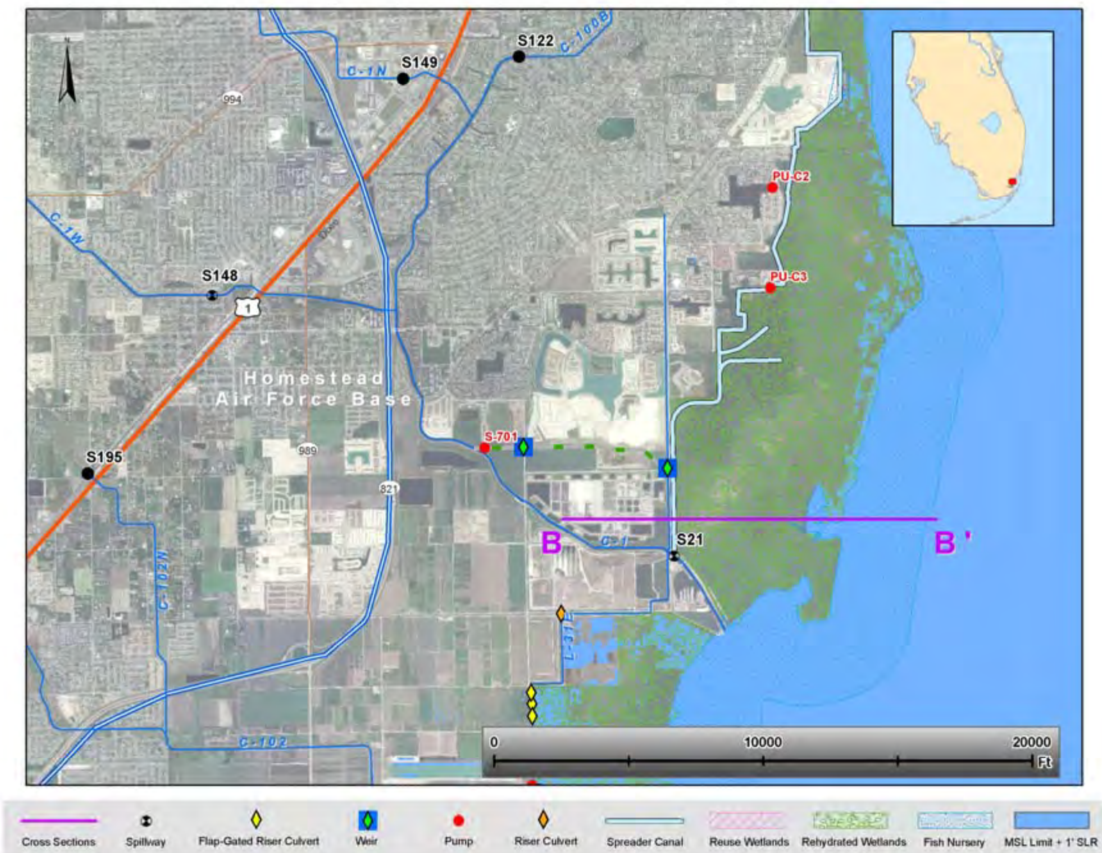

FIGURE 7-23: CULTER WETLAND AREA AS IMPACTED BY MSL+1 ft SLR.

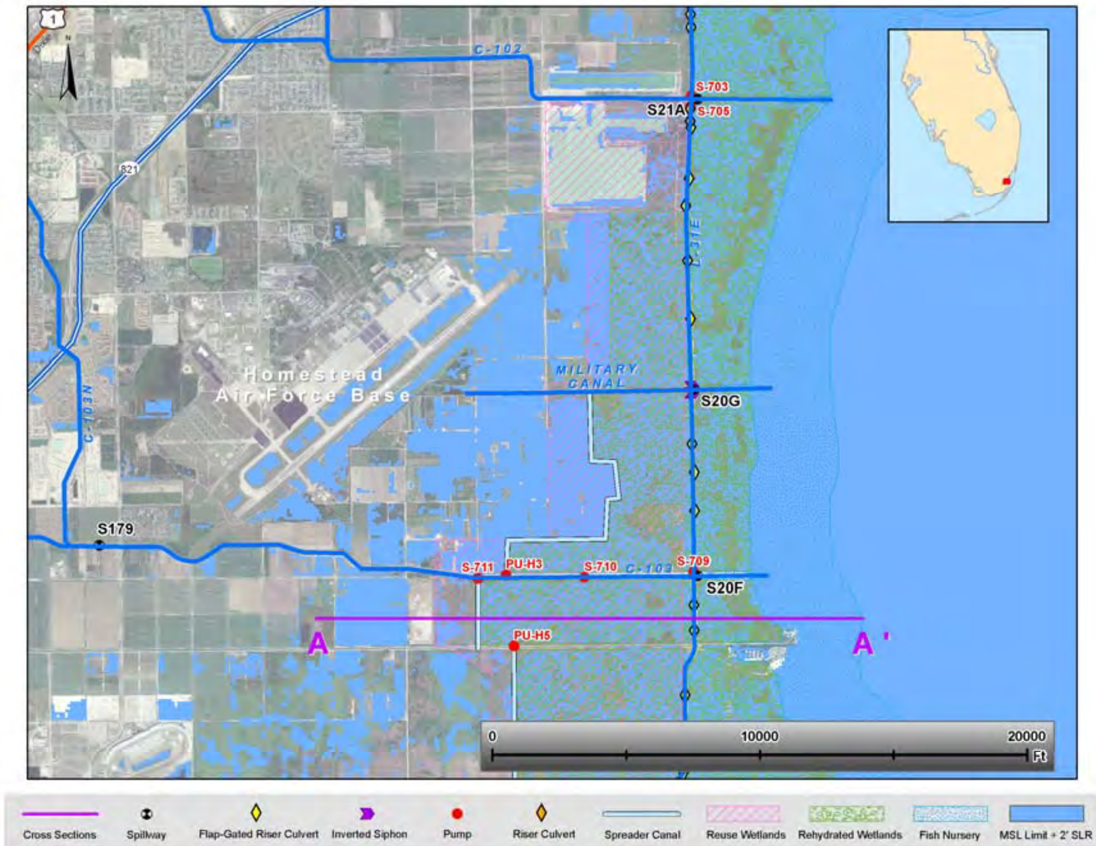

FIGURE 7-24: L-31E WETLAND AREA AS IMPACTED BY MSL+2 ft SLR.

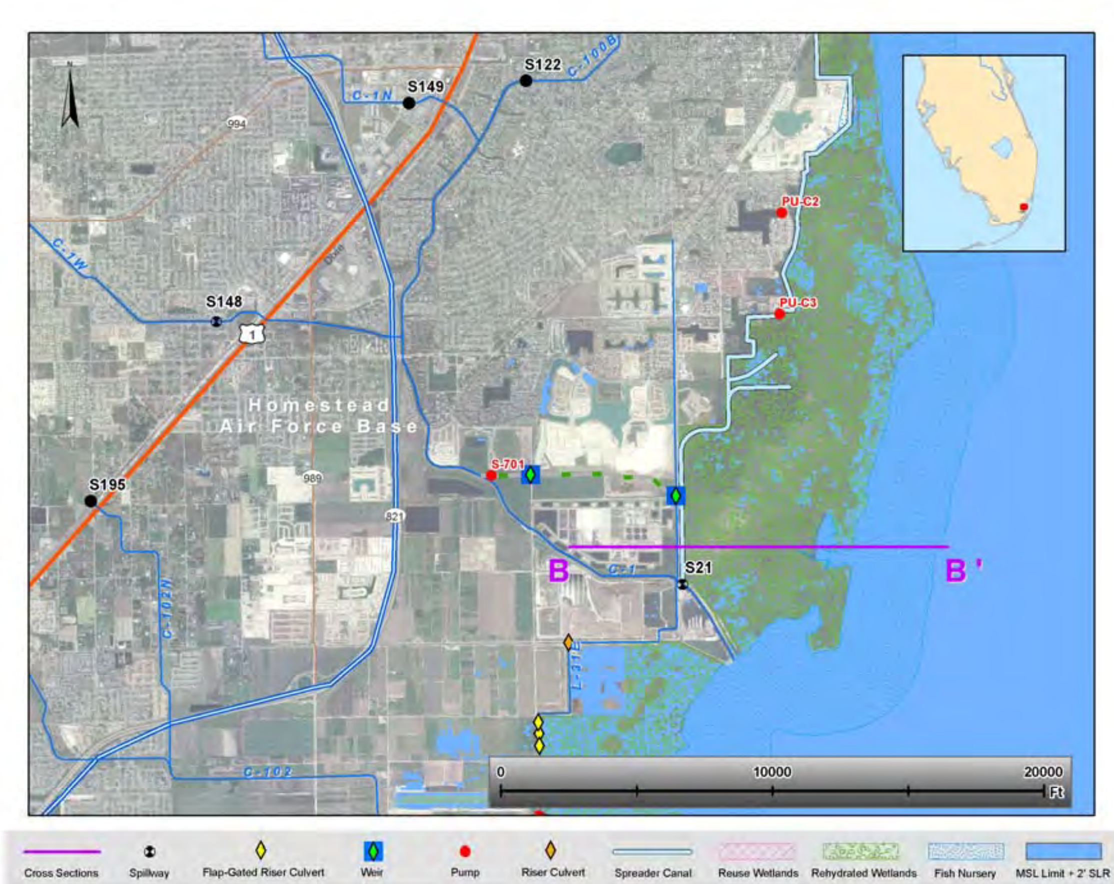

FIGURE 7-25: CUTLER WETLAND AS IMPACTED BY MSL+2 ft SLR.

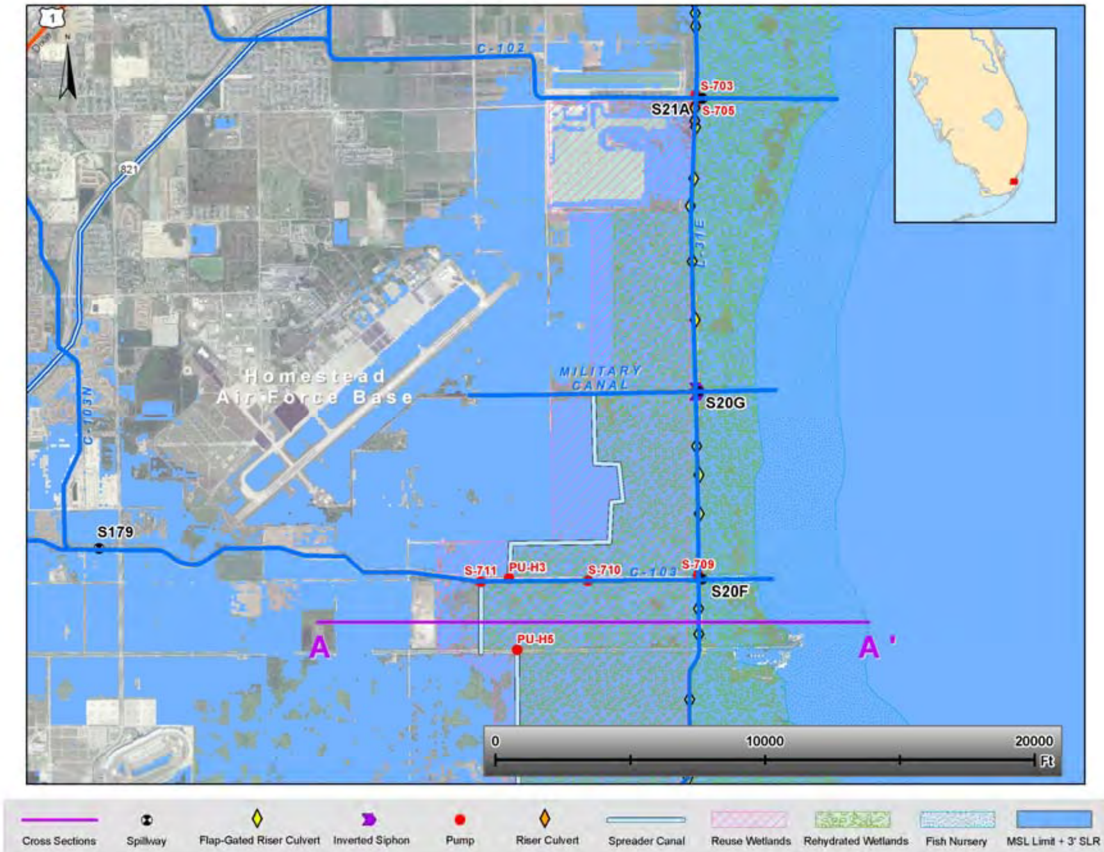

FIGURE 7-26: L-31E WETLAND AREA AS IMPACTED BY MSL+3 ft SLR.

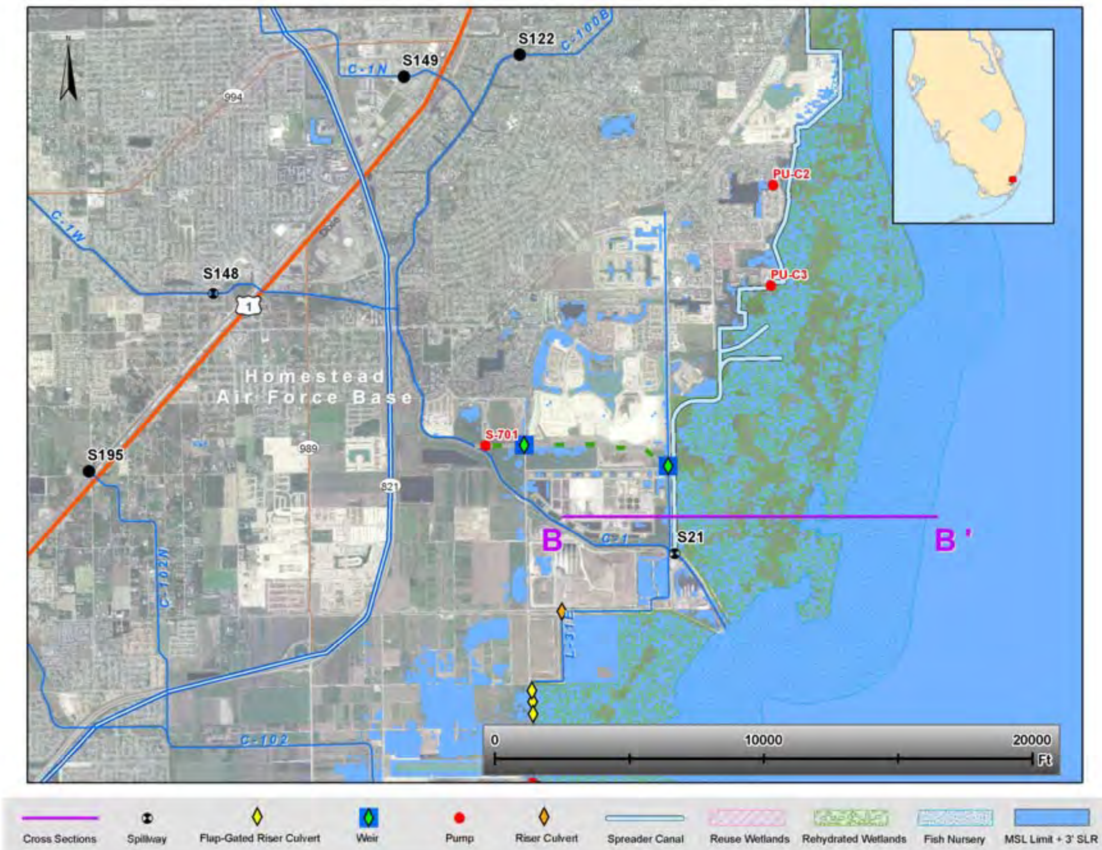

FIGURE 7-27: CUTLER WETLAND AREA AS IMPACTED BY MSL+3 ft SLR.

TABLE 7-19: EFFECTS ON RESTORATION BENEFITS AFTER 50 YEARS OF SEA LEVEL RISE

50 years of SLR	Freshwater Wetland Benefits	Saltwater Wetland Benefits	Nearshore Salinity	Percent of Project Benefits
Low (4.4 inches)	100%	94%	100%	96%
Intermediate (9.1 inches)	100%	83%	100%	89%
High (24.5 inches)	48%	46%	88%	59%

c) Projected Effect of SLR for Low, Intermediate, and High at 100 years Post Construction

Analyzing the effect of SLR at 100 years is a requirement of EC 1165-2-211; however, it is important to recognize that the CERP and all its anticipated benefits were based on a fifty (50) year planning horizon. Any benefits lost to SLR after 50 years would have accrued in the absence of SLR after the anticipated life of the project and are not used to justify the project in the CE/ICA. With that said, the low projection for SLR at 100 years is 8.8 inches, the intermediate projection is 22.8 inches, and the high projection is 68.8 inches. The location of the benefited areas relative to the flood lines for MSL+2 and MSL+3 foot conditions are shown in ***Figure 7-24*** through ***Figure 7-27*** for the L-31E component and the Cutler Wetlands component. A summary of the percentage of benefits available under the three SLR scenarios at 100 years is shown in

Table 7-20. After 100 years, the low projection for SLR will reduce estimated benefits by approximately 11%. Under the low SLR projection, it is likely that deposition in the nearshore, mudbank, and mangrove areas will match SLR so that there will be minimal change in average embayment depth. The moderate projection for SLR at 100 years, is estimated to result in approximately a 41% reduction of project benefits. Under the moderate SLR projections, there may be some change in the total area where salinity conditions are optimal for some mesohaline and oligohaline species. The high projection for SLR at 100 years (68.8 inches) will likely result in the elimination of all project related restoration benefits. However, productive saltwater and nearshore habitat is likely to exist in former freshwater wetland habitat areas as these zones move inland in response to SLR. The high estimate of SLR at 100 years may reduce the area available for estuarine habitat; however, this will depend upon whether man-made flood protection barriers are constructed in locations that limit the extent of nearshore shallow areas suitable for estuarine habitat. Under the high SLR estimate at 100 years, salinity conditions within Biscayne Bay would become much more marine like since average depth of the shallow nearshore areas of the bay will more than double from 1.0+ meters to 3 meters,. Much of the eastern barrier island lands will disappear under MSL if SLR proceeds at a high rate over the next 100 years.

TABLE 7-20. EFFECTS ON RESTORATION BENEFITS AFTER 100 YEARS OF SEA LEVEL RISE

100 years of SLR	Freshwater Wetland Benefits	Saltwater Wetland Benefits	Nearshore Salinity	Percent of Project Benefits
Low (8.8 inches)	100%	83%	0%	89%
Intermediate (22.8 inches)	48%	46%	88%	59%
High (68.8 inches)	0%	0%	0%	0%

3) RELATIVE IMPACT OF SLR ON THE FINAL ARRAY OF PROJECT ALTERNATIVES

A detailed analysis of SLR impacts on each of the plans included in the final array of project alternatives has not been prepared since the Alternative Formulation Briefing and the identification of the selected plan preceded the issuance of the latest SLR guidance (EC 1165-2-211). Nonetheless, the relative impact of SLR on the final array of project alternatives has been qualitatively assessed by comparing the features and expected location of benefits for each alternative to the selected plan (Alternative O, Phase 1). A short discussion of each of the final alternatives follows.

Alternatives YB and Q: These two alternatives generate relatively more freshwater wetland benefits and less saltwater wetland and nearshore salinity benefits than Alternative O, Phase 1. SLR conditions less than approximately 24 inches would likely result in relatively less impairment to overall project benefits for these alternatives in comparison to Alternative O, Phase 1. Conversely, some of the project related freshwater wetland rehydration (and the associated project benefits) would likely occur in the absence of the project as a result of increased groundwater stages caused by sea level rise. This is particularly true for the higher SLR projections since maintaining the existing level of flood protection will be difficult given the porous nature of the underlying Biscayne Aquifer. For SLR in excess of 24 inches, the freshwater wetlands restored by these alternatives will likely begin to transition to saltwater wetlands particularly in areas directly west of the L-31E levee.

Alternative O: For SLR less than 24 inches, this alternative would experience relatively less impairment to the predicted benefits than Alternative O, Phase 1, since a larger proportion of the benefits come from freshwater wetland. For SLR above 24 inches, this alternative would begin to lose freshwater wetland benefits for rehydrated areas directly adjacent to the L-31E Levee as these wetlands begin to transition to saltwater species.

Alternative M: This alternative generates almost all of its benefits east of the L-31E Levee. In the L-31E Wetlands area, the alternative does not include pumps to move water over or through the levee. This means that project benefits are particularly at risk given that higher sea level conditions will reduce the flow rate through culverts in L-31E. Thus, under any SLR condition, the benefits from this alternative would be reduced to a greater extent than any of the other with project alternatives.

Alternative O, Phase 1: The SLR analysis prepared in this report was done assuming that this plan is the preferred plan.

No Action Alternative: As sea level rise occurs, the critical habitat where oligohaline and mesohaline salinity conditions exist in the saltwater wetlands and mangroves east of the L-31E Levee will shrink relative to the existing conditions. The selected plan (Alternative O, Phase 1) will counteract the reduction in this habitat through the diversion of freshwater into these areas. Freshwater wetland areas will likely experience some beneficial rehydration as a result of moderate SLR; however, at levels above 24 inches of SLR, freshwater wetlands in areas south of the C-1 canal and adjacent to the L-31E Levee are likely to begin to transition to saltwater species as flood protection efforts begin to fail.

4) DESIGN CONSIDERATIONS AND SLR

There is a good deal of uncertainty surrounding the magnitude of SLR over the next 50 to 100 years. To reduce the risk associated with implementing the project, flexibility in the design and operation features can be incorporated into the project during the planning phases. For instance, pump station equipment can be designed to accommodate higher water surface elevations. Impoundment levees, spreader canals, and culverts can be designed to incorporate higher tailwater conditions.

Future modifications of the project features or operations to counteract the impact of sea level rise should be focused on preserving and maintaining project benefits as well as existing coastal habitat. Project modifications that both preserve project benefits and enhance flood protection are preferred if they are available. Features planned and operated for one purpose can be repurposed as SLR begins to affect water management needs into the future. For instance, the planned S-705 pump station that is located at the intersection of the C-102 canal and the L-31E Levee can be repurposed to help maintain a hydraulic barrier of freshwater in the L-31E Canal. Similarly as SLR contributes to marginal decreases in the C-103 canal systems' ability to provide flood protection due to increased tail water conditions at S-20F, the project's S-710 and S-711 pump stations can be used to assist in removing some of the marginal increase in flood flows from the C-103 canal. Rather than compromise the project, such a modification would likely enhance the freshwater wetland habitat downstream of these two pump stations.

More extreme methods of preserving the targeted habitat such as breaching the existing L-31E Levee and constructing a new one further inland are outside of the scope of the BBCW project at this time; however, they may be considered in the future as a method of ensuring the future existence of nearshore and tidal wetland habitat in the project area.

5) CONCLUSION

This analysis looked at the effect of sea level rise on the benefits predicted for the selected Alternative O, Phase 1, per the guidance provided in EC 1165-2-211. The results indicate that within the 20-year planning horizon, less than 10% of the project ecosystem benefits are likely at risk to SLR. At the end of the 50-year planning horizon, the benefits attributed to the selected plan may be diminished by as much as 40% as a result of sea level rise. Limited impacts to project benefits are anticipated at the low and moderate SLR projections at 50-years. Under the high SLR scenario at 100 years, the project benefits will not occur. As mentioned above, the project is justified based on a 50-year project lifespan. The effects of SLR on project benefits that occur after the 50-year project lifespan should be treated the same as benefits that occur after the project lifespan. In other words, effects that occur after the 50 year project lifespan should not be considered for plan selection or determination of project viability.

A qualitative comparison of SLR impacts to benefits accorded other project alternatives was done. This analysis showed that the selected plan will likely experience a greater percent reduction in overall benefits as compared to the alternatives that focus on freshwater wetland rehydration (Alternatives YB and Q); however, these alternatives would not provide as much preservation of the critical oligohaline and mesohaline habitat located east of the L-31E Levee. In comparison to the No Action Alternative, the selected plan will provide more protection to oligohaline and mesohaline habitat located east of the L-31E levee. The selected plan should perform the same as the No Action Alternative in terms of effects to freshwater wetland habitat west of the levee.

As with the predictions of future rates of SLR, there is uncertainty in the estimation of effects to project related ecosystem benefits due to the accuracy and reliability of the datasets used in this analysis. The MSL flood prediction maps are based upon topographic data that is known to be accurate to within plus or minus 0.5 ft. The land elevation is assumed to be static over the 20, 50, and 100 year periods; however, topographic change is likely to occur in the saltwater wetland areas as a result of SLR and other natural processes. Despite these limitations and inherent uncertainties, the analysis is presented here since it is the most reliable information available at this time.

There is no doubt that SLR over the last 100 years has impacted the southern portion of Biscayne Bay and the adjacent basin. This is evident by the landward migration of the saline white zone habitat and the abandonment of farming activities just east and west of the L-31E Levee. The selected project will delay further degradation of coastal wetland habitat caused by increased sea level conditions by redirecting freshwater flows into the critical habitat east of the L-31E levee.

6) REFERENCES

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7.15 ADDITIONAL CONSIDERATIONS

7.15.1 USACE Campaign Plan

The Selected Plan is consistent with USACE's "12 Actions for Change". The 12 Actions for Change can be grouped into three overarching themes: effectively implement a comprehensive systems approach; communication; and reliable public service professionalism. Below is a summary of the grouped actions for change, and how the BBCW is consistent with those actions.

Effectively Implement a Comprehensive Systems Approach:
Comprehensively design, construct, maintain and update engineered systems to be more robust, with full stakeholder participation.

1. Employ integrated, comprehensive and systems-based approach
2. Employ risk-based concepts in planning, design, construction, operations, and major maintenance
3. Continuously reassess and update policy for program development, planning guidance, design and construction standards
4. Employ dynamic independent review
5. Employ adaptive planning and engineering systems
6. Focus on sustainability
7. Review and inspect completed works
8. Assess and modify organizational behavior

In order to effectively implement a comprehensive systems approach the Selected Plan was formulated to optimize system-wide benefits to further CERP goals and objectives. The PDT reviewed CERP program guidance and applied lessons learned from other projects to this project. Independent review was conducted at the programmatic level by the National Academy of Sciences/National Research Council. Lessons learned from those programmatic reviews were applied in the planning and design of the Selected Plan. In addition, external independent technical review (ITR) was conducted at key milestone points throughout the planning and decision document preparation process. The Selected Plan includes program-level adaptive assessment and ecological monitoring that would study the long-term system-wide contributions of the Selected Plan.

Communication: Effective and transparent communication with the public, and within USACE, about risk and reliability.

1. Effectively communicate risk
2. Establish public involvement risk reduction strategies

Information has been provided regularly via public notices, PDT meetings and summaries, newsletters, internet and other methods. Risk reduction strategies have been communicated through the utilization of the above methods, as well as by gathering the input of the public through public meetings, PDT meetings and by public review of the PIR. Risk and uncertainty analyses have been documented throughout the PIR.

Reliable Public Service Professionalism: Improve the state of the art and USACE's dedication to a competent, capable workforce on a continuing basis. Make the commitment to being a "learning organization" a reality.

1. Manage and enhance technical expertise and professionalism
2. Invest in research

USACE, SFWMD and SFWMD consultants have extensive expertise in spreader canals, pump station construction and operation, and other technologies used in this project.

7.15.2 Environmental Operating Principles

The Selected Plan is consistent with each of USACE "Environmental Operating Principles" particularly with respect to the south Florida ecosystem-wide approach for plan formulation, evaluation and selection, and a holistic consideration of water resources needs and solutions to water resources problems in the study area.

Principle One: **Strive to achieve environmental sustainability. An environment maintained in a healthy, diverse condition is necessary to support life.**

Natural resource specialists agree that the remaining ecosystems in south Florida no longer maintain the functions and richness that defined the pre-drainage system. These measures of ecological health would continue to decline without preventative actions. Not only is it certain that these natural systems would not recover their defining attributes under current conditions, it is unlikely that the current, degraded ecological conditions could be sustained in the future.

The Selected Plan would contribute to the restoration of historic tidal creeks and estuarine ecosystems of southwestern Biscayne Bay by re-directing flow from canals into the coastal wetlands to re-establish more natural overland flow patterns that would provide appropriate hydro-patterns and salinity regimes to re-establish and maintain unique and productive estuarine habitats.

Principle Two: Recognize the interdependence of life and the physical environment. Proactively consider environmental consequences of USACE programs and act accordingly in all appropriate circumstances.

Outside of small-scale farming, life within the coastal community of Biscayne Bay is generally dependent upon the natural resources of that area and by the recreational opportunities provided through BNP such as fishing, boating, hiking, kayaking and other activities. The re-establishment of overland flow regimes through coastal wetlands is essential to the restoration of local resources and the assurance of increased productivity of estuarine habitats that include commercially harvested shrimps and food fishes. As a result, implementation of the BBCW project is expected to provide ecological conditions suitable for expanded and intensified wildlife utilization through improvements in wetland habitat functional quality, and improvements in native plant and animal species diversity and abundance.

The BBCW project would provide immediate benefits to southwestern BBCW and estuarine communities, a part of the South Florida Everglades Ecosystem. The damaging effects of point source canal discharges would be reduced. Untimely discharges of fresh water to the estuaries would be partially equalized, leading to more natural salinity levels and the recovery of the estuarine ecosystem in the project area. By maintaining salinity balance and preventing salinity intrusion, the Selected Plan would reduce the need for desalinization technologies.

The Selected Plan footprint is located primarily on degraded freshwater and coastal wetlands that support marginal farming employment in the local community. Any loss of jobs related to the construction and operational actions of the project would be offset by farming relocation, increased recreation opportunities, and overall restoration of prime estuarine habitat.

Principle Three: Seek balance and synergy among human development activities and natural systems by designing economic and environmental solutions that support and reinforce one another.

The BBCW project was designed to meet the needs of competing municipal, agricultural and environmental water supplies in the basin. Every effort was made to provide for a beneficial effect in the adjacent natural system and to ensure that the proposed project would not impact the current water supply needs. The proposed restoration would provide a functional lift to wetland habitats benefiting both the natural resources and the human environment. The BBCW project would have no negative effect on water resources for urban utilities, agricultural or flood damage reduction.

Principle Four: **Continue to accept corporate responsibility and accountability under the law for activities and decisions under our control that impact human health and welfare and the continued viability of natural systems.**

The BBCW PIR complies with all applicable laws such as the NEPA, the Clean Water Act, the Endangered Species Act, and all other applicable legislation. The proposed habitat restoration would enhance both ecologic values and economic values and social well-being.

Principle Five: **Seek ways and means to assess and mitigate cumulative impacts to the environment: bring systems approaches to the full life cycle of our processes and work.**

The BBCW project is one of 68 different projects that are a part of the CERP. Congress approved the CERP as the "framework for modifications and operational changes to the C&SF 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 (WRDA, 2000). As such, the primary purpose of the CERP is the restoration of the Everglades ecosystem, including specific safeguards to ensure that the benefits to the natural system are achieved and maintained, while providing for other water-related needs of the south Florida region. By doing this, USACE is able to avoid and minimize any potential project impacts that may occur as a result of the implementation of any project.

Potential impacts to the natural system have been assessed as part of the PIR process and considered in the plan selection. Specifically, NEPA consultation is being performed for the American crocodile, American alligator, West Indian manatee, Florida panther, smalltooth sawfish, wood stork, eastern indigo snake, Schaus swallowtail butterfly, green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's Ridley sea turtle, loggerhead sea turtle, crenulated lead plant, Garber's spurge, tiny polygala, deltoid spurge, and Small's milkpea. Guidelines for fill rates, operations and control structures have been established to minimize impacts to these species. In addition, a system-wide monitoring plan of the natural environment would be in place to continue to assess all impacts, and used along with AM of the project and other CERP components, in order to maximize benefits to the system while identifying and limiting any negative effects.

Principle Six: Build and share an integrated scientific, economic and social knowledge base that supports a greater understanding of the environment and impacts of the work.

As part of the AM strategy for the CERP, three sub-teams from RECOVER meet monthly to discuss ways to improve the overall effects of the CERP program. The three RECOVER teams are the Planning, Evaluation and Assessment teams. These three teams collectively are composed of many individuals with separate disciplines in order to integrate their specific knowledge of science, economics and sociology. The teams evaluate the different environmental effects that are expected to occur as a result of CERP implementation, and also assess possible impacts to any areas that could be beneficially adjusted through AM. RECOVER reviewed the proposed BBCW PIR as it was being developed and provided input as to how the project could best be implemented and operated. Additionally, extensive modeling was performed to mimic the natural system in the project area, both hydrologically and ecologically, in order to better understand how the system would function with the Selected Plan in place.

Principle Seven: Respect the views of individuals and groups interested in USACE activities, listen to them actively, and learn from their perspective in the search to find innovative win-win solutions to the nation's problems that also protect and enhance the environment.

USACE fully addressed and considered all public comments concerning the proposed BBCW project. Comments were received from state and Federal agencies as well as non-governmental agencies, tribal interests, and the general public. As part of the NEPA process, USACE sent out a scoping notice to provide information to the public and/or other agencies in order to encourage participation and receive comments about the proposed project. Further public input was encouraged through public meetings, stakeholder meetings, and Regional PDT meetings.

7.16 RESIDUAL AGRICULTURAL CHEMICALS

The USACE HTRW policy (ER 1165-2-132) directs that Construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable. In September 2011, the ASA(CW) provided an exception to this HTRW policy for CERP Projects (Memorandum for Deputy Commanding General for Civil and Emergency Operations, Subject: Comprehensive Everglades Restoration Plan (CERP) – Residual Agricultural Chemicals, Dated September 14, 2011). A copy of this policy is included in **Appendix A, Part 2, Section A.1.1.** If specific criteria are met, this policy memorandum allows residual agrichemicals to remain on project lands and allows the USACE to integrate response actions directly into the construction plan. At the request of the SFWMD, this section of the PIR has been included in the BBCW PIR to comply with the ASA(CW) policy. A copy of the letter from the SFWMD requesting application of the policy is included in **Appendix A, Part 2, Section A.1.1.** This section sometimes refers to soils containing agricultural chemicals as "impacted soils."

7.16.1 General Discussion of CERP Residual Agricultural Chemical Policy Requirements

Compliance with the policy is discussed in this section where a given policy requirement can be evaluated over the entire project area. Discussion of policy requirements specific to individual project components begins in **Section 7.16.2.**

Residual Agricultural Chemicals

Nature and Extent of Residual Agricultural Chemicals:

Table 7-21 below includes a summary by residual agricultural chemical and acreage of parcels where they were found for each of the three project components. Since areas can have more than one residual agricultural chemical present, the data shown in this table is not intended to be summed in the vertical direction. (For example, at Deering Estate, a total of 10 acres are potentially impacted with arsenic, copper, DDT, and dieldrin.) A component by component discussion of the nature and extent of residual agricultural chemicals is found in **Sections 7.16.2, 7.16.3, and 7.16.4**.

TABLE 7-21: SUMMARY OF MOST FREQUENTLY DETECTED RESIDUAL AGRICULTURAL CHEMICALS BY ACREAGE OF PARCELS WHERE THEY WERE FOUND.

Summary of Most Frequently Detected Residual Agricultural Chemical				
Agricultural Chemical	Deering Estate (Acreage of potential Ag-Chem impact)	Cutler Wetlands (Acreage of potential Ag-Chem impact)	L-31 East Flow-Way (Acreage of potential Ag-Chem impact)	Total (Acreage of potential Ag-Chem impact)
Arsenic	10	947	775	1732
Barium	0	363	0	363
Cadmium	0	433	0	433
Chromium	0	517	699	1216
Copper	10	212	714	936
Lead	0	530	62	592
Mercury	0	396	699	1095
Silver	0	505	0	505
DDT	10	554	0	564
Chlordane	0	12	0	12
Dieldrin	10	0	0	10

** Note: Parcels can have more than one agricultural chemical present.

Legal Application of Agrichemicals: The September 14, 2011 guidance addresses only residual agricultural chemicals that resulted from the use of commercially available products that were lawfully applied for their intended purpose to enhance agricultural production. The term residual agricultural chemicals means those chemicals found in formerly cultivated soils that were legally applied, in accordance with their Environmental Protection Agency (EPA) registration, any Federal, state or local legal requirements, any labeling or other instructions and which, over time, remain in the soil.

For the BBCW project component lands, the environmental professionals who conducted the site audits used their expertise in conducting Phase I/II audits on agricultural lands to identify where on project land the detected chemicals were determined to be present at concentrations that are consistent with the routine application of commercially available farm chemicals as applied for their intended purpose to enhance agricultural production and where the detected chemicals were identified to be more likely present as the result of a spill or illegal disposal. Since parcel by parcel information on historic farming activities is not available, the audit professionals consulted with the USDA Farm Service

Area regarding historical cropping patterns and the likely pesticides in use in Miami-Dade County at that time. The USDA identified copper, organo-chlorine pesticides, and arsenic had likely been applied to crops historically grown in the area.

Given historical evidence of long-term agricultural production, the fact that: 1) the chemicals found on agricultural lands were active ingredients formerly found in commercially-available products registered under Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), 2) the concentrations are within a range expected after long-term use on cultivated lands, and 3) site specific research has revealed no evidence of illegal activities causing the presence of these chemicals within the cultivated areas, it is reasonable to conclude that these chemicals were legally applied as part of farming activities.

A component specific assessment of project lands where residual agricultural chemicals appear to be present as a result of legal application is provided in **Sections 7.16.2, 7.16.3., and 7.16.4. As discussed in 7.9.3 parcels with hotspots indicating a spill or illegal disposal will be addressed by the SFWMD at 100 percent their cost prior to construction.**

Availability of Lands With No Agrichemicals Present: Implementation of the BBCW project requires lands which are located adjacent to Biscayne Bay within the C-100, C-1, C-102, and C-103 drainage basins. Potential project lands that were considered during project development were not presently used for commercial or residential development and were generally located adjacent to the existing drainage canals and/or the bay to facilitate cost-effective implementation of diversion structures. A summary of the findings of an aerial photography review is included in the "Summary of Environmental Conditions" report in Appendix C.3. A discussion of the availability of non-agriculturally impacted lands by project component is included beginning in Section 7.16.2. To the extent that alternative project lands could be identified in any of the three zones, it is very likely that these alternative lands would exhibit similar residual agrichemical concentrations given the likelihood of past agricultural activities.

Actions Taken are Necessary Because Project Property is Converted from Agricultural to Aquatic Restoration Purpose, which inundates the land with water in order to meet federal project goals: The primary objectives of the BBCW project is the restoration of wetlands adjacent to Biscayne Bay and improvement of salinity conditions in the bay waters immediately adjacent to the project wetlands. Much of the project land has been farmed in the past. Successful implementation of this project requires the conversion of the former agricultural lands into aquatic restoration features such as restored freshwater and saltwater wetlands. Non-RCRA response actions to reduce ecological risks associated with the presence of the residual agricultural chemicals DDT, its metabolites DDE and DDD and copper on lands coincident with feature construction footprints have been completed at Deering Estate and are proposed for the Cutler Wetlands Flow-way. These non-RCRA response actions also address the presence of arsenic observed at concentrations which typically do not pose an ecological risk on the project lands. Similar non-RCRA response actions to be conducted at the other project features (Cutler Spreader Canal, L-31E Freshwater Wetlands, L-31E Pumps/Culverts) are anticipated to address residual agricultural chemicals that pose an ecological risk similar to those at Deering Estate and Cutler Wetland Flow-Way. The non-RCRA response actions include blending impacted soils with clean fill and testing to ensure that resulting concentrations meet the FDEP approved requirements. Blending the impacted soils with the clean fill should result in a mixed material with concentrations of residual agricultural chemicals that are below ecological threshold concentrations relevant to aquatic systems. Concentrations will also be below relevant human health exposure concentrations. The proposed actions to inundate areas adjacent to Biscayne Bay, converting these agricultural lands to wetlands, require no action by FDEP to address residual agricultural chemicals.

Table 7-22 below shows a summary of agricultural and non-agricultural acreage by component.

TABLE 7-22: SUMMARY OF HISTORIC USE OF PROJECT LANDS.

Component	Feature	History of Farming (acres)	No History of Farming (acres)	Impacted Acreage in Feature Footprint
Deering Estate				
	Pump Station	10	0	6
	Weir	20	166	0
Cutler Wetlands				
	Flow-Way	30	0	30
	Spreader Canal	972	761	20
L-31 East Flow-Way				
	Pumps / Culverts	0	134	< 4
	Freshwater Wetland	370	62	≈200
	Tidal Wetland	702	711	0
Total		2104	1834	≈260

Regulatory Coordination:

Documentation of the available Phase I, Phase II audits, associated ecological risk assessment studies, and soil management plans have been prepared by the SFWMD for most of the project land and some of the project features. These documents are located in Appendix C.3. The following correspondence between the SFWMD and the FDEP and USFWS are included in Appendix A, Part II, Section A.1.1:

1. FDEP comments dated 6/28/2010 on the Summary Environmental Report, FDEP letter to the SFWMD dated 10/21/2011 regarding status of FDEP review of site conditions,
2. FDEP letter to SFWMD dated 10/21/2011 regarding status of environmental audit reviews and soil management plans.
3. FDEP memorandum dated 5/17/2011 regarding review of the revised Deering Soil Management Plan
4. FDEP memorandum dated 9/28/2011 regarding review of the Cutler Flow-Way Soil Management Plan
5. USFWS letter to the SFWMD dated 7/10/2010 regarding environmental reports and the Services recommendations for protection of threatened and endangered species and migratory birds.

As of October 2011, not all of the environmental audits have been completed because several parcels have yet to be purchased. **Table 7-11 in Section 7.9.3** includes a summary of the parcels that require additional investigations. Once the parcels have been purchased and all of the environmental audits have been completed, the SFWMD will again initiate coordination with the FDEP, the delegated RCRA authority for Florida, to determine what response actions, if any, are required. If required non-RCRA response actions exist, the SFWMD may enter into an "Agreement for Specified Remediation" (ASR) or similar type agreement with the FDEP that lays out the steps necessary to ensure that the final project design meets human health and ecological protection standards. The SFWMD and FDEP will consult with the USFWS to ensure that the final project design protects USFWS Trust Species protected under the Endangered Species Act and the Migratory Bird Treaty Act. Written documentation of all regulatory coordination will be provided to HQUSACE for review prior to project construction.

Sections 7.16.2, 7.16.3, and 7.16.4 provide a detailed discussion of the regulatory coordination status for each major component of the project.

Soils Removed:

To comply with the CERP Residual Agricultural Chemical Policy, soils that are hazardous waste under RCRA must be removed from project by the SFWMD at 100% their cost. If a potential RCRA waste is not listed under Subpart D, a waste characteristics test is called for under Subpart C (40 CFR 261.20 et seq), The four RCRA characteristics of hazardous waste are: ignitability, corrosivity, reactivity, and toxicity. Ignitable wastes readily catch fire and sustain combustion. Corrosive wastes are acidic or alkaline wastes that readily corrode or dissolve flesh, metal, or other materials. Reactive wastes readily explode or undergo violent reactions. Toxic wastes leach toxic compounds or elements into underlying soils or groundwater supplies. The USEPA allows a waste generator to rely on known traits of the materials in question, as well as testing, to establish whether the materials are likely to be RCRA characteristic wastes.

Demonstration of RCRA toxicity characteristics can be done using either the TCLP (Toxicity Characteristics Leachate Procedure) test or by analyzing for total constituent concentration and applying the "Rule of 20" to infer whether the RCRA Toxicity Characteristics regulatory limits would be exceeded. The "Rule of 20" allows a toxicity determination to be made by dividing the total constituent concentration (mg/Kg) by 20 and comparing this value to the RCRA toxicity regulatory limit (40 CFR 261.24). If the calculated value is less than the RCRA regulatory toxicity limit, then the substance is not a RCRA characteristic waste based on toxicity. The rule can also be used by multiplying the RCRA toxicity characteristics limit by 20 and then comparing this value to the measured total constituent concentration. If this calculated value is greater than the measured total constituent concentration, the material is not a RCRA characteristic waste, based on toxicity.

An evaluation of soils removed from the project lands and additional RCRA sampling to be conducted is provided for each project component beginning in **Section 7.16.2.**

***Cost Comparison Between Removing or Leaving Soils With Agrichemicals*:**
Cost comparisons are provided for each project component and major feature to determine if it is cost effective to incorporate impacted soils into project features. The assumptions used to develop the cost estimates for removing impacted soils are: 1) impacted soils that are disturbed during project feature construction are to be removed from the project lands; 2) stockpiling of these materials is done on non-project lands, and 3) clean replacement material necessary to complete construction of the project feature is brought on site. The assumptions used to develop the cost estimates for incorporating the impacted material into project features are: 1) based on existing soil management plans, where the impacted soils for all features are assumed to be blended at a ratio of two parts clean fill to one part impacted soil 2) placement of the blended material costs the same as placement of clean fill, 3) additional soil testing and oversight will occur to ensure that the blended materials meet environmental and human health requirements, and 4) impacted soils disturbed during clearing/grubbing for exotic vegetation control will be left in place if the regulator determines that they present no risk to human health or the environment. The cost estimates presented here included a 35% contingency.

The comparison of costs for removing or incorporating impacted soils into the project are presented for major features of the project beginning in **Section 7.16.2**. As required by the September 14, 2011 guidance, the SFWMD bears responsibility for disposing of all current and future project-related impacted soil.. The SFWMD assumes all current and future responsibility for disposal units.

Cost Comparison for the USACE Acting as the Construction Agency and Performing the non-RCRA Response Action for the NFS: Cost effective analyses for determining if it is cost effective for the USACE to perform the non-RCRA response actions for the SFWMD have been prepared for each major feature of the project. The assumptions used to develop the costs for the construction scenario, where the USACE does not touch impacted soil, are: 1) the SFWMD performs all earth moving construction activities that involve excavating impacted soils, stockpiling impacted soils, blending impacted soils, and placing blended materials; 2) the USACE performs construction actions such as pump foundation excavation of clean limerock, pump station construction, culvert installation, and concrete channel lining in areas where impacted soils have either been removed or are covered with a minimum of 6 inches of clean fill; 3) splitting the work between the two agencies does not result in additional costs associated with actual construction activities, ie., no additional material handling occurs; and 4) the additional cost of having two construction agencies and two contracts, results in an increase in the total amount required for design/engineering and contract supervision/administration.

The costs for constructing the project features under the single construction agency scenario are provided in the MCASES cost estimates, with the exception of the cost of blending the soils and testing the blended materials that are placed within the project features. Costs associated with blending and testing are solely the responsibility of the SFWMD and are excluded from the MCASES cost estimate. The final cost-effective comparison of the two construction agency strategy versus the single construction agency strategy is based upon the additional E&D (Engineering & Design) and S&A (Supervision & Administration) costs that can be attributed to the necessity of providing additional sets of plans and specifications, additional contract acquisition actions, additional contract supervision, and potentially additional mobilization costs. Each component of the E&D and S&A costs for the two construction agency strategy are estimated to be 50% higher than the E&D and S&A costs for the single construction agency strategy. Costs associated with anticipated delays inherent in a two construction agency strategy, or double handling of materials, are difficult to quantify and are not quantified here.

The comparison of costs for having the USACE include the non-RCRA response action as part of its construction activities are presented for major features of the project beginning in **Section 7.16.2**.

Engineering and Other Risks:

Engineering Risk: The USACE will address risks during design and construction of the project components by: 1) Regulatory review of plans and specifications by the FDEP which is the delegated RCRA authority in Florida; 2) Review of environmental audits and environmental risk assessments by the USFWS for potential impacts to Threatened and Endangered Species; 3) Incorporation of appropriate safety and handling specifications into the project bid documents; 4) Review of plans and specifications by the USACE Environmental and Munitions Center for Expertise (EM CX) prior to contract advertisement; 5) Conducting appropriate supervision and oversight of construction; 6) Conducting confirmation sampling after feature construction, and 7) SFWMD's obtaining final approval of construction actions by FDEP. These safeguards further reduce the risk of future releases or exposure and are consistent with USACE construction standards and requirements.

Ecological and Human Health Risk: Soil management plans, developed for each of the project components, include additional testing of soils within the project footprints as part of determining the appropriate ratio of clean fill to impacted soil used in the blended material to be placed within the constructed features. Excavation and placement of impacted soils on the project lands will be done in accordance to the final FDEP approved soil management plans developed for each project feature. Confirmation testing of placed soils will be done to ensure that concentrations of residual agricultural chemicals are acceptable to the regulator for the protection of human health, ecological receptors, and groundwater. Construction Health and Safety plans will specify safety requirements for handling soils containing residual agricultural chemicals. During detailed design of project features, if an area with unusually high levels of residual agricultural chemicals is identified, the USACE will reconsider constructing features at this location if performing the construction would result in unacceptable risk or liability.

Once constructed, it is possible that man-made actions might disturb the soils containing residual agricultural chemicals placed within the project features. To limit this risk, land use restriction covenants may be incorporated into the property deeds where required by FDEP or other regulatory parties to limit the possibility of future releases to the environment. The SFWMD shall ensure that land use restrictions will not reduce ecosystem restoration benefits, hinder O&M, or interfere with the Project's proper function. From an ecological impact standpoint, the liability associated with a release of arsenic or other residual agricultural chemicals is limited, since the soils containing residual agricultural chemicals that are blended and placed into constructed features will have average concentrations below ecological thresholds as confirmed by testing prior to final placement of the material. From a human health impact standpoint, the liability associated with a release of residual agricultural chemicals is limited and acceptable to the regulator, given the low concentrations of residual agricultural chemicals found on the project lands and the limited human visitation patterns on the project lands.

Considering the low concentrations of hazardous substances found, the extremely low probability of concentrating these materials through construction, and the limited human exposure potential after project implementation, the risk, if there is a release of the materials, is considered very low. For instance, it is possible that blended construction fill containing impacted soils might be transported to adjacent non-project lands as a result of erosion. If a release occurred, it is likely that the impacts would be minimal given that the response action, if any, would require no special handling of the eroded soils or long-term monitoring of groundwater due to the low contaminant concentrations in the project soils.

Financial Risk: As stated in the guidance, the NFS is responsible for any future costs associated with the presence of residual agricultural chemicals remaining on Federal project lands, including any potential liability related to their presence. Regardless of the constructing agency, the SFWMD will be financially responsible for correcting any portion of a constructed feature that fails to meet a specification for maximum total constituent concentration or leachate concentration as required in the relevant FDEP approved soil management plan.

Final Risk Determination:

The USACE and SFWMD will prepare a final determination report for each feature to confirm that the overall project risk from impacted soils is low and acceptable. The final determination report will be submitted to HQUSACE prior to construction of each feature. For each construction contract managed by the USACE, the SFWMD will be responsible for providing full funding to the USACE prior to contract advertisement for the identified contract specific cost of addressing residual agricultural chemicals.

Statement of NFS Responsibility:

Consistent with the September 14, 2011 Memorandum from Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works), SFWMD, the NFS, will be 100% responsible for the costs of all actions taken due to the presence of residual agricultural chemicals, at no expense to the Federal Government and any future costs associated with the presence of residual agricultural chemicals at the Federal project site are 100% a SFWMD cost and responsibility. As stated in the September 14, 2011 Memorandum, normal project engineering and construction activities will remain part of total project cost, provided that these are the same activities required to implement the project features absent the presence of residual agricultural chemicals. More specifically:

- SFWMD will ensure the development, planning and execution of Federal, state, and/or locally required response actions to address residual agricultural chemicals, including any soil management activities, at 100% SFWMD cost.

- SFWMD is 100% responsible for costs of characterization of the project lands necessary to determine an appropriate response action for the residual agricultural chemicals.
- Removal of soils that are RCRA hazardous waste are a 100% SFWMD responsibility.
- SFWMD is 100% responsible for the costs of characterizing the project lands in preparation for conducting a response action for removal of soils that are identified as hazardous waste.
- SFWMD will regularly update the District Commander regarding its progress in developing and ensuring execution of the required response actions.
- SFWMD agrees that any future costs associated with the presence of residual agricultural chemicals remaining on Federal project lands are 100% SFWMD responsibility, including any potential liability related to their presence. This includes future responsibility for any disposal units.
- SFWMD acknowledges that the Jacksonville District will not conduct actions to address residual agricultural chemicals during the operation, maintenance, repair, replacement and rehabilitation phase of the project.

Component by component discussion of the requirements of the ASA(CW) policy for CERP Residual Agricultural Chemicals are included below.

7.16.2 Deering Estate Component

This component consists of a 125 cfs pump station, intake canal, and weir for the purpose of directing C-1 canal flows into the Deering freshwater and tidal wetlands. The SFWMD is currently completing construction of the pump station (S700), and the C100A spur canal. The construction of the pump station and intake canal required a soil management plan to address handling and incorporation of soils with residual agricultural chemicals. The soil management plan which included blending of clean fill with soils containing residual agricultural chemicals was reviewed and approved by the FDEP prior to construction. During construction, the SFWMD incorporated an estimated 3,000 cubic yards of soils containing residual agricultural chemicals into the project features and moved approximately 7,000 cubic yards of impacted soils to a temporary stockpile located in the Cutler Wetlands area. The SFWMD will be submitting testing results for samples collected during construction and anticipates confirmation from FDEP that the soil management plan was properly executed. The non-project costs associated with handling the soils with residual agricultural chemicals at this component will be identified in project crediting submittals provided by the SFWMD. A distribution weir located east of Old Cutler Highway was completed in 2008. No soil management plan was necessary for the installation of the weir located east of Old Cutler Highway.

Per the requirements of the CERP Residual Agricultural Chemical Policy, discussions of the residual agricultural chemicals present, the status of regulatory coordination, soil removed, applicable cost comparisons, and engineering and other risks for the Deering Estate component are included below. Summary information for this component, provided in ***Table 7-23*,** is followed by detailed discussion of the relevant policy requirements.

TABLE 7-23: SUMMARY OF ENVIRONMENTAL AUDITS, RCRA SOILS REMOVED, AND REGULATORY COORDINATION STATUS FOR DEERING ESTATE.

Component	**Env. Conditions Audit Status**	**RCRA Soils Removed / Identified**	**Regulatory Coordination Status**
Pump Station/Intake Canal	Phase I/II completed. Arsenic, copper, and DDT detected on tract (TA500-074).	None	Soil Management Plan reviewed and approved by FDEP. Feature construction nearing completion. SFWMD to submit testing results for incorporated soils to FDEP for compliance back check.
Box Culvert and Weir	Phase II needed on 20 acres outside of construction footprint on tract TA500-073).	None	Not applicable. No impacted soils present within feature footprint.

Nature and Extent of Residual Agricultural Chemicals*:* At Deering Estate, approximately 30 acres have a history of agricultural use. Ten of these acres are located on the project tract (TA500-074) located west of Old Cutler Road, and 20 acres are located on a former citrus grove site located within Deering Estates Park. No history of past or present agricultural use was found or is expected to be found on approximately 160 of the Deering Estate component project acreage. Per standard environmental audit protocols, no soil testing is likely to be conducted on these non-agricultural lands because no recognized environmental conditions (REC), agricultural or otherwise, were identified during the initial phase I audits.

Arsenic, copper, DDT, chlordane, and dieldrin were the residual agricultural chemicals found on tract TA500-074 of the Deering Estate component. During construction of the S-700 pump station and adjoining intake canal on tract

TA500-074, impacted soils were excavated from approximately 6 acres of land. A portion of the impacted material was incorporated into the project footprint after blending with clean fill. At present, approximately 3 acres of potentially impacted soils remain on this parcel in areas that are not coincident with project feature footprints.

Legal Application of Agricultural Chemicals: The audits conducted to date at Deering Estate have not identified locations where agricultural chemicals may be present in quantities suggesting a spill or disposal occurred, or locations where non-agricultural pollution is potentially present. Arsenic, copper, and dieldrin were detected on the 10 acre tract (TA500-074) located west of Old Cutler Road. It is very likely that elevated levels of arsenic, copper, and dieldrin found in soils on this former grove area are primarily the result of the legal application of commercially available pesticides used for their intended purpose and in a manner that was consistent with labeling instructions. A Phase II audit has yet to be completed on 20 acres of former citrus grove land located within parcel TA500-073. It is likely that the findings of this audit will also indicate soils with residual agricultural chemicals present at concentrations consistent with legal application.

Availability of Lands With No Agrichemicals Present: Implementation of the Deering Estate component requires available and suitable lands which are located adjacent to Biscayne Bay within the C-100 drainage basin. In the vicinity of the C-100 canal, current and historic aerial photography indicates limited potential alternative acreage to the north. Some of these potential alternative lands have been farmed in the past and would therefore be expected to contain similar levels of residual agrichemicals. To the west and south, extensive residential development precludes the placement of potential Deering Estate features.

Regulatory Coordination:

The FDEP and USFWS have reviewed the Phase I, Phase II audits, associated ecological risk assessment studies, and soil management plans for the Deering Estate component. The SFWMD has implemented the FDEP approved soil management plan for the Deering Estate pump station and intake canal which included incorporation of impacted soils into constructed features. Construction of the Deering Estate features is nearing completion as of October 2011. The SFWMD will submit to FDEP the results of post-construction soil testing conducted at the pump station and intake canal. The FDEP will review in late 2011 or early 2012 this information and determine if placed soils meet the ecological and human health standards agreed to in the soil management plan.

The SFWMD will conduct a Phase II audit of the 20 acres of a former citrus grove located on tract TA500-073 and submit this information to the FDEP, USFWS as well as the USACE for review and comment.

Soils Removed:

To comply with the CERP Residual Agricultural Chemical Policy, soils that are hazardous waste under RCRA must be removed from the project by the SFWMD at 100% their cost. The SFWMD has conducted total constituent concentration testing of soils at the Deering Estate component. Per the discussion provided in **Section 7.16.1**, the testing conducted at Deering Estate, as well as knowledge of the properties of the soils indicate that none of the tested soils are RCRA hazardous wastes (listed or characteristic). No "hotspots" were identified on the Deering Estate properties so no known RCRA Sub-Part D RCRA materials required removal from these lands. There is the possibility that the outstanding Phase II audit of the 20 acre former citrus grove will result in the detection of a spill or illegal disposal. The SFWMD is responsible for conducting any response action identified in this Phase II audit. Since the project features at the Deering Estate component are nearing construction completion, no other RCRA characteristics testing or RCRA removal actions, other than that discussed above, are anticipated.

Cost Comparison Between Removing or Leaving Soils With Agrichemicals:

As of October 2011, the SFWMD has almost completed the construction of the project features at the Deering Estates component. The Soil Reuse Plan (Appendix A, Part II, correspondence between URS Corp and FDEP, dated May 6, 2011) indicates that 3,000 cubic yards of impacted topsoils were blended with 7,000 cubic yards of clean limestone fill and placed in the project footprint. An additional 7,000 cubic yards of impacted topsoil and 12,500 cubic yards of excavated limerock were moved to a staging area at Cutler for use on the Cutler Wetlands. The cost of incorporating the impacted soils into the Deering Estate features and providing the required oversight and testing is estimated to be $170,000. If the impacted soils could not be incorporated into the Deering Estate component, the SFWMD would have had to remove 10,000 cubic yards of impacted topsoil, stockpile it on non-project lands, and replace the material with 3,000 cubic yards of clean topsoil used to blend with the limerock. (Alternatively, the SFWMD would potentially have had to haul in 10,000 cubic yards of clean topsoil and placed it without blending; however, if they did this, they would have had to haul an additional 7,000 cubic yard of limerock to Cutler.) The cost of removing and stockpiling 10,000 cubic yards of impacted soil and replacing 3,000 cubic yards of fill required for topsoil cover is estimated to be $420,000. The net savings for incorporating the materials into the Deering project feature are estimated to be $250,000. Based on this analysis it is cost effective to incorporate impacted soils at Deering Estate.

Cost Comparison for the USACE Acting as the Construction Agency and Performing the non-RCRA Response Action for the NFS:

The SFWMD has nearly completed construction of all of the Deering Estate component features. For this reason, the USACE will not act as the construction agency for this component and thus, this cost-effectiveness analysis is not applicable.

Engineering and Other Risk:

Engineering Risk: Engineering risks were addressed through the development, FDEP approval, and implementation of the soil management plan for Deering Estate component features. Blended fill placed during construction at this site was tested by the SFWMD to ensure that the material met the minimum geotechnical specifications as well as the ecological, human health, and groundwater quality protection specifications.

Ecological Risk: The soil management plan called for blending the impacted soils with clean fill to ensure that concentrations of arsenic, copper, and DDT were below ecological threshold concentrations, as well as leachate groundwater quality protection criteria. As of October 2011, the SFWMD is preparing a final report for submittal to FDEP that details testing and placement of blended soils at Deering. The FDEP will review this report to determine if the procedures and target soil concentrations outlined in the soil management plan were achieved during construction.

The SFWMD has nearly completed construction of the Deering Estate component. By handling the soils in a manner consistent with the FDEP approved soil management plan, the SFWMD has minimized an unintended release of soils containing residual agricultural chemicals. While it is possible that erosion of placed materials may result in the unintended release of impacted soil, the concentrations of chemicals within the blended materials are so low that ecological or human health risk is limited and any resulting corrective action would require work similar to addressing erosion of materials containing no measurable contaminants.

7.16.3 Cutler Wetlands:

The Cutler Wetlands component is shown in ***Figures 7-13 and 7-14*** on Pages 7-54 and 7-55. There are two major features to this component, the Cutler Wetlands Flow-Way and the Cutler Wetlands Spreader Canal. A short description of each is provided below.

Cutler Wetlands Flow-way: The major features include a 400 cfs pump station and a 6,900 ft long concrete-lined channel. The SFWMD has developed a soil management plan to address residual agricultural chemicals for the lined-channel alignment. This plan included the collection of additional soil samples to develop the proposed mix ratios for soil placement in the channel embankment. The FDEP has reviewed and approved the soil management plan, but construction has not begun. The USACE is seeking approval for SFWMD to certify project lands containing residual agricultural chemicals for potential USACE construction of this feature. Should the USACE be the construction agency for this feature, the contract(s) will include payment line items to track costs associated with dealing with residual agricultural chemicals.

Cutler Wetlands Spreader Canal: This is a 13,000 + ft long water distribution ditch that runs north-south in wetlands located east of the L-31E levee. The SFWMD has not yet created a soil management plan for this area but intends to create one similar to that for Deering Estate and Cutler Wetlands Flow-Way. The FDEP is expected to approve the soil management plan. The USACE is seeking approval for SFWMD to certify project lands containing residual agricultural chemicals for potential USACE construction of this feature. Should the USACE be the construction agency for this feature, the contract(s) will include payment line items to track costs associated with dealing with residual agricultural chemicals.

Per the requirements of the CERP Residual Agricultural Chemical Policy, discussions of the residual agricultural chemicals present, status of the regulatory coordination, soils removed, applicable cost comparisons, and engineering and other risks for the Cutler Wetland component is included below. Summary information for this component, provided in ***Tables 7-24 and 7-25*,** is followed by detailed discussion of the relevant policy requirements.

TABLE 7-24: SUMMARY OF ENVIRONMENTAL AUDITS, RCRA SOILS REMOVED, AND REGULATORY COORDINATION STATUS FOR CUTLER WETLAND.

Component	Env. Conditions Audit Status	RCRA Soils Removed / Identified	Regulatory Coordination Status
Cutler Flow-way	Phase I/II audits completed except for 16.9 acres within TA500-001. The following contaminants were detected in Cutler soil: Organo-chlorine pesticide (OCPs) such as DDT, DDE, DDD, chlordane. Metals: arsenic, barium, cadmium, chromium, lead, selenium, silver. Also various PCB's and PAHs.	Yes. A 20 acre construction debris landfill just south of project land was removed and closed out on the parcel identified as PIN #3066016020020. Soil from a probable agricultural chemical spill site was removed from parcel identified as PIN#3060170000080. No known RCRA materials present at this time.	Env. Audits reviewed by USFWS and FDEP. Soil Management Plan reviewed and approved by FDEP. Feature construction not initiated.
Cutler Spreader Canal	Phase I/II reports completed on 21 of 22 parcels. Update of the Phase I for 36 acres on parcel TA500-021 coincident with project lands. Contaminants found to date on these lands are: As, Ag, Ba, Cr, Cd, Cu, Hg, Pb, DDT, and DDE.	Total constituent testing conducted. No RCRA soils identified or removed to date.	Environmental audits reviewed by FDEP and USFWS. Soil management plan to be developed and submitted for review and approval.

TABLE 7-25: SUMMARY OF NON-RCRA CORRECTIVE ACTIONS, AND COST EFFECTIVENESS ANALYSES FOR CUTLER WETLAND.

Component	Residual Agricultural Chemicals Identified Within feature footprint	Cost-Effective To Leave On Site/Incorporate	Cost-Effective for Corps to Handle Soils
Cutler Flow-way	Feature is likely to be constructed by USACE after project authorization. An estimated 58,400 cu.yds of impacted topsoils will be handled during construction. Additional information required in area adjacent to former landfill prior to USACE construction.	Yes. Incorporation saves $1.1 million	Yes. USACE performing non-RCRA actions as part of construction saves $1.2 million
Cutler Spreader Canal	Feature is likely to be constructed by USACE after authorization. An estimated 40,200 cubic yards of impacted soils will be handled during construction.	Yes. Incorporation saves $790,000	Yes. USACE performing non-RCRA actions as part of construction saves $260,000

Residual Agricultural Chemicals

Nature and Extent of Residual Agricultural Chemicals: At Cutler Wetlands approximately 1000 out of 1763 acres have a history of agricultural use. Soil samples collected on these parcels show evidence of organo-chlorine pesticides (DDT, DDE, DDE, chlordane) and metals such as arsenic, barium, cadmium, chromium, lead, selenium, and silver. No history of past or present agricultural use was found or is expected to be found on approximately 763 of the surveyed acres in Cutler Wetlands. These lands are thus not covered under the September 14, 2011 guidance. Per standard environmental audit protocols, no soil testing was conducted on these non-agricultural lands because no recognized environmental conditions (REC), agricultural or otherwise, were identified during the initial phase I audits.

Arsenic is one of the most commonly found soil contaminants on lands with a history of agricultural use. Cutler Wetland land parcels totaling approximately 947 acres show evidence of soil with arsenic above concentrations of concern for human health and/or ecological protection. At Cutler Wetlands, approximately 50 acres of land impacted by arsenic and other agrichemicals are coincident with the construction footprint of project features. The arsenic impacted soils on the approximately 900 acres that are not coincident with the construction footprint of project features will be left in place since the quantity of arsenic in these soils according to the regulator poses no ecological impact or significant human health risk.

Legal Application of Agricultural Chemicals: Historic aerial photography for Cutler Wetlands reviewed as part of the Summary Environmental Conditions report in Appendix C.3 show agricultural activity as early as 1938. Environmental audit data compiled in ***Table 7-22*** in **Section 7.16.1** indicates that 30 acres of Cutler Flow-Way feature lands have been farmed and 772 acres of the Cutler Spreader Canal feature have been farmed, and 761 acres have no record or evidence of having been farmed in the past. The summary environmental conditions report in Appendix C.3 states that the agricultural chemicals such as copper, arsenic and organic pesticides are likely present as the result of past farming activities. Given the history, type of chemicals and concentrations, it is very likely that the residual agricultural chemicals found in soils on the 772 acres of the Cutler Spreader Canal feature and the 30 acres of Cutler Flow-Way feature lands are the result of the legal application of commercially available pesticides used for their intended purpose and in a manner that was consistent with labeling instructions.

Availability of Lands With No Agricultural Chemicals Present: Implementation of the Cutler Wetlands component requires available and suitable lands which are located adjacent to Biscayne Bay and within the C-1 drainage basins. A summary of the findings of an aerial photography review of the Cutler Wetlands area is included in the "Summary of Environmental Conditions" report in Appendix C.3. In the vicinity of the Cutler Wetlands feature and the C-1 canal, current and historic aerial photography indicates limited availability of alternative acreage since the project currently includes almost all of the adjacent bayside lands. There exists available land in the C-1 basin south of the South Miami-Dade Landfill and the South Dade Regional Wastewater Treatment Plant. To construct a similarly effective Cutler Wetlands component south of the landfill and wastewater treatment plant, a 7,000 ft long lined channel would have to be built from the present location of the planned S-701 pump station to the open lands south of the South Miami-Dade Landfill. This lined channel alignment would cross lands that have been used for agriculture and solid waste disposal. The tidal wetlands in this scenario appear to be ditched and drained so they probably have some history of agricultural use. The acreage of tidal wetland between the C-1 Canal and the C-102 Canal is less than that of the proposed tidal wetland acreage north of the C-1 Canal. so project benefits would be reduced. The environmental risks presented by this alternative feature location appear to be very similar to those posed by the proposed Cutler Wetland acreage, given the similarity in past land use. Alternative lands without agricultural chemicals present are not available for this project component.

Regulatory Coordination:

The Phase I and Phase II audits performed on the Cutler Wetlands project lands identified point source sites as well as elevated concentrations of residual agrichemicals in formerly cultivated areas. These reports were submitted in draft form to the FDEP and USFWS for review and comment. The FDEP has reviewed the soil management plan developed for the Cutler Wetlands Flow-way features. (A copy of the soil management plans is included in Appendix A, Part II.) No construction has been done on the Cutler Flow-way.

As of September 2011, not all of the environmental audits have been completed in the Cutler Wetlands. For the Cutler Flow-way, 17 acres on a single parcel (TA500-001) require a Phase II audit. For the Cutler Spreader Canal, one parcel of 36 acres (TA500-021) requires a Phase II audit. Once the remaining environmental audits have been completed and design plans are advanced, the SFWMD will again initiate coordination with the FDEP. A soil management plan will be developed and submitted to FDEP for the Cutler Wetlands Spreader feature.

The SFWMD and FDEP will consult with the USFWS to ensure that the final project design protects USFWS Trust Species protected under the Endangered Species Act and the Migratory Bird Treaty Act. Though the SFWMD has obtained regulatory approval of the soil management plan for the Cutler Flow-way, the USACE expects that the FDEP will again consider the soil management plan during the review of the 60% design documents submitted for water quality certification permit review. Written documentation of all regulatory coordination will be provided to HQUSACE for review prior to project construction.

Soils Removed:

To comply with the CERP Residual Agricultural Chemical Policy, soils that are hazardous waste under RCRA must be removed from project by the SFWMD at 100% their cost. The SFWMD has conducted total constituent concentration testing of soils at the Cutler Wetlands component. Per the discussion provided in **Section 7.16.1**, the testing conducted at Cutler Wetland, as well as knowledge of the properties of the soils, indicate that none of the tested soils remaining on the Cutler lands are RCRA listed or characteristic wastes. One "hotspot" was identified on the Cutler Flow-Way land (tract TA500-002); however, a response action has been completed. A construction debris landfill located adjacent to the lined Flow-Way channel (tract TA500-062) was removed and closed out. There is the possibility that the outstanding Phase II audit of the parcels totaling 63 acres may result in the identification of soils with chemical concentrations consistent with a spill or illegal disposal and thus potentially RCRA materials. The SFWMD will be responsible for conducting any response action identified in this Phase II audit.

During design and construction of the Cutler Wetlands features, soils that will be excavated, placed, or otherwise disturbed will be sampled and analyzed for total constituent concentrations. This testing can only be conducted once the final feature alignments are established at the 60% or better design plan stage. The soil testing will be conducted by the SFWMD and the results will be provided to the FDEP and the USACE. The "Rule of 20" will be applied to determine if TCLP (Toxicity Characteristics Leachate Potential) testing is required to identify soils that are characteristically toxic. The contents of the leachate will be compared to the regulatory limits for 39 different toxic chemicals. Soils failing the TCLP test will be removed from the project lands by the SFWMD at their cost.

Cost Comparison for Soils Containing Residual Agricultural Chemicals Remaining on Project Lands:

Cutler Flow-Way:
Construction of the Cutler Flow-Way feature will require the removal or incorporation of approximately 58,400 cubic yards of material containing residual agricultural chemicals. The cost of removing this material, stockpiling it off of project lands, and replacing it is estimated to be $2,460,000. To incorporate the impacted soils into the project feature, additional testing will be done to establish the appropriate ratio of clean fill to impacted soils. Based on the Deering Estate and Cutler Flow-Way Soil Management Plans, incorporating this material into the project features requires that these impacted soils to be blended with clean fill at a ratio of 2 parts clean to 1 part impacted soil. The blending may be accomplished by placing alternative lifts of clean and impacted material and running a road grader or disk plow over the material prior to final compaction. The cost of blending, oversight, and testing associated with incorporating the impacted soil into this project feature is $1,320,000. The cost savings for incorporating the soils into the project features is $1,140,000.

Cutler Spreader Canal:
Construction of the Cutler Spreader Canal feature will require the removal or incorporation of approximately 40,200 cubic yards of material containing residual agricultural chemicals. The cost of removing this material, stockpiling it off of project lands, and replacing it is estimated to be $1,740,000. Incorporating this material into the project features is likely to require that these impacted soils are blended with clean fill at a ratio of 2 parts clean to 1 part impacted soil. The blending may be accomplished by placing alternative lifts of clean and impacted material and running a road grader or disk plow over

the material prior to final compaction. The cost of blending, oversight, and testing associated with incorporating the impacted soil into this project feature is $950,000. The cost savings for incorporating the impacted soils into this project feature is $790,000.

Based on the assumptions presented here for these two features, it is cost-effective to incorporate the impacted soils into the Cutler Wetlands features since this will save taxpayers an estimated $1,930,000. (Note that the costs presented here are planning level costs. Refined estimates of blending costs will be developed during project design.)

Cost Comparison for the USACE Acting as the Construction Agency and Performing the non-RCRA Response Action for the NFS:

This analysis requires comparison of a “Two Construction Agency Scenario” versus a “Single Construction Agency Scenario”. The overarching assumption for the Two Construction Agency Strategy is that the USACE does not handle impacted soils and that the SFWMD will perform all construction activities associated with handling impacted soils or blended soils. The USACE would perform only earthwork activities such as excavating limerock from pump station foundations and canal alignments after the SFWMD moves impacted topsoils. Construction of berms or levees would have to be done by the SFWMD since this would involve blending and placing impacted soils. The USACE could construct the pump stations and culverts under the Two Construction Agency Scenario as long as the work was properly sequenced. The “Single Construction Agency Scenario” would have the USACE contract all of the construction activities.

Cutler Flow-Way:

Two Construction Agency Scenario: The construction of the flow-way’s concrete lined channel, pump station, and culverts will require the excavation and handling of approximately 58,400 cubic yards of impacted soils. Under the scenario where the USACE avoids handling impacted soils or fill containing impacted soils, the SFWMD would be responsible for clearing impacted materials from the pump station footprint in advance of USACE construction. Final grading at the pump station project site would be done by the SFWMD if blended soils were used. The SFWMD would have to construct the lined-channel embankment foundation prior to the USACE installing the concrete lining. The SFWMD would excavate the impacted soils from the flow-way footprint, blend these soils with clean fill brought onto the site, place the blended material in the flow-way embankment, then cover the blended material with ‘6 to 12” of clean fill so that the USACE contractor could place the concrete lining without coming into contact with the blended materials. The two construction agency scenario would add an estimated $1,200,000 to the E&D and S&A costs associated with constructing the pump station and lined channel. These additional costs arise because the two construction agency scenario would require one additional contract acquisition action, one additional survey, one additional set of plans and specifications, and additional construction quality assurance expenses. Additional costs associated with delays, scenario imposed double handling of materials, additional clean fill potentially brought on-site to limit USACE contact with impacted soils, and increased potential for change orders are not included in this cost-effective analysis because they are difficult to quantify with certainty given that the design of these features is less than 30% complete.

Single Construction Agency Strategy: The cost of this strategy is identical to the MCASES cost estimate since this approach uses the same assumptions (no special handling of soils is required). The SFWMD would have to provide the USACE funding in advance of construction to cover the non-project costs of blending impacted soils for incorporation into the features.

Cutler Spreader Canal:

Two Construction Agency Scenario: The construction of the Spreader Canal will require the excavation and handling of approximately 40,200 cubic yards of impacted soils. Under the assumption that the USACE does not handle impacted soils, the SFWMD would have to excavate the impacted topsoils from the spreader canal footprint. The USACE would then excavate the underlying limerock to the design template and stockpile the limerock for blending with impacted soil by the SFWMD. The SFWMD would blend the stockpiled limerock with the impacted soil and place the blended material in the adjacent levee cross-section. Carefully planned, this two contractor process might be sequenced such that scenario imposed double handling of material would be minimal. The two construction agency scenario would add at least $260,000 to the E&D and S&A costs associated with constructing the spreader canal and adjacent levee. These additional costs arise because the two construction agency scenario would require one additional contract acquisition action, potentially one additional survey, potentially one additional set of plans and specifications, and additional construction quality assurance expenses. Additional costs associated with delays, scenario imposed confusion regarding quantity payment tracking, and increased potential for change orders are not included in this cost-effective analysis. These potential additional costs are difficult to quantify with certainty given that the design of this feature is less than 30% complete.

Single Construction Agency Scenario: The cost employing this strategy to construct the Cutler Spreader Canal feature is identical to the MCASES cost estimate since this approach uses the same assumptions (no special handling of soils is required). The SFWMD would have to provide the USACE funding in advance of construction to cover the non-project costs of blending impacted soils for incorporation into the features.

Based on the costs presented here, having the USACE conduct the non-RCRA response action during construction of the Cutler Wetland features is cost-effective since it would save taxpayers a minimum of $1,500,000. Having a single construction agency manage the majority of the integrated non-RCRA response actions and construction activity provides a higher quality product and also has the advantage of minimizing risk associated with potential release of agrichemicals and the attendant liability this would entail.

Engineering and Other Risks

Engineering Risk: Engineering risks were addressed through the development, FDEP approval, and implementation of the soil management plan for Cutler Flow-Way feature. Aside from risks associated residual agricultural chemicals, the risk of constructing the Cutler Flow-Way feature is somewhat higher than that presented for other BBCW project components because the lined channel alignment is adjacent to a former construction debris landfill. It is possible that groundwater contamination or other pollution from the former landfill is present on or beneath the footprint of the lined channel. The use of an above-grade embankment for the lined channel reduces the likelihood that construction of the flow-way feature will disturb groundwater conditions on the former landfill site during construction. Post construction, the concrete lining of the channel will greatly reduce seepage into the ground so that the groundwater flow patterns on the former landfill property is unlikely to be affected.

Blended fill placed during construction of the Cutler Wetland features will be tested by the SFWMD to ensure that the material meets the minimum geotechnical specifications. A soil management plan will be developed for the Cutler Spreader Canal feature. Engineering risks in this plan will be addressed in a manner similar to the Deering Estate and Cutler Flow-way soil management plans.

Ecological and Human Health Risk: The soil management plan for the Cutler Flow-Way feature calls for blending the impacted soils with clean fill to ensure that concentrations of arsenic, copper, and DDE are below human health and ecological threshold concentrations as well as leachate groundwater quality protection criteria. This soil management plan has been reviewed and approved by the FDEP. A soil management plan for Cutler Spreader Canal will be developed by the SFWMD prior to constructing this project feature. It is anticipated that this plan will call for similar soil management actions and that the FDEP will approve the incorporation of impacted soils into this project feature. During construction, verification testing will be done to confirm that the blended soils contain concentrations of residual agricultural chemicals that meet the targets established in the two soil management plans. Construction specifications will include health and safety precautions appropriate for the soils handled on-site.

Prior to the USACE constructing in this area, the SFWMD will provide all documents pertaining to the removal and close-out of the former landfill as well as additional soil and groundwater quality data to be collected in the area as required by the USACE. The USACE will move forward with construction on lands adjacent to the former landfill if the potential PRP risk is deemed acceptable. This determination will be made prior to construction. Construction of the Cutler Spreader Canal feature presents a low and acceptable risk since the blended soils placed on these lands will have low concentrations of residual agricultural chemicals. In the unlikely event that a release occurred, corrective action to address it would be the responsibility of the SFWMD.

Final Risk Determination:

A government cost estimate will be prepared during the preparation of plans and specifications for each of the features to be constructed to estimate the additional costs associated with incorporating the soils with residual agrichemicals into the constructed features. The cost of removing the soils with residual agricultural chemicals from the feature footprints will also be estimated to verify that incorporation of the impacted soils is cost-effective for each feature. The USACE and SFWMD will prepare a final determination report to confirm risk of future release. The final determination report will be submitted to HQUSACE prior to construction. The Jacksonville District must receive a concurrence memorandum from HQUSACE prior to initiating construction. For each construction contract managed by the USACE, the SFWMD will be responsible for providing full funding to the USACE prior to contract advertisement for the identified cost of addressing residual agricultural chemicals.

7.16.4 L-31 East Flow-Way

The L-31E Flow-Way component is shown in **Figures 7-15.** There are three major features to this component, L-3E Freshwater Wetlands, L-31E

Culverts/Pumps, and the L-31E Tidal Wetlands. A short description of each is provided below.

L-31E Culverts and Pump Stations: This feature includes 11 culverts and 2 pump stations located along the L-31 Levee. Four of the culverts were constructed by the SFWMD over the last 4 years. No soil management plan for agricultural residual chemicals were required since these culverts were installed within the levee embankment which is composed of limerock from the adjacent L-31E Borrow Canal. The SFWMD will develop a soil management plan and obtain FDEP approval if soil testing during design identifies soils within the footprints of the remaining features that contain residual agricultural chemicals. The USACE is seeking approval for SFWMD to certify project lands containing residual agricultural chemicals for potential USACE construction of this feature. Should the USACE be the construction agency for this feature, the contract(s) will include payment line items to track costs associated with dealing with residual agricultural chemicals.

L-31E Freshwater Wetlands: This feature is a 432 acre freshwater wetland with two pump stations and a distribution canal. It is also referred to as the "Homestead Freshwater Wetlands Component". SFWMD has not yet created a soil management plan for this area but intends to create a soil management plan, if necessary, similar to that for Deering and Cutler Wetlands Flowway. FDEP is expected to approve the soil management plan. The USACE is seeking approval for SFWMD to certify project lands containing residual agricultural chemicals for potential USACE construction of this feature. Should the USACE be the construction agency for this feature, the contract(s) will include payment line items to track costs associated with dealing with residual agricultural chemicals.

L-31E Tidal Wetlands: This feature includes 1,400 acres of tidal wetlands bounded by the L-31E Levee to the west, the C-102 Canal to the north, and North Canal on the south. The L-31E Culverts discharge into this area; however, there are no constructed features located in the tidal wetlands themselves. No soil disturbance associated with construction in this area will be done so no impacts associated with residual agricultural chemicals are anticipated.

Per the requirements of the CERP Residual Agricultural Chemical Policy, discussions of the residual agricultural chemicals present, status of the regulatory coordination, soils removed, applicable cost comparisons, and engineering and other risks for the Cutler Wetland component is included below. Summary information for this component, provided in ***Tables 7-26 and 7-27*** is followed by detailed discussion of the relevant policy requirements.

TABLE 7-26: SUMMARY OF ENVIRONMENTAL AUDITS, RCRA SOILS REMOVED, AND REGULATORY COORDINATION STATUS FOR L-31EAST FLOW-WAY

Component	Env. Conditions Audit Status	RCRA Soils Removed / Identified	Regulatory Coordination Status
L-31E Culverts / Pump Stations	Phase I audits complete on all 8 parcels coincident with L-31E pump stations or culverts. No current or past agricultural use of these lands was found. Phase II audits not recommended. Assessments complete.	Non-agricultural lands. No areas were identified with recognized environmental conditions. No RCRA soils likely to be present.	The SFWMD has constructed four of the eleven L-31E culverts. No soil management plans were required for this so no FDEP coordination was required. Additional soil management plans may be required for three pump stations.
L-31E Freshwater Wetlands	Phase I/II reports completed on 9 of 25 tracts. Phase I/II studies required for 16 tracks covering 332 acres. Arsenic, copper, chromium, lead, and mercury found.	Hot spot identified on parcel 3070170010020 in area outside of feature footprint. SFWMD to address prior to construction.	Available Phase I/II audits reviewed by FDEP and FWS. Additional studies and regulatory coordination will occur prior to feature construction. Soil Mgmt Plan required.
L-31 E Tidal Wetlands	Phase I/II reports completed on 14 of 17 tracts. Phase II studies required for 3 tracts covering 240 acres. Arsenic, copper, chromium, lead, and mercury found.	No RCRA soils detected during testing.	Available Phase I/II audits reviewed by FDEP and FWS. Additional studies and regulatory coordination will occur though no construction in this area is planned.

TABLE 7-27: SUMMARY OF NON-RCRA CORRECTIVE ACTIONS, AND COST EFFECTIVENESS ANALYSES FOR L-31 EAST FLOW-WAY.

Component	Residual Agricultural Chemicals Identified Within feature footprint	Cost-Effective To Leave On Site/Incorporate?	Cost-Effective for USACE to Handle Soils?
L-31E Culverts / Pump Stations	Remaining 7 culverts and 3 pump stations to be designed and constructed by USACE after project authorization. Soil testing at footprints of S703, 705, and 709 pump stations will be done during design to determine if soil management plan required. Approximately 9,000 cubic yards of topsoil at these three pump stations may require special handling.	Yes. Incorporation of impacted soils saves $210,000	Yes. USACE performing non-RCRA actions as part of construction saves $540,000
L-31E Freshwater Wetlands	USACE to design and construct after project authorization. An estimated 13,000 cubic yards of impacted soils will be handled during construction of the two pump stations, swale, and distribution canal. An incidental volume of impacted soil from within the freshwater wetland area is anticipated to require removal.	Yes. Incorporation of impacted soils saves $5.9 million	Yes. USACE performing non-RCRA actions as part of construction saves $450,000
L-31 E Tidal Wetlands	Yes. However, no construction will occur in this area.	Not applicable	Not applicable

Residual Agricultural Chemicals

Nature and Extent of Residual Agricultural Chemicals*:* At L-31 East Flow-way, approximately 1072 out of 1980 acres have a history of agricultural use (***Table 7-22***). No history of past or present agricultural use was found or is expected to be found on approximately 907 acres of the project lands. Per standard environmental audit protocols, no soil testing was conducted on these non-agricultural lands because no recognized environmental conditions (REC), agricultural or otherwise, were identified during the initial Phase I audits.

Table 7-21 includes a summary of parcel acreage by residual agricultural chemicals found within the L-31 East Flow-Way component lands. Arsenic (775 acres) is the most commonly found soil contaminant on L-31East Flow-Way lands followed by copper (714 acres), chromium (699 acres), mercury (699), and lead (62 acres). Though no lands within the footprints of the L-31 East pump station features have identified residual agricultural soils, it is possible that some agriculturally impacted soils will require special handling in the footprint of the L-31E Flow-way pump station features. At the L-31E Freshwater Wetlands feature, arsenic has been found on a 92 acre parcel; however it is estimated that within the Freshwater Wetland lands, up to 200 of the 432 acres will have residual agrichemicals including arsenic present. Within the L-31E Tidal Wetlands area, 684 acres have been identified as having arsenic present in the topsoil. The arsenic impacted soils on these 684 acres are not coincident with the construction footprint of project features. These soils will be left in place since the quantity of arsenic in these soils poses no ecological impact and only a limited human health risk given restricted access to these lands.

Legal Application of Agrichemicals: The summary environmental report in Appendix C.3 includes a historic aerial photography review for the L-31 East Flow-way component that shows agricultural activity as early as 1938. Environmental audit data compiled in ***Table 7-22*** in **Section 7.16.1** indicates that none of L-31E Pumps/Culverts feature lands have been farmed, 370 acres of the L-31E Freshwater Wetland feature have been farmed, and 702 acres of the Tidal Wetlands have been farmed. No history of farming has been determined for 134 acres of L-31E Pumps/Culverts feature lands, 62 acres of the L-31E Freshwater Wetland feature, and 711 acres of the Tidal Wetlands. The summary environmental conditions report in Appendix C.3 states that the agricultural chemicals such as copper, arsenic and organic pesticides are likely present on project lands as the result of past farming activities and these chemicals are likely the result of applying commercially available agricultural chemicals used for their intended purpose in accordance with labeling instructions. The summary environmental report has identified locations in the L-31E Freshwater Wetlands (tract 45800) where the concentrations of detected chemicals found may not be consistent with the routine application of agricultural chemicals. In the L-31E Freshwater Wetland Feature, two parcels (PINs 3070180010390, 3070180010380, shown in Figure 7-16) have a history of prior agricultural use; however, evidence of illegal solid waste disposal was found on these two parcels which comprise approximately 20 acres. Prior to lands certification, the SFWMD will, at 100% its own costs, remove the solid waste from these parcels and conduct additional soil / groundwater testing to determine if there is any remaining associated contamination.

Availability of Lands With No Agrichemicals Present: Implementation of the L-31 East Flow-Way component requires lands which are located adjacent to

Biscayne Bay within the C-102, and C-103 drainage basins. In the vicinity of the L-31 East Flow-way project features and the C-102 / C-103 canals, current and historic aerial photography shows no suitable alternative acreage since the project includes all of the adjacent bayside lands. In developing the L-31E Freshwater Wetlands feature, the project team selected suitable freshwater wetland lands that. for the most part, have not been used for farming for at least 20 years. Other potential freshwater wetland lands to the north or south have a more recent history or apparently more intense history of agricultural activity so they likely present a higher risk to the project.

Regulatory Coordination:

Documentation of Regulatory Approvals of NFS' Proposed Actions: The FDEP and USFWS have reviewed the available Phase I, Phase II audits for 9 land tracts within the L-31E Flow-Way component. Copies of the coordination letters are included in the "Summary of Environmental Conditions" report of Appendix C.3. In general, the FDEP and USFWS determined that under the proposed project conditions there will be minimal risk to humans and the environment. Additional Phase I/II audits are necessary for 16 tracts covering 332 acres within the L-31E Freshwater Wetland feature and 3 tracts covering 240 acres within the L-31E Tidal Wetlands feature. These lands have yet to be acquired by the SFWMD.

Once the parcels have been purchased and all of the environmental audits have been completed, the SFWMD will again initiate coordination with the FDEP and USFWS. If outstanding non-RCRA response actions exist, the SFWMD may enter into an "Agreement for Specified Remediation" or similar type agreement with the FDEP that lays out the steps necessary to ensure that the final project design meets human health and ecological protection standards. The SFWMD and FDEP will consult with the USFWS to ensure that the final project design for L-31 East Flow-Way components protects USFWS Trust Species protected under the Endangered Species Act and the Migratory Bird Treaty Act. Soil management plans will be developed by the SFWMD and submitted to FDEP for the L-31E Freshwater Wetlands, and portions of the L-31E Culverts/Pump Stations features since construction of these features is likely to involve blending of soils with residual agricultural chemicals. Written documentation of all regulatory coordination will be provided to HQUSACE for review prior to project construction.

Soils Removed:

To comply with the CERP Residual Agricultural Chemical Policy, soils that are hazardous waste under RCRA must be removed from project by the SFWMD at 100% their cost. The SFWMD has conducted total constituent concentration testing of soils at the L-31 East Flow-Way component. Per the discussion provided in **Section 7.16.1**, the testing conducted at L-31 East Flow-Way as well as knowledge of the properties of the soils indicate that none of the tested soils are RCRA characteristic wastes. One potential "hotspot" was identified on L-31E Freshwater Wetlands tract 45800-171. Additional testing may be warranted to determine if a response action is required to address this hotspot if it is confirmed a RCRA Sub-Part D listed waste is present at the location. No other potential RCRA listed wastes were evident from the soil testing on L-31 East Flow-Way lands. There is the possibility that the outstanding Phase I/II audits of the 16 parcels totaling 322 acres at the L-31E Freshwater Wetlands feature and the 3 parcels totaling 240 acres within the Tidal Wetlands feature may result in the identification of soils with chemical concentrations consistent with a spill or illegal disposal and thus potentially RCRA materials. The SFWMD will be responsible for conducting any response action identified in this Phase II audit.

During design and construction of the L-31East Flow-Way component, soils that will be excavated, placed, or otherwise disturbed will be sampled and analyzed for total constituent concentrations. This testing can only be conducted once the final feature alignments are established at the 60% or better design plan stage. The soil testing will be conducted by the SFWMD and the results will be provided to the FDEP and the USACE. The "Rule of 20" will be applied to determine if TCLP (Toxicity Characteristics Leachate Potential) testing is required to identify soils that are characteristically toxic. The contents of the leachate will be compared to the regulatory limits for 39 different toxic chemicals. Soils failing the TCLP test will be removed from the project lands by the SFWMD at their cost.

Cost Comparison Between Removing or Leaving Soils With Agrichemicals: Soils with residual agricultural chemicals are present within the probable construction footprints of the L-31E Freshwater Wetlands and the L-31E pump station features. The cost comparisons presented below assume that impacted soils will be removed offsite, stockpiled, and an equivalent volume of replacement material will be used during feature construction.

L-31E Freshwater Wetland:

Construction of the L-31E Freshwater Wetland pump stations (S-710, S-711), seepage management canal (C-711W), and distribution canal (C-711E) will require the removal or incorporation of approximately 13,000 cubic yards of material containing residual agricultural chemicals. Removal of arsenic impacted soils coincident with areas requiring clearing and grubbing within the freshwater wetland rehydration area will require the removal of an additional 202,000 cubic yards of impacted soils that are likely to be impacted for the most part by arsenic. The cost of removing this material, stockpiling it off of project lands, and replacing it is estimated to be $6,320,000. If impacted soils can remain onsite, the 13,000 cubic yards of impacted soil from the pump stations, seepage management canal, and distribution canal will be incorporated into the project features after blending with clean fill at a ratio of 2 parts clean to 1 part impacted soil. Most of the 200,000 cubic yards of impacted soils from within the freshwater wetland rehydration area is not expected to require blending or some other corrective action by the regulator because the residual agricultural chemical concentrations are likely to pose a limited risk to the ecosystem. The arsenic concentrations in this material will pose a limited risk to human health given the inaccessibility of these soils once the wetland is rehydrated. The cost of blending, oversight, and testing associated with incorporating the impacted soil from the pump stations, swale, and distribution ditch into this project feature is $390,000. The cost savings for incorporating the soils into the project features is $5,930,000.

L-31E Pumps/Culvert:
The installation of the remaining seven L-31E Levee culverts is not expected to require any special soil handling since the first four culverts installed by the SFWMD required no soil management plan to address residual agricultural chemicals. These culverts are being constructed in the L-31E Levee right-of-way where there is no known history of agricultural activity and thus no reason to suspect that agrichemicals are present in the soil.

The construction of the S-703, S-705, and S-709 pump stations require significantly larger footprints than the culverts so they are likely to include some areas outside of the canal right-of-ways where residual agricultural chemicals may be present. Construction of the L-31E Pumps will require the removal or incorporation of approximately 9,000 cubic yards of material containing residual agricultural chemicals. The cost of removing this material, stockpiling it off of project lands, and replacing it is estimated to be $490,000. Incorporating this material into the project features is likely to require that these impacted soils are blended with clean fill at a ratio of 2 parts clean to 1 part impacted soil. The blending may be accomplished by placing alternative lifts of clean and impacted material and running a road grader or disk plow over the material prior to final compaction. The cost of blending, oversight, and testing associated with incorporating the impacted soil into this project feature is $280,000. The cost savings for incorporating the impacted soils into this project feature is $210,000.

Based on the assumptions presented here for these two features, it is cost-effective to incorporate the impacted soils into the L-31 East Flow-Way component since this will save taxpayers an estimated $6,140,000. (Note that the costs presented here are planning level costs. Refined estimates of blending costs will be developed during project design.)

Cost Comparison for the USACE Acting as the Construction Agency and Performing the non-RCRA Response Action for the NFS:

This analysis requires comparison of a "Two Construction Agency Scenario" versus a "Single Construction Agency Scenario". The overarching assumption for the Two Construction Agency Strategy is that the USACE does not handle impacted soils and that the SFWMD will perform all construction activities associated with handling impacted soils or blended soils. The USACE would perform only earthwork activities such as excavating limerock from pump station foundations and canal alignments after the SFWMD moves impacted topsoils. Construction of berms or levees would have to be done by the SFWMD since this would involve blending and placing impacted soils. The USACE could construct the pump stations and culverts under the Two Construction Agency Scenario as long as the work was properly sequenced. The "Single Construction Agency Scenario" would have the USACE contract for and manage all of the construction activities.

L-31E Freshwater Wetlands:

Two Construction Agency Scenario: The construction of the L-31E Freshwater Wetlands feature will require the excavation and handling of approximately 13,000 cubic yards of impacted soils located at the S-710, S-711 pump stations, the C-711E distribution canal and C-711W seepage canal. Under the assumption that the USACE does not handle impacted soils, the SFWMD would have to excavate the impacted topsoils from these feature footprints. The USACE would then excavate the underlying limerock to the design template and stockpile the limerock for blending with impacted soil by the SFWMD. The SFWMD would blend the stockpiled limerock with the impacted soil and place the blended material in the adjacent levee cross-section. Carefully planned, this two contractor process might be sequenced during the construction of the seepage canal and the distribution canal such that scenario imposed double handling of material would be minimized. The two construction agency scenario would add at least $450,000 to the E&D and S&A costs associated with constructing the pump stations and canals. These additional costs arise because the two construction agency scenario would require one additional contract acquisition action, potentially one additional survey, potentially one additional set of plans and specifications, and additional construction quality assurance expenses. Additional costs associated with delays, scenario imposed confusion regarding quantity payment tracking, and increased potential for change orders are not included in this cost-effective analysis. These other potential additional costs are difficult to quantify with certainty given that the design of this feature is less than 30% complete.

Single Construction Agency Scenario: The cost employing this strategy to construct the Cutler Spreader Canal feature is identical to the MCASES cost estimate since this approach uses the same assumptions (no special handling of soils is required). The SFWMD would have to provide the USACE funding in advance of construction to cover the non-project costs of blending impacted soils for incorporation into the features.

L-31E Pumps/Culverts:

Two Construction Agency Scenario: The construction of the L-31E culverts is not anticipated to involve impacted soils; however the construction of the S703, S-705, and S709 pump stations may require the excavation and handling of approximately 9,000 cubic yards of impacted soils. Under the scenario where the USACE avoids handling impacted soils or fill containing impacted soils, the SFWMD would be responsible for clearing impacted materials from the pump station footprints in advance of USACE construction. Final grading at the pump station project site would be done by the SFWMD if blended soils were used. The two construction agency scenario would add an estimated $540,000 to the E&D and S&A costs associated with constructing these three pump stations. These additional costs arise because the two construction agency scenario would require one additional contract acquisition action, one additional survey, one additional set of plans and specifications, and additional construction quality assurance expenses. Additional costs associated with delays, scenario imposed double handling of materials, additional clean fill potentially brought on-site to limit USACE contact with impacted soils, and increased potential for change orders are not included in this cost-effective analysis because they are difficult to quantify with certainty given that the design of these features is less than 30% complete.

Single Construction Agency Scenario: The cost of this strategy is identical to the MCASES cost estimate since this approach uses the same assumptions (no special handling of soils is required). The SFWMD would have to provide the USACE funding in advance of construction to cover the non-project costs of blending impacted soils for incorporation into the features.

Based on the costs presented here, having the USACE conduct the non-RCRA response action during construction of the L-31E Flow-Way features is cost-effective since it would save taxpayers a minimum of $990,000. Having a single construction agency manage the majority of the integrated non-RCRA response actions and construction activity provides a higher quality product and also has the advantage of minimizing risk associated with potential release of agrichemicals and the attendant liability this would entail.

Engineering and Other Risks

Engineering Risk: Engineering risks will be addressed through the development, FDEP approval, and implementation of the soil management plans for L-31 East Flow-Way features. The risk of constructing the L-31 East Flow-Way features feature is somewhat higher than that presented for other BBCW project components because more of the project land in the L-31E region has not been acquired and properly surveyed for environmental conditions. However, given similar land use patterns in the L-31 East Flow-Way as compared to the Deering Estate or Cutler Wetland components, the USACE and SFWMD expect that soil management plans developed for features in this component will be similar to those approved by FDEP at Deering and Cutler.

Ecological and Human Health Risk: Similar to the plans developed for construction at Deering and Cutler, the soil management plans for the L-31 East Flow-Way component features are likely to require blending the impacted soils with clean fill to ensure that concentrations of arsenic, copper, and DDE (and other organo-chlorine pesticides) are below human health and ecological threshold concentrations as well as leachate groundwater quality protection criteria. During construction, verification testing will be done to confirm that the blended soils contain concentrations of residual agricultural chemicals that meet the targets established in the FDEP approved soil management plans. Construction specifications will include health and safety precautions appropriate for the soils handled on-site.

The incorporation of impacted soils into L-31 East Flow-Way features will be done in a manner similar to that done at Deering and proposed at Cutler. The risk associated with unintended releases of residual agricultural chemicals at this component is low and acceptable given the low concentrations of residual agricultural chemicals anticipated in the blended soils. In the unlikely event that a release occurred, corrective action to address it would be the responsibility of the SFWMD.

Final Risk Determination:

A government cost estimate will be prepared during the preparation of plans and specifications for each of the features to be constructed to estimate the additional costs associated with incorporating the soils with residual agrichemicals into the constructed features. The cost of removing the soils with residual agricultural chemicals from the feature footprint will also be estimated to verify that incorporation of the impacted soils is cost-effective for each feature. The USACE and SFWMD will prepare a final determination report to confirm risk of future release. The final determination report will be submitted to HQUSACE prior to construction. The Jacksonville District must receive a concurrence memorandum from HQUSACE prior to initiating construction. For each construction contract managed by the USACE, the SFWMD will be responsible for providing full funding to the USACE prior to contract advertisement for the identified cost of addressing residual agricultural chemicals.

SECTION 8

PLAN IMPLEMENTATION

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8.0 PLAN IMPLEMENTATION

8.1 DIVISION OF IMPLEMENTATION RESPONSIBILITIES

SFWMD and USACE Jacksonville District will be jointly responsible for the preparation of this PIR and ancillary studies. Support in the development of the PIR and ancillary studies will be provided by the FWS and other Federal, state, and local agencies. USACE Jacksonville District is responsible for assigning staff for developing the PIR, and for seeking to obtain Congressional authorization for the project.

The SFWMD is responsible for design and construction of the State's Expedited Construction program features associated with this project. USACE Jacksonville District is responsible for the design and construction of project features not covered under the State's Expedited Construction program portion of the effort.

The degree to which SFWMD will design and construct will vary significantly by project component for example, as currently envisioned, SFWMD will design and construct virtually all of the Deering Estates project components, while at L-31E SFWMD will only design and construct four flap gated culverts, which have been completed.

More specifically, as currently envisioned, for Deering Estates, SFWMD will design and construct the approximately 500' long extension of the C-100A Spur Canal, the 2.07 acre educational wetland, the 100 CFS (S-700) pump station, 538 linear feet of 60" diameter pipe, and the proposed spreader structure.

For the Cutler Flow way, as currently envisioned, SFWMD will design and construct the 400 CFS (S-701) pump station, the 1.3 mile long lined conveyance canal, box culverts under SW 97th Ave, SW 87th Ave, and L-31E, and 2.0 miles of spreader canal. The USACE will then be responsible for constructing the remaining portions of the spreader canal, all recreation features, and for plugging approximately 2500 linear feet of mosquito ditches.

As described previously, for the L-31E flow way, SFWMD has designed and installed four of the ten proposed flap gated culverts (S-23A, S-23B, S-23C, and S-23DS). Because of this, the USACE will be responsible of designing and constructing all of the remaining recommended features, including; the 50 CFS (S-703) pump station and outlet spreader, the 100 CFS (S-705) pump station, the 40 CFS (S-709) pump station, the 40 CFS (S-711) pump station, and spreader canal, the 40 CFS (S-710) pump station and spreader structure, the inverted siphon (S-707) at Military Canal, the remaining six flap gated culverts, and all recreation features.

The O&M associated with this project is the responsibility of the SFWMD.[1] Regional ecosystem monitoring would be performed as part of the CERP Adaptive Assessment and Management Program implemented by RECOVER.

8.1.1 Schedule

The Draft PIR was published in the Federal Register in March 2010. A public workshop on the Draft PIR was conducted during April 2010. The following bulleted list provides an overview of the important dates remaining for the Biscayne Bay Coastal Wetlands project.

- September 2011 Civil Works Review Board
- September 2011 Final Report Published in Federal Register
- January 2013 Congressional Authorization
- November 2013 Project Partnership Agreement Executed
- July 2014 Real Estate Acquisition Complete
- November 2014 November 2017: Construction

8.1.2 Pre-Construction Engineering and Design

Pre-Construction Engineering and Design (PED) of some of the project's features has been completed by the State's Expedited Construction program. The design of the rest of the features, which lack detailed survey and geotechnical investigations, will be completed by USACE after the PIR document has been approved. See Section 6.4.2 (Construction and Implementation of the Plan) for lists of plan features to be constructed by each agency.

8.1.3 Operational Testing and Monitoring Period

As defined in the CERP Master Agreement, the term "Operational Testing and Monitoring Period" (OTMP) shall mean a reasonable, limited period of time within the period of construction, after physical construction has been completed, during which the authorized CERP Project or a functional portion of the authorized CERP Project is operated, tested and monitored to verify that the constructed features perform as designed, and to allow for any adjustments to such features as may be necessary so that such features perform as designed.

The CERP Master Agreement requires, when applicable, four criteria to be met to consider the Project, or a functional portion of the Project, operational and therefore ready to be turned over to the Non-Federal Sponsor for operation, maintenance, repair, replacement, and rehabilitation (OMRR&R). The OTMP is one of the four criteria.

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[1] PUBLIC LAW 106-53, "Water Resources Development Act of 1996", § 528(d)(3), 12 OCT 1996, 110 STAT. 3658

In accordance with the CERP Master Agreement, the following criteria will be used to determine when a project is "operational":

1. that construction of the authorized CERP Project or a functional portion of the authorized CERP Project is physically complete;
2. that the authorized CERP Project or a functional portion of the authorized CERP Project has completed an Operational Testing and Monitoring Period, where applicable;
3. that the features of the authorized CERP Project or functional portion of the authorized CERP Project:

   i. meet applicable design and construction standards; and
   ii. as supported by the results of an applicable Operational Testing and Monitoring Period, operate as designed and in accordance with applicable permit conditions and applicable operating manuals; and

4. that the Parties have completed and approved in writing the applicable System Operating Manual, Project Operating Manual, and MRR&R Manuals, final as–built drawings have been provided, Written Notices of Acceptance of Completed Work have been finalized and provided to the Non-Federal Sponsor, unless the Parties otherwise agree in writing that the Non-Federal Sponsor shall initiate OMRR&R based on interim manuals approved by the Parties.

Prior to initiating the OTMP, each major operational component will undergo a short period of testing and commissioning. During this period, functional performance tests will be conducted on all pumps, reduction gears, diesel engines, control systems and ancillary equipment. Tests will replicate all modes of operation and will verify all other relevant contract requirements. Following the testing and commissioning, operational testing and monitoring will be conducted for one full wet season (i.e. June 1st to November 30th). If the OTMP begins after the start of a wet season, the OTMP should be extended as needed to encompass a full wet season. Beginning the OTMP prior to the start of a wet season, if needed, will allow continuity between the construction contractor and the identification of any necessary services identified by the Federal Government and Non-Federal Sponsor. Contractor services to be provided during the OTMP will include, but will not be limited to, the following: answering questions on equipment operation; contacting the appropriate vendor/manufacture for response or site visits; arranging and officiating supplemental owner training sessions; assisting in resolution of functionality issues. The operational testing and monitoring period activities of the construction contractor will be separate from and supplemental to the warranty requirements of the contract. The USACE and SFWMD will share in the responsibilities for conducting water management operations during the Operational Testing and Monitoring Period.

During the OTMP the Federal Government and the Non-Federal Sponsor will work together closely to identify any features which are not operating as designed. Any features which are not operating as designed will be identified in writing to the District Engineer and the Non-Federal Sponsor. At the conclusion of the OTMP, the District Engineer and the Non-Federal Sponsor will make a determination as to whether the Project is "operational" as defined in the CERP Master Agreement. After this determination, the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the Project.

8.1.4 Implementation of Project Operations

A Project Operating Manual (POM) has been prepared and is included in ***ANNEX D*** of this PIR. As described in Section 5 of the July 2007 Revised Final Draft Programmatic Regulations, Development of the POM will involve an iterative process that will continue throughout the life of the Project. The Draft POM will include operating criteria based on the initial operating regime (IOR) and will generally discuss the transitions to operations during, construction, the Operational Testing and Monitoring Phase, and the Long-term Operations and Maintenance Phase. Refinements to the operating criteria will be made as more design details, data, operational experience and information is gained during these phases. A Preliminary POM will be prepared and approved for the Operational Testing and Monitoring Phase. This will be followed by a Final POM that will be prepared and approved for the Long-term Operations and Maintenance phase. After the Final POM is completed and the Long-term Operations and Maintenance Phase is underway, the Final POM and the system operating manual (SOM) will continue to be revised based on additional scientific information, new CERP or non-CERP activities being implemented, and new CERP updates. The USACE and SFWMD will share in the responsibilities for conducting water management operations during the Operational Testing and Monitoring Period.

8.1.5 Flood Plain Management and Flood Insurance Programs Compliance

The Non-Federal Sponsor agrees to participate in and comply with applicable Federal floodplain management and flood insurance programs consistent with its statutory authority.

Not less than once each year the Non-Federal Sponsor shall inform affected interest of the extent of protection afforded by the authorized CERP Project.

The Non-Federal Sponsor shall publicize flood plain information in the area concerned and shall provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the authorized CERP Project.

The Non-Federal Sponsor shall comply with Section 402 of WRDA 1986, as amended (33 U.S. C. 701b-12), which requires a non-Federal interest to have prepared, within one year after the date of signing a Project Partnership Agreement for the authorized CERP Project, a floodplain management plan. The plan shall be designed to reduce the impacts of future flood events in the Project area, including but not limited to, addressing those measures to be undertaken by non-Federal interests to preserve the level of flood protection provided by the authorized CERP Project. As required by Section 402, as amended, the non-Federal interest shall implement such plan not later than one year after completion of construction of the authorized CERP Project. The Non-Federal Sponsor shall provide an information copy of the plan to the Government upon it preparation.

The Non-Federal Sponsor shall prescribe and enforce regulation to prevent obstruction of or encroachment on the authorized CERP Project or on the lands, easements, and rights-of-way determined by the Government to be required for the construction, operation, maintenance, repair, replacement, and rehabilitation of the authorized CERP Project, that could reduce the level of protection the authorized CERP Project affords, hinder operation or maintenance of the authorized CERP Project, or interfere with the authorized CERP Project's proper function.

8.2 COST SHARING

Responsibilities for implementing the Selected Plan would be shared by USACE and the SFWMD. USACE and SFWMD would cost share equally in the design, construction and O&M of the plan. The SFWMD would acquire the necessary LERRs. The costs to remediate HTRW contaminated lands, if any, would be the responsibility of SFWMD in accordance with the cost sharing agreement and USACE regulations. Construction contracts to build the project features would be managed by either USACE or SFWMD to maintain as close to a 50/50 cost share as possible to help meet the overall CERP program goal of a 50/50 Federal/non-Federal cost share. Costs associated with HTRW will be borne 100 percent by the SFWMD. For more detail, see Section 7.9.3.

Rules which determine how project responsibilities are shared are established in Federal law and the administration's implementing policies. Section 601 of the Water Resources Development Act (WRDA) 2000 provides an opportunity for in-kind cost sharing credit to the non-Federal sponsor for design, construction and O&M, and for treatment of credit between projects to maintain a 50/50 cost share. The PIR recommends crediting the non-Federal sponsor for work completed under the State's Expedited Construction program in advance of approval and authorization of the Federal project. ***Table 8-1*** includes an apportionment of the costs of the Selected Plan.

Section 601(e)(5)(B) of the WRDA 2000 authorizes the Secretary of the Army to provide credit to the Non-Federal sponsor for work completed by it during the period of construction pursuant to a Project Partnership Agreement (PPA) and a determination by the Secretary that the work is integral to the CERP. As part of its initiative for early implementation of certain CERP projects, the Non-Federal sponsor has stated that it will construct the Biscayne Bay Coastal Wetlands Project consistent with this report, in advance of Congressional authorization and the signing of a PPA. Under the authority of Section 6004 of WRDA 2007, the Non-Federal sponsor, on August 13, 2009, executed the required pre-partnership credit agreement (PPCA) to preserve its opportunity for credit for in-kind work completed in advance of execution of a PPA. The Non-Federal sponsor is exploring alternative project delivery methods to expedite implementation of the Project through the State expedited program. Such delivery methods may include public-private partnerships in which the Non-Federal sponsor contracts with a private or not-for-profit entity for services that may include designing, building, operating or financing these components.

TABLE 8-1: COST APPORTIONMENT OF THE SELECTED PLAN
(FY 11 Price Levels)

Item	Federal Cost	Non-Federal Cost	Total
Ecosystem Restoration (ER)			
PED[1]	$ 27,690,000	$ 5,260,000	$ 32,950,000
Construction Management	$ 8,106,000	$ 8,106,000	$ 16,212,000
LER&R		$ 80,985,000	$ 80,985,000
Ecosystem Restoration Construction Cost[2]	$ 58,555,000		$ 58,555,000
ER Subtotal			
Recreation (Rec)	$ 1,158,000	$ 1,158,000	$ 2,316,000
Total Project Cost	$ 95,509,000	$ 95,509,000	$ 191,018,000
Total Project Level Monitoring Costs	$ 958,500	$ 958,500	$ 1,917,000
Annual OMRR&R	$ 936,500	$ 961,500	$ 1,898,000
OMRR&R (vegetation management)[3]	$ 96,500	$ 96,500	$ 193,000
OMRR&R (non-recreation)	$ 840,000	$ 840,000	$ 1,680,000
OMRR&R (recreation)		$ 25,000	$ 25,000

[1]PED estimates for non-recreation components are derived directly from the MCACES. PED includes development of the PIR and sunk costs of $22,995,000.

[2]The ecosystem restoration construction cost and PED cost are not detailed as being shared equally due to the non-Federal Sponsor's land costs. The Federal shares were changed to bring the total project cost to a 50/50 share basis.

[3]OMRR&R for vegetation management annual costs are greater during the first 5 years ($218,000). After the first 5 years of OMRR&R for vegetation management the costs of continued vegetation management decreases ($190,000).

8.2.1 Construction and Land Costs for Restoration Features

Section 601 of the WRDA of 2000 and USACE policy requires that the non-Federal sponsor will provide LERR.

The total first cost of the restoration features of the project, including the value of LERR and pre-construction engineering and design costs will be shared equally between the Federal Government and the non-Federal sponsor. The non-Federal sponsor will provide cash or manage a portion of construction as necessary to meet its 50 percent share of the total first cost of the project to be balanced according to Section 601 of WRDA 2000.

The total first cost of the recreation features of the Project, including the value of LERR and pre-construction engineering and design costs will be shared equally between the Federal government and the Non-Federal Sponsor under the CERP program as a whole. The Non-Federal Sponsor will provide cash or manage a portion of construction as necessary to meet its 50 percent share of the total first cost. The Non-Federal Sponsor will be responsible for 100 percent of the OMRR&R costs of the recreation features. The total recreation costs increase the total project costs by less than 10 percent. A detailed description of the recreation features of the Project is included in ***Appendix H***.

As currently envisioned, detailed design of the ecosystem restoration features will be accomplished by SFWMD with coordination and review by USACE under the state expedited construction program. All project features will be designed in accordance with USACE regulations and standards. Construction activities for the State Expedited Construction project will be in accordance with the State Expedited Construction program and will be the responsibility of SFWMD. Crediting for work performed by SFWMD will be subject to project authorization and adherence to USACE design standards and regulations.

8.2.2 Monitoring

A project monitoring plan, including hydrometeorological (Part 1), water quality (Part 2), and ecological monitoring (Part 3), as well as adaptive management (Part 4), have been prepared and are included as ***Annex E*** of this PIR. Cost sharing of the construction and O&M phases of the project for all four elements of the project monitoring plan will be in accordance with Section 601(e) of WRDA 2000 and USACE policy for cost-sharing and operational monitoring. Regional data collected as part of the monitoring program are critical to the refinement of the features and operation of the selected alternative plan because they provide the basis for any needed modifications to design and operational criteria.

8.2.3 Operations and Maintenance

For most typical USACE Civil Works projects, after project implementation is complete, the Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) phase begins. The term "OMRR&R" is sometimes shortened to "O&M", Operations and Maintenance, and generally includes all operation activities and maintenance needed to keep the project features functioning as intended.

Section 601(e)(4) of the WRDA 2000 specifies that the O&M of authorized projects of the CERP would be cost shared equally by the Federal Government and the non-Federal sponsor. Consistent with the provisions of Section 601(e)(4) of the WRDA of 2000 and given the multi-objective nature of the features in this plan, it is appropriate for the OMRR&R associated with this plan to be shared equally between the Federal Government and the non-Federal sponsor. Except as described in the following sentence, the Federal and non-Federal Sponsor's obligations to provide OMRR&R will continue indefinitely unless the project is deauthorized by Congress. OMRR&R costs associated with recreation features of the plan will be funded 100 percent by the non-Federal sponsor.

Activities included in the OMRR&R costs are:

- Pump and facility maintenance which are per manufacturer's recommendations and schedules.
- Erosion control to make sure banks and areas around culverts and other structures are not compromised by weather, plant or animal forces.
- Mowing to maintain grass areas for a neat and clean appearance and also to make sure there are no other maintenance issues being hidden by high grass vegetation. Mowing also reduces the ability of woody plants to gain a foothold and lead to larger issues.
- All monitoring, required by permit, USFWS Incidental Take Statement, and/or needed to adaptively manage the Project.
- Invasive, exotic, native, and nuisance vegetation control. Vegetation control is done both to control underwater infestations and surface infestations. Invasive plants can prevent correct project function and can damage vital structural components if allowed to grow unchecked.
- Adaptive Management (AM) measures needed to ensure project benefits or avoid violating one or more project constraints.

8.2.4 Non-Federal Sponsor Work-In-Kind

The Non-Federal Sponsor may be provided in-kind credit for project related work as described in Section 601(e)(5)(B) of the Water Resources Development Act of 2000, as amended by Section 6004 of the Water Resources Development Act of 2007. The Secretary may provide credit, including in-kind credit, toward the non-Federal share for the reasonable cost of any work performed in connection with the study, pre-construction engineering and design, or construction that is necessary for the implementation of the Plan if:

a. the work is defined in an agreement between the Secretary and the Non-Federal Sponsor providing for such credit;
b. the agreement must prescribe the terms and conditions of the credit;
c. the project must ultimately be authorized by Congress as a Federal project; and
d. the Secretary must determine that the work performed by the Non-Federal Sponsor is integral to the Project.

Such credit would be applied toward the Non Federal sponsor's share of the costs associated with the implementation of the CERP as authorized by Section 601(e)(5)(C) of WRDA 2000, shall not include cash reimbursements, and shall be subject to: a) the authorization of the Biscayne Bay Coastal Wetlands Project by law; b) a determination by the Secretary of the Army that the construction work completed under the PPCA is integral to the authorized CERP restoration project; c) a certification by the District Engineer that the costs are reasonable, allowable, necessary, auditable, and allocable; and d) a certification by the District Engineer that the activities have been implemented in accordance with USACE design and construction standards and applicable Federal and State laws. Also, per Section 601(e)(5)(E) of the Water Resources Development Act of 2000, in-kind credit is subject to audit by the Secretary.

8.3 PROJECT ASSURANCES

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. The Federal Government and the Non-Federal Sponsor are committed to the protection of the appropriate quantity, quality, timing, and distribution of water to ensure the restoration, preservation, and protection of the natural system as defined in section 601 of WRDA 2000, for so long as the Project remains authorized. This quantity, quality, timing, and distribution of water shall meet applicable water quality standards and be consistent with the natural system restoration goals and purposes of CERP, as the Plan is defined in the Programmatic Regulations. The Non-Federal Sponsor will protect the water for the natural system by taking the following actions to achieve the overarching natural system objectives of the Plan:

1. Ensure, through appropriate and legally enforceable means under Florida law, that the quantity, quality, timing, and distribution of existing water that the Federal Government and the Non-Federal Sponsor have determined in this Project Implementation Report is available to the natural system, will be available at the time the Project Partnership Agreement for the Project is executed and will remain available for so long as the Project remains authorized.

2a. Prior to the execution of the Project Partnership Agreement, reserve or allocate for the natural system the necessary amount of water that will be made available by the Project that the Federal Government and the Non-Federal Sponsor have determined in this Project Implementation Report.

2b. After the Project Partnership Agreement is signed and the Project becomes operational, make such revisions under Florida law to this reservation or allocation of water that the Federal Government and the Non-Federal Sponsor determines, as a result of changed circumstances or new information, is necessary for the natural system.

3. For so long as the Project remains authorized, notify and consult with the Secretary of the Army should any revision in the reservation of water or other legally enforceable means of protecting water be proposed by the Non-Federal Sponsor, so that the Federal Government can assure itself that the changed reservation or legally enforceable means of protecting water conform with the Non-Federal Sponsor's commitments under paragraphs 1 and 2. Any change to a reservation or allocation of water made available by the Project shall require an amendment to the Project Partnership Agreement.

Federal laws and regulations implementing the CERP require PIRs to address certain assurances as part of the project recommendation for approval and subsequent implementation. This section addresses provisions of Section 601(h) of WRDA 2000 and the Programmatic Regulations for the CERP (33 CFR Part 385) for Savings Clause requirements and Project-Specific Assurances.

The following sections describe the specific requirements from WRDA 2000 and the CERP Programmatic Regulations and present the methods and results of the analyses necessary to meet those requirements.

8.3.1 Savings Clause-Effects on Water Supply for Existing Legal Sources and Level of Service for Flood Protection

The Savings Clause analysis was required by WRDA 2000 as a means to protect users of legal sources of water supply and flood protection that were in place at the time of enactment. Briefly, Section 601(h)(5) of WRDA 2000, entitled "Savings Clause", requires an analysis of each project's effects on legal sources of water supply that were in existence on the date of enactment of WRDA 2000 (December 2000), and its effects on levels of service for flood protection in existence on the date of enactment of WRDA 2000.

Section 385.36 of the Programmatic Regulations requires that PIRs determine if existing legal sources of water are to be eliminated or transferred as a result of project implementation. If a project is expected to result in an elimination or transfer of an existing legal source of water, the PIR shall include an implementation plan that ensures a new source of water of comparable quantity and quality is available to replace the source that is being transferred or eliminated.

Section 385.37 of the Programmatic Regulations requires that PIRs include an analysis of the project's impacts on levels of service for flood protection that existed on the date of enactment of WRDA 2000, December 2000, and in accordance with applicable law. These conditions would be included in the pre-CERP baseline (***Section C.1.2.1***).

This project results in no elimination or transfer of water from existing legal sources because canal flows and levels upstream of the coastal control structures are not be affected by the project.

Each of the four geographically separate project components was analyzed individually, for potentially significant and adverse impacts to flood protection as described in ***Annex C***. The project is designed so that there would not be any significant or adverse affects to the pre-CERP level of service for flood protection of adjacent properties.

8.3.2 Identification of Water Made Available for the Natural System and Water for Other Water-Related Needs

Subsection 601(h)(4) of WRDA 2000, entitled "Project-Specific Assurances," contains requirements for PIRs and requires the identification of the appropriate quantity, timing, and distribution of water dedicated and managed for the natural system. The WRDA contains additional requirements to identify the amount of water to be reserved or allocated for the natural system necessary to implement under state law.

Section 385.35(b) of the Programmatic Regulations requires that each PIR identify the quantity, timing and distribution of water to be dedicated and managed for the natural system necessary to meet the restoration goals of the CERP. This evaluation considers the availability of the pre-CERP baseline water and previously reserved water, and whether improvements in water quality are necessary. The existing conditions for this project do not include any previously reserved water within the project area.

Section 385.35(b) of the Programmatic Regulations requires that procedures be developed for identifying water generated by the CERP for use in the human environment and that the quantity, timing and distribution of water for other water-related needs be identified in PIRs.

Water made available by the Biscayne Bay Coastal Wetlands project's Selected Plan, Alternative O Phase 1, was identified by calculating the quantity of water diverted by all the project features (i.e., water diverted from canals) on a daily basis. In general, the features in Alternative O Phase 1 use just a portion of the total amount available on any given day. This is especially true in the wet season when runoff is greatest. The project features are not designed to capture all water available, because it would be impractical to install pumps large enough to capture all peak flows. ***Figure C-14***, in ***Annex C***, provides an estimate of the quantity of water the project would divert to the natural system. No water is made available for other water-related needs by this project.

The water made available by Alternative O Phase 1 for the combined C-100, C-1, C-102 and C-103 basins (as indicated in total water diverted) ranges from 113,619 acre-feet per year (10th percentile) to 282,982 acre-feet per year (90th percentile). The State of Florida would use its water reservation or allocation authority to protect the water made available by the project for the natural system as required by Section 601 of WRDA 2000. The state has elected to protect the existing water in the natural system that the PIR identifies as necessary to achieve the benefits of the project, using resource protection authority under Florida law. If the difference between the quantity indicated as total water diverted and total available canal flow is required to protect the natural system, it would be reserved or allocated through a state process pursuant to §373.223 Florida Statutes. The SFWMD would protect water for Biscayne Bay based on the best available science to support the identification of water for the natural system at the time such protection is undertaken. The SFWMD is engaged in an ongoing effort to collect and analyze the best available science, which will be the basis for defining flows to the natural system in Biscayne Bay.

8.3.3 State and Federal Assurances

The overarching objective of the CERP (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. The federal government and the State of Florida are committed to the protection of the appropriate quantity, quality, and timing, and distribution of water to achieve and maintain the benefits to the natural system described in the Plan. As envisioned in WRDA 2000 and the Programmatic Regulation, each PIR will identify this appropriate quantity, quality, timing, and distribution of water for the natural system.

The following language sets forth these commitments:

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. The federal government and the Non-Federal Sponsor are committed to the protection of the appropriate quantity, quality, timing, and distribution of water to ensure the restoration, preservation, and protection of the natural system as defined in WRDA 2000, for so long as the Project remains authorized. This quantity, quality, timing, and distribution of water shall meet applicable water quality standards and be consistent with the natural system restoration goals and purposes of CERP, as the Plan is defined in the programmatic regulations. The

Non-Federal Sponsor will protect the water for the natural system by taking the following actions to achieve the overarching natural system objectives of the Plan:

The Non-Federal Sponsor shall execute under State law the reservation or allocation of water for the natural system as identified in the PIR for this authorized CERP Project as required by Sections 601(h)(4)(B)(ii) of WRDA 2000 and the Non-Federal Sponsor has provided information to the Government regarding such execution. In compliance with 33 CFR 385, the District Engineer has verified such reservation or allocation in writing. Any change to such reservation or allocation of water shall require an amendment to the PPA after the District Engineer verifies in writing in compliance with 33 CFR 385 that the revised reservation or allocation continues to provide for an appropriate quantity, timing, and distribution of water dedicated and managed for the natural system after considering any changed circumstances or new information since completion of the PIR for the authorized CERP Project.

8.4 PROJECT MONITORING PLAN

The Selected Plan includes water quality, hydrologic and ecological monitoring activities to ensure that the intended purposes of the project would be achieved through long-term operations.

Water quality and hydrologic monitoring activities are described in detail in ***Annex E*** (Project Monitoring Plan). Water quality monitoring involves sample collection and analysis for baseline, startup, and operational phases of the project. Water quality parameters to be monitored include physical parameters (e.g., temperature, salinity and dissolved oxygen concentration), turbidity, nutrients, and organochlorine compounds. Hydrologic monitoring includes measurements of stage and elevation (groundwater) and flow at water control structures.

A project-specific ecological monitoring plan was prepared, focusing on estuarine performance measures that include oysters, submerged aquatic vegetation (SAV), estuarine fishes, juvenile crocodiles, nearshore salinity, wetland vegetation and wetland algae.

Implementation guidance for monitoring ecosystem restoration contained in Section 2039 of the Water Resources Development Act of 2007 was issued by the Chief of Planning and Policy Division on 31 August 2009. The revised guidance states:

SEC. 2039. MONITORING ECOSYSTEM RESTORATION.

(a) IN GENERAL.--In conducting a feasibility study for a project (or a component of a project) for ecosystem restoration, the Secretary shall ensure that the recommended project includes, as an integral part of the project, a plan for monitoring the success of the ecosystem restoration.

(b) MONITORING PLAN. --The monitoring plan shall--

(1) include a description of the monitoring activities to be carried out, the criteria for ecosystem restoration success, and the estimated cost and duration of the monitoring; and

(2) specify that the monitoring shall continue until such time as the Secretary determines that the criteria for ecosystem restoration success will be met.

(c) COST SHARE.--For a period of 10 years from completion of construction of a project (or a component of a project) for ecosystem restoration, the Secretary shall consider the cost of carrying out the monitoring as a project cost. If the monitoring plan under subsection (b) requires monitoring beyond the 10-year period, the cost of monitoring shall be a non-Federal responsibility.

On 27 May 2010 CERP-specific guidance was issued and signed by the Director of Civil Works. In summary, the guidance states that ecosystem restoration project monitoring will be initiated upon the completion of project construction until ecological success is determined. Project funds used for monitoring after the period of construction shall be considered OMRR&R costs (Section 601 (e)(4) of WRDA 2000). Pursuant to the statutory limitation in Section 2039(c) of WRDA 2007, if the project monitoring plan requires monitoring beyond a 10-year period after completion of construction, the cost of monitoring shall be a non-Federal responsibility. As a result of this guidance, the duration of project-level ecological monitoring has been extended from five to ten years and the associated monitoring costs have increased incrementally to accommodate the longer monitoring period. Specific details, including monitoring parameters, duration and costs of ecological monitoring plan are contained in Annex E.

8.5 SUBSEQUENT PROJECT IMPLEMENTATION REPORT

The remaining features of Alternative O, other than those included in Alternative O Phase 1, will be studied in a future PIR.

8.6 COMPLIANCE WITH ENVIRONMENTAL LAWS, STATUTES AND EXECUTIVE ORDERS

For complete information on all coordination, please see ***Section 9***, ***Summary of Coordination, Public Views and Comments*** in this PIR.

TABLE 8-2: ENVIRONMENTAL COMPLIANCE AND COORDINATION

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
Clean Air Act of 1972	PC	Project Implementation Report (PIR)/ Environmental Impact Statement (EIS) will be coordinated with public agencies. Air emissions permit may be required for large diesel pumps; normally applied for during Pre-Construction Engineering and Design (PED) phase.	Notice of Intent (NOI) 3/7/03; subsequent project workshops.	Compliance with Section 309 of Clean Air Act will occur with the coordination and review of the PIR/EIS by Environmental Protection Agency (EPA).
Clean Water Act of 1972	PC	A 404 (b) (1) evaluation has been prepared and is contained in Section B.2 of the Final; Water Quality Certification (WQC) will be required; (State permit); National Pollutant Discharge Elimination System (NPDES) permit will be required (State delegation); water quality is expected to improve with project.	Informal coordination with Florida Department of Environmenta l Protection (FDEP) through participation in Project Delivery Team (PDT) meetings.	Full compliance upon issuance of the WQC and NPDES permits by the state.
National Environmental Policy Act of 1969	PC	NOI published; scoping and stakeholder meetings held; no new issues have	Central and Southern Florida (C&SF) Restudy 1999;	Full compliance upon coordination of the Final PIR/EIS, public

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
		been identified; Draft PIR/EIS for Biscayne Bay Coastal Wetlands will be prepared after the Recommended Plan.	NOI on 3/07/03; scoping letter sent on 3/01/03; with subsequent scoping meetings held on 10/29/02 and 10/28/03.	outreach activities completed and signing of the Record of Decision (ROD).
Fish and Wildlife Coordination Act of 1958	PC	Funds transferred annually to U.S. Fish and Wildlife Service (FWS); Planning Aid Letters (PALs) received; FWS and NMFS have been active team participants and have provided information on fish and wildlife elements on project. An ongoing consultation process between USACE, FWS, the FWC, and the NMFS has involved regular communication and exchange of input between the agencies through monthly interagency coordination meetings, public scoping meetings, and official correspondence.	Ongoing. The FWS has participated in PDT meetings and creation of draft National Environmental Policy Act (NEPA) document. PALs and Planning Aid Reports (PARs) received dated 03/25/02, 06/21/02, 12/24/02, 06/05/03, 10/23/03, 05/13/04, 06/21/04, 01/27/05, 06/09/05, 11/21/05, 01/20/06, and 09/26/06. Final FWCA report was received May 21, 2010.	With receipt of the final Fish and Wildlife Coordination Act (FWCA) report, this project is in full compliance with this Act.
Endangered Species Act of	PC	Initial letter sent to USFWS	Confirmation of T&E	Full compliance expected by final

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
1973		regarding Threatened and Endangered (T&E) species. A list of potentially affected Threatened and Endangered species has been confirmed by the FWS along with listed species under the purview of the NMFS. Coordination with both FWS and NMFS is ongoing.	species by letter dated, January 24, 2005.	PIR/EIS. Informal consultation with FWS, FWC and NMFS has resulted in agency concurrence with the Corps' "no affect", and "may affect not likely to adversely affect" species determinations the formal letter of concurrence from the FWS is contained in Annex of the FPIR/EIS.
Magnuson-Stevens Fishery Mgt Act	PC	Overall project is expected to benefit Essential Fish Habitat (EFH); National Oceanic and Atmospheric Administration (NOAA) will accept Draft EIS as the EFH assessment.	Informal coordination has been conducted with NOAA. Agency representative has attended PDT meetings.	The project is in full compliance with this Act per NMFS concurrence letter dated April 23, 2010.
Fishery Conservation and Management Act	PC	The project is being coordinated with National Marine Fisheries Service (NMFS).	Informal coordination with NOAA representative at PDT meetings.	Full compliance after review of the Final PIR/EIS by NMFS.
Coastal Zone Management Act of 1972	PC	Based on a review of the March 2003 scoping notice and comments provided by state reviewing agencies, the state has determined	March 2003	Additional consistency review by the state will occur during coordination of the Draft and Final PIR/EIS.

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
		that, at this stage, the project is consistent with the Florida Coastal Management Program.		Full compliance will occur with issuance of the WQC by the state.
Coastal Barrier Resources Act and Coastal Barrier Improvement Act	NA	There are no designated coastal barrier resources in the project area that will be affected by this project. These Acts do not apply.		
Marine Mammal Protection Act	PC	The West Indian Manatee does occur near some of the project sites. Incorporation of the safeguards used to protect T&E species during construction and operation will protect any marine mammals in the area. Coordination with the USFWS will continue as construction and operational guidelines are incorporated to avoid impacts to this species.	March 2003 and coordination through PDT meetings.	Full compliance after review of the Final PIR/EIS by NMFS.
Marine Protection, Research and Sanctuaries Act	NA	The term "dumping" as defined in the Act (3[33 U.S.C. 1402] (f)) does not apply to this project. Therefore the MPRSA does not apply.		

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
Estuary Protection Act of 1968	PC	It is anticipated that estuaries will be positively affected by this project.	March 2003 and coordination through PDT meetings.	Full compliance after review of the Final PIR/EIS by NMFS.
Anadromous Fish Conservation Act	PC	Anadromous fish species will not likely be adversely affected. The project is being coordinated with NMFS.	March 2003 and coordination through PDT meetings.	Full compliance after review of the Final PIR/EIS by NMFS.
Migratory Bird Treaty Act and Migratory Bird Conservation Act	PC	No migratory birds will likely be adversely affected by project activities. Opportunities exist to promote usage of additional foraging areas provided by the project.	Coordination through PDT meetings with FWS and FWC.	Full compliance after review of the Final PIR/EIS by FWS and FWC.
Wild and Scenic River Act of 1968	NA	No designated Wild and Scenic river reaches will be affected by project related activities.		
Federal Water Project Recreation Act	C	The principles of this Act (PL 89-72) have been fulfilled by complying with the recreation cost sharing criteria.		
Submerged Lands Act of 1953	PC	The project will eliminate point source freshwater discharges and provide freshwater overland flow that will ultimately benefit the ecological habitats that occur on		Full compliance by completion of the Final PIR/EIS.

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
		submerged lands of the State of Florida. No construction is expected on submerged lands; therefore, full compliance is anticipated.		
Rivers and Harbors Act of 1899	NA	The proposed work will not obstruct navigable waters of the United States.		
National Historic Preservation Act of 1966 and the Archaeology and Historic Preservation Act	C	Coordination with State Historic Preservation Officer (SHPO) has been completed. See SHPO letters: March 5, 2007 (DHR no. 2007-803), January 11, 2008 (DHR no. 2007-7384-B), July 16, 2008 (DHR no. 2009-3961)	Section 106 process is complete.	As a result of stated coordination, the project is in full compliance with this Act.
Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or Superfund Act)	PC	Local sponsor has completed most of the Phase I and Phase II site investigations. Known HTRW sites that presented an unacceptable risk to human health or environment have been remediated. Local sponsor will remediate any outstanding HTRW sites prior to lands	FDEP and USFWS coordination is ongoing	Local sponsor will complete Phase I and II audits prior to feature construction. Low level contamination in areas of probable public areas will be addressed prior to or during construction.

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
		certification. Low level soil contamination that presents an acceptable risk to humans and the ecosystem will remain on project lands if acceptable to Corps, FDEP and USFWS.		
Farmland Protection Policy Act of 1981	C	Coordination with the Natural Resources Conservation Service (NRCS) was initiated through a letter dated 30 April 2008 providing project information regarding farmland conversion. Submittal of Form AD-1006 was sent to NRCS for their evaluation and a determination of no impact to unique farmland was provided by the NRCS through a letter on 9 May 2008 (***Annex B – Section B.5.1***). In the response from NRCS, they concurred no "prime and unique" farmland will be taken out of production due to the project.	Concurrence letter dated 9 May 2008	As a result of stated coordination, the project is in full compliance with this Act.

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
Executive Order (E.O.) 11988 Floodplain Management	PC	(Floodplain Development). The areas for proposed restoration in the project area are virtually all considered floodplain. The purpose of the EO is to discourage Federally induced development in floodplains. Commitment of lands to project restoration will preclude such development.	Ongoing.	Full compliance expected after completion of the Final PIR/EIS.
E.O. 11990 Protection of Wetlands	PC	(Wetlands protection) The areas proposed for restoration are a combination of freshwater and coastal wetlands. A net functional "lift" is expected.	Ongoing habitat mapping and other analysis of wetlands.	The project is in full compliance with this Executive Order.
E.O. 12898 Environmental Justice	PC	The team is in compliance for this phase of the study, as no minority or economically disadvantaged population clusters have been identified in the immediate southern Miami-Dade County region where project features are proposed.	1999 Restudy	The project is in full compliance with this Executive Order.
E.O. 13089 Coral Reef Protection	PC	This project is expected to provide overall	March 2003 and coordination	Full compliance after review of the Final

Law, Regulation or Policy	Status *	Comments	Last Coordinated	Full Compliance Expected
		benefits to hard bottom communities and coral reef resources.	through PDT meetings.	PIR/EIS by NMFS.
E.O. 13112 Invasive Species	C	Project is expected to reduce the abundance and variety of invasive plant species in the project area.	Ongoing coordination with USFWS and Miami-Dade County Department of Environmenta l Resources Management (DERM).	The project is in full compliance with this Executive Order.
E.O. 13186 Migratory Birds	C	No migratory birds would be adversely affected by project activities.	This coordination has been on-going throughout the duration of the planning process.	This project is in compliance with this Executive Order.

C: Complies fully; PC: partial compliance due to plan development; NC: non-compliant; NA: not applicable.

8.7 COMPLIANCE WITH FLORIDA STATUTES

The State of Florida has enacted several laws pertaining to implementation of CERP projects. These include amendments to Section 373.026 (8), Florida Stature (F.S.), which establishes a requirement for the SFWMD to submit a report for review and approval by the FDEP prior to formal submission of a request for authorization from Congress and prior to receiving an appropriation of state funds for construction and other implementation activities (except the purchase of lands from willing sellers); the enactment of Section 373.1501 F.S., which establishes the intent of the Florida Legislature with respect to the CERP and the criteria for FDEP approval and the procedures to be followed by the SFWMD and FDEP for submitting and reviewing requests for approval; the enactment of Section 373.1502 F.S., which establishes permitting requirements and a process for the submittal, review, and issuance of certain regulatory permits for CERP projects; and the enactment of Section 373.470 and Section 373.472 F.S., establishing the "Save Our Everglades Trust Fund," funding and reporting requirements, and procedures for distributions from the trust fund.

The SFWMD's State Compliance Report addressing the criteria for approval listed in Section 373.1501 F.S. is included in ***Annex C–Analyses Required by WRDA 2000 and State Law***.

In addition to the above-described statutory requirements, other sections of Chapters 373 (Water Resources) and 403 (Environmental Control) of the Florida Statutes include requirements that may apply to various aspects of CERP project planning and implementation. In particular, Chapter 403 F.S. and the administrative laws adopted in accordance with Chapters 373 and 403 F.S., contain the requirements for facilities that involve the discharge or potential discharge of pollutants to surface and groundwaters, and the discharge of air pollutants, including facilities regulated under the Federal Clean Water and Safe Drinking Water Acts and the Federal Clean Air Act. Based on the information contained in the PIR, the Selected Plan complies with the applicable provisions of the Florida Statutes. A detailed explanation of how the project complies with the applicable requirements for CERP projects contained in the Florida Statutes can be found in ***Annex C–Analyses Required by WRDA 2000 and State Law.***

8.7.1 Permits, Entitlements and Certifications

Construction activities on the Biscayne Bay Coastal Wetlands project began in 2010 in accordance with the schedule for the State of Florida's advanced construction program. The SFWMD is responsible for obtaining permits issued by the Regulatory Division of USACE under the authority of Section 404 (discharge of dredged or fill material into waters) of the Clean Water Act and any corresponding permits required by the State of Florida in accordance with Chapters 373 and 403 of the Florida Statutes.

Section 402 of the National Pollutant Discharge Elimination System (NPDES) notes permits required under the Clean Water Act may be necessary for the construction (non-point source runoff) of project features. This program has been delegated by the Environmental Protection Agency (EPA) to the FDEP for implementation. It would be the responsibility of the SFWMD to obtain the NPDES permits for the construction of project features under the State of Florida's advanced construction program prior to Federal approval and authorization of the Biscayne Bay Coastal Wetlands project. At this time, a NPDES permit would not be required for the operation of Biscayne Bay Coastal Wetlands project features, as the project does not involve the discharge of pollutants.

Depending upon the schedule for obtaining Federal review and approval of the project, USACE would obtain the necessary permits to construct and perform initial operational testing and verification of the remaining project features that have not been constructed by the state's advanced construction program

(Deering Estate, C-1 Flow Way, and four L-31E Culverts). The cost and schedule for obtaining the necessary permits are included in the PMP.

8.7.2 Compliance with Applicable Water Quality Standards and Permitting Requirements

The Biscayne Bay Coastal Wetlands project Selected Plan complies with water quality standards applicable to the project and adjacent waters. The Selected Plan's features are located in and adjacent to waters designated as Class III. In accordance with Florida Administrative Code (F.A.C.) Rule 62-302 ("Surface Water Quality Standards"), the use classification of Class III waters is "Recreation, Propagation, and Maintenance of a Healthy, Well-Balanced Population of Fish and Wildlife." In addition to the minimum and general criteria for surface waters found in Section 62-302.500(1) F.A.C., there are numerous water quality criteria for specific parameters for Class III waters listed in Section 62-302.530, F.A.C.

Although the Selected Plan for the Biscayne Bay Coastal Wetlands project is not expected to affect most of the parameters listed in this rule, certain parameters (e.g., turbidity, dissolved oxygen and nutrients) listed in the criteria may be affected by construction and operations activities.

In general, any short-term impacts to water quality associated with construction of the Selected Plan would be ameliorated by construction sequencing, best management practices (BMPs) for erosion and sedimentation control and monitoring during construction. If potentially adverse effects are observed or predicted, longer-term impacts to water quality associated with the operation of project features would be addressed through operational monitoring and adaptive management actions. Upon completion of construction and initiation of operations, water quality and hydrology would be monitored to determine whether project design and operational objectives are being achieved.

8.7.3 Compliance with Public Outreach Requirements

The Biscayne Bay Coastal Wetlands project Selected Plan complies with public outreach requirements applicable to the project and project area as outlined in WRDA 2000 and CERP Programmatic Regulations below.

WRDA 2000; Section 601(k):

(2) COMMUNITY OUTREACH AND EDUCATION.—

(A) IN GENERAL.—The Secretary shall ensure that impacts on socially and economically disadvantaged individuals, including individuals with limited English proficiency, and communities are considered during

implementation of the Plan, and that such individuals have opportunities to review and comment on its implementation.

(B) PROVISION OF OPPORTUNITIES.—The Secretary shall ensure, to the maximum extent practicable, that public outreach and educational opportunities are provided, during implementation of the Plan, to the individuals of South Florida, including individuals with limited English proficiency, and in particular for socially and economically disadvantaged communities.

CERP Programmatic Regulations; § 385.18 Public outreach:

(c) Outreach to socially and economically disadvantaged individuals and communities.

(1) The Corps of Engineers and non-Federal sponsors shall develop and conduct public outreach activities to ensure that socially and economically disadvantaged individuals, including individuals with limited English proficiency, and communities are provided opportunities to review and comment during implementation of the Plan.

(2) The Corps of Engineers and non-Federal sponsors shall monitor the effectiveness of outreach activities conducted to ensure that socially and economically disadvantaged individuals and communities, including individuals with limited English proficiency, are provided opportunities to review and comment during implementation of the Plan.

(3) Project Management Plans and Program Management Plans shall include information, concerning any outreach activities to be undertaken during the implementation of the project or activity, to socially and economically disadvantaged individuals and communities, including individuals of limited English proficiency.

(4) The Corps of Engineers and non-Federal sponsors shall make project and program information available in languages other than English where a significant number of individuals in the area affected by the project or program activity are expected to have limited English proficiency.

(5) The Corps of Engineers and non-Federal sponsors shall provide translators or similar services at public meetings where a significant number of participants are expected to have limited English proficiency.

During the scoping phase of the BBCW project, the SFWMD Miami-Dade Service Center in consultation with USACE Outreach personnel determined there was not sufficient need to provide translator services and/or project materials in other languages, unless requested. This determination was based on local knowledge of the potentially affected area and communities located within the project area. However, SFWMD Miami-Dade Service Center personnel are frequently present at public meetings held in the city of Miami, and are fluent in Creole and Spanish to serve as translators should the need arise.

Spanish and Creole speaking team members from the non-Federal sponsor were in attendance at the initial Feasibility Scoping Meeting (October 28-30, 2002) for the project to address any requests for translations and assess the need for future meetings. There were no requests or need for the translator's services during this meeting. This experience, combined with an assessment of the Miami-Dade County 2000 Census Minority/Low Income Analysis (see ***Figure 8-1***) indicated there was no need to provide translator services, or project materials in other languages, for BBCW project meetings open to the public on a regular basis unless specifically requested by members of the public. Subsequent BBCW PDT meetings held in the South Florida area, and noticed to the public on evergladesplan.org, did not receive any requests for translators or materials being made available in other languages.

The BBCW Draft Project Implementation Report was noticed to the public on March 19, 2010 in the Federal Register. The public meeting for the document was advertised within the project area through newspapers, news outlets, e-mail notices and online at the evergladesplan.org website. The BBCW Public Meeting on the Draft Project Implementation Report was held on April 21, 2010 at the Deering Estate; Miami, Florida. This meeting was held to brief the local population on the project, the contents of the DPIR and to receive feedback on the document and project. The e-mail notice issued by USACE provides the public with the option of requesting special assistance, such as Spanish language translation, through request (see ***Figure 8-2***) if attending the meeting. There were no requests for special assistance prior to, or during the meeting.

Additional information on the project's compliance with public outreach requirements can be found in Appendix E, Agency and Public Coordination and Annex B, NEPA Information.

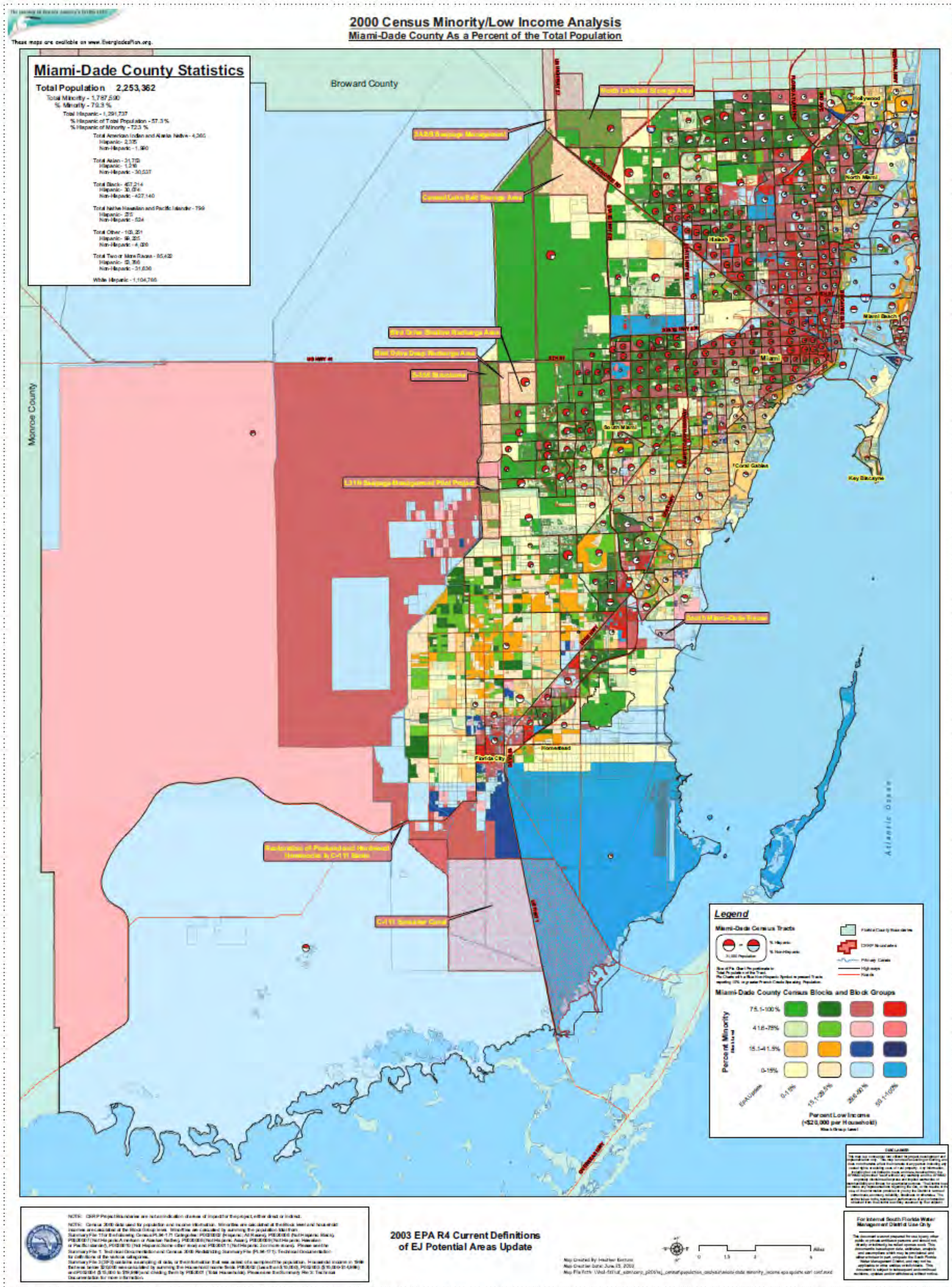

FIGURE 8-1: 2000 CENSUS MINORITY/LOW INCOME ANALYSIS

Subject bar: Public meeting April 21 for Biscayne Bay Coastal Wetlands Project

E-mail text:

The U.S. Army Corps of Engineers, Jacksonville District will host a public meeting for the Biscayne Bay Coastal Wetlands Project April 21 in Miami-Dade County. The purpose is to present the Draft Project Implementation Report (PIR) and Environmental Impact Statement (EIS) and take public comments. Public and agency comments may be submitted in writing through May 2, as well.

The Biscayne Bay Coastal Wetlands Project is a component of the Comprehensive Everglades Restoration Plan (CERP). The project goal is to improve the ecology of Biscayne Bay, including the freshwater wetlands, tidal creeks and near-shore habitat. The project team will accomplish this by adjusting the quantity, quality, timing and distribution of fresh water entering the bay and Biscayne National Park. The project includes pump stations, spreader swales, storm water treatment areas, flow ways, levees, culverts and backfilling canals in southeast Miami-Dade County.

The Corps is hosting the public meeting Wednesday, April 21 at the Deering Estate at Cutler, 16701 S.W. 72nd Ave., Miami, Fla. An open house begins at 6:30 p.m., followed by the public meeting at 7 p.m. Persons needing special assistance such as Spanish-language translation are asked to call 561-472-8885.

A public comment period is open through May 2, 2010. The draft PIR/EIS is available online at http://tinyurl.com/ydg4mkf. People may submit comments online at BBCWDPIRComments@evergladesplan.org or via mail to Brad Tarr, U.S. Army Corps of Engineers, Jacksonville District, P.O. Box 4970, Jacksonville, Fla. 32232-0019.

This is a project of the U.S. Army Corps of Engineers and South Florida Water Management District. For more information, please contact Eunice Ford, Corps of Engineers project manager, at 904-232-3618 or eunice.ford@usace.army.mil; or John Shaffer, SFWMD project manager, at 561-681-2563 or jshaffe@sfwmd.gov. More is available online by visiting www.evergladesplan.org, and clicking Projects on the top right. For information on the public meeting, please call 561-472-8885.

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FIGURE 8-2: BBCW DPIR PUBLIC MEETING NOTICE

8.7.4 Technical Reviews

Agency technical reviews (ATR) of the Biscayne Bay Coastal Wetlands document were carried out through collaboration with the Planning Centers of Expertise (PCX) in compliance with guidance at the time of draft PIR completion (2007) and in accordance with the following policy documents; EC 1105-2-408 dated 31 May 2005 “Peer Review of Decision Documents”, Peer Review Process Memorandum dated 30 March 2007; “Supplemental Information for the “Peer Review Process” Memo, dated March 2007 found on the Corps Planning CoP web site at: http://www.usace.army.mil/cw/cecw-cp/peer/revplan_23may07.pdf; and memorandum dated 25 October 2005 (CESAD-RBT SOP 11-1-3), and EC 1105-2-410 dated 22 August 2008 "Water Resources Policies and Authorities Review of Decision Documents".

An internal SAJ Internal Technical Review (ITR) team, independent of the PDT, reviewed the subject study at the FSM stage in September 2004. The comments were incorporated into the project process and documentation. Following the FSM, an external Peer Review action plan was developed and a dedicated team established external to SAJ, comprised of members of other SAD districts, under the leadership of Wilmington District (SAW). The external ATR Team reviewed the AFB package in August and September, 2006. The same team then reviewed the draft report in March, 2007. A third external ATR was conducted for the Final PIR/EIS. This ATR of the Final PIR/EIS was a follow-on review to the previous review of the DPIR. The primary purpose of this review was to verify that previous Project Delivery Team (PDT) commitments to incorporate ATR comments were carried forward into the final report, and to review new technical information. The Cost Engineering Directorate of Expertise (DX) was charged with overseeing the ATR of cost engineering. ATR certification of the Final PIR/EIS was received on 30 July 2007.

Extensive external scientific peer review through the National Academy of Science has been conducted at the programmatic level and will continue throughout the planning and implementation of the CERP program. The findings and recommendations of these programmatic reviews have been applied to and incorporated in the Biscayne Bay Coastal Wetlands project, as applicable. In addition, Paragraph 385.10 of the Programmatic Regulations for CERP requires extensive consultation and coordination in a timely manner throughout the implementation of CERP. Such consultations have provided opportunities for external review of CERP PIRs and other documents from a diverse group of agencies and stakeholders interested in Everglades and South Florida ecosystem restoration. Consultation is required with the following external entities: Miccosukee and Seminole Tribes of Florida, Department of Interior, Environmental Protection Agency, Department of Commerce, Florida Department of Environmental Protection, and other state, federal and local agencies. The Biscayne Bay Coastal Wetlands project document has also been reviewed by the CERP Restoration Coordination and Verification (RECOVER) team that, while not independent of CERP, serves as a first-level of scientific review that is independent of the PDT.

In addition to the programmatic reviews and in order to comply with the intent of external peer review (EPR) regulations and guidance of the time (2007), the PDT documented application of previous CERP External Peer Reviews and previous CERP project reviews to the Biscayne Bay Coastal Wetlands project. This documentation covers all major areas of concern for EPR of a project of this type. The PDT, SAJ and the vertical team concurred that the subject matter covered in the decision document is not novel, controversial, or precedent-setting, and that the project will not have significant interagency interest or significant economic, environmental or social effects. The PDT and SAJ concluded, and the vertical team concurred, that the project, with its application of previous EPRs, has met the intent of EPR requirements outlined in the referenced Corps guidance. No further EPR was deemed necessary or recommended at the time. Documentation of the application of previous CERP External Peer Reviews and previous CERP project reviews to the Biscayne Bay Coastal Wetlands project is included in Biscayne Bay Coastal Wetlands Peer Review Plan as Attachment 1. This review plan was approved by PCX and SAD (see memorandum from SAD dated 16 August 2007).

8.8 ENVIRONMENTAL COMMITMENTS

USACE, SFWMD (the non-Federal sponsor), and all contractors who are or will be associated with the project will commit to avoiding, minimizing or mitigating adverse effects during construction activities by taking the following actions:

1. The contractor will be required to employ BMPs with regard to erosion and turbidity control. Prior to and throughout construction, the construction team should examine all areas of proposed erosion/turbidity control in the field, and make adjustments as warranted by actual field conditions at the time of construction.

2. The contract specifications would prohibit the contractor from dumping oil, fuel or hazardous wastes in the work area and would require that the contractor adopt safe and sanitary measures for the disposal of solid wastes. The contractor would be required to prepare a spill prevention plan.

3. Any construction and demolition debris would be transported and disposed of in accordance applicable requirements.

4. Inform contractor personnel of the potential presence of threatened and endangered species in the project area, the need for precautionary measures, and Endangered Species Act (ESA) prohibitions.

5. Any requirements resulting from ESA Section 7 consultation shall be implemented.

6. USACE and SFWMD agree to maintain an open and cooperative communication with the FWS and Florida Fish and Wildlife Conservation

Commission (FWC) as appropriate throughout the design, construction and operation of this restoration project.

7. To protect cultural resources, appropriate measures will be taken following consultation with the State Historic Preservation Officer..

8. As required under WRDA 2000, the Project Delivery Team (PDT) has identified water to be reserved for ecosystem restoration. This requirement is addressed in Annex C of this PIR.

9. As required under WRDA 2000, the Selected Plan has been evaluated in the light of its potential effects on existing legal sources of water and the level of service for flood protection. This requirement is addressed in Annex C of this report.

10. Compliance with the State of Florida's requirements for approval of CERP projects is also addressed in Annex C.

8.9 VIEWS OF NON-FEDERAL SPONSOR

The non-Federal sponsor (the SFWMD) supports Alternative O Phase 1 of the Biscayne Bay Coastal Wetlands project, and, as of the generation of this document, the expedited features within the Selected Plan have been fully designed by SFWMD, and phased construction of the expedited features by the SFWMD has begun. Construction has been completed in the Deering Estates component. In the L-31E component, four culverts have been constructed. The remaining features have not been scheduled as yet, nor have the features in the Cutler wetlands been scheduled.

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SECTION 9

SUMMARY OF COORDINATION, PUBLIC VIEWS AND COMMENTS

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9.0 PROJECT COORDINATION

9.1 SUMMARY OF PUBLIC AND AGENCY COORDINATION

This NEPA document is an integrated PIR and EIS. Early in project planning, a letter notifying interested parties, tribes, and federal and state agencies was mailed to scope for potential issues or project suggestions. Comments received were evaluated and incorporated into the project planning, as appropriate. Please see ***Annex B*** for additional information on scoping and comments received.

9.1.1 Cooperating Agencies

While not officially noted as cooperating agencies for the purposes of National Environmental Policy Act (NEPA), the following state and Federal agencies are members of the PDT, and have contributed to the development of the PIR/Environmental Impact Statement (EIS): USFWS, FDEP, National Park Service (NPS), and DERM. These agencies are considered to be partners in the CERP projects.

In accordance with regulations pertaining to the NEPA (Title 40 of the Code of Federal Regulations [C.F.R.], part 1501.6), the following agencies were formally invited to become a cooperating agency for an EIS on the Biscayne Bay Coastal Wetlands project:

US Environmental Protection Agency
US Fish and Wildlife Service
National Park Service
Florida Fish and Wildlife Conservation Commission
Florida Department of Environmental Protection
US Geological Survey
Miami-Dade Department of Environmental Resources Management
National Oceanographic and Atmospheric Administration / National Marine Fisheries Service

See ***Appendix E*** for Cooperating Agency Letters.

9.2 ENVIRONMENTAL COMPLIANCE

The following sections provide detailed information regarding environmental compliance activities. Please refer to ***Annex B*** for a summary of compliance and coordination for environmental statutes and regulations.

9.3 CLEAN AIR ACT OF 1972

The existing air quality within south Florida is considered good. Section 176 (c) of the Clean Air Act (CAA) requires that Federal agencies assure that their activities are in conformance with the Federally-approved CAA state implementation plans for geographical areas designated as "non-attainment" and "maintenance" areas under the CAA. The Biscayne Bay Coastal Wetlands project is not located within a "non-attainment" area since there are none within the State of Florida. The only potential source of air pollution would be from pump station(s). Pursuant to rule 62-210.300(3)(a)(21)(b), operations staff will be required to determine if stations will be exempt from air permitting or if an air general permit will be required.

This project has been and will continue to be coordinated with USEPA for compliance with Section 309 of the Act. A Title V Source air permit application will be submitted to the Environmental Health and Engineering Section of the County's Department of Health prior to construction.

9.4 CLEAN WATER ACT OF 1972

The Biscayne Bay Coastal Wetlands project is in compliance with the Clean Water Act of 1972. A Section 404 (b)(1) evaluation has been prepared and is contained in Section B.2 of this PIR/ EIS. The Water Quality Certification (WQC) will be met by a NPDES permit. All state water quality standards will be met.

9.5 COASTAL ZONE MANAGEMENT ACT OF 1972

The State of Florida Clearinghouse provided comments in response to a scoping letter of March 2003 and indicated probable consistency with the Coastal Zone Management Act (CZMA). A Federal consistency determination in accordance with 15 CFR 930 Subpart C is included in the PIR/EIS. The consistency review, delegated to the State of Florida, is performed during the coordination of the PIR prior to final report approval.

9.6 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

The Biscayne Bay Coastal Wetlands project is in compliance with the NEPA of 1969. Initial coordination began with a three-day workshop October 28-30, 2002, at the Deering Estate in Miami, Florida. The workshop, advertised through newspapers, radio news releases and email notices, introduced the project's goals and objectives, discussed preliminary ecological performance measures, facilitated numerous presentations by non-agency scientists on the history and present status of the Biscayne Bay area, and provided opportunities for the public to voice their concerns on an array of project issues.

On March 7, 2003, a Notice of Intent to prepare an EIS was published in the Federal Register (Vol. 68, Number 45). And on October 22, 2003, at the Chamber South Conference Center on 6410 SW 80th Street, in Miami, Florida, a stakeholders meeting, consisting of concerned members of agricultural, fishing, and environmental groups, was held.

Subsequently, a public workshop, discussing issues, concerns, opportunities and constraints related to the project, took place on October 28, 2003, at the John D. Campbell Agricultural Center, located at SW 288th Street, Homestead, Florida. This information-gathering workshop served to exchange information among team members and helped assist in the development of alternative plans, as well as point out potential constraints to project development.

In general, the resource agencies and public attendees expressed overall support of the proposed project and the potential for improved habitat to benefit fish and wildlife resources. Initial concerns focused on continued saltwater intrusion along the coast; the potential leaching of soil contaminates into surface water and groundwater; the need for backfilling mosquito ditches; and the lack of water available and the amounts needed for restoration. Recommendations encouraged the continued pursuit of utilizing reclaimed wastewater from the South Dade Wastewater Treatment Plant to ensure the amount of freshwater required for restoration goals.

A number of subsequent Project Delivery Team meetings were held throughout the planning process of the project where stakeholders and representatives of non-governmental environmental organizations provided written comments and statements. The primary focus of their concerns centered on splitting the original plan into two phases; uncertainties about full restoration opportunities and the need to identify additional sources of water to fulfill restoration goals, specifically in the dry season to sustain salinities conducive for estuarine biological and vegetative communities. One recommended component was the need to include storage features in the upland for hydration during the dry season.

Additional concerns raised include the need for Alternatives to account for sea level rise and demonstrate the ability to meet project goals given the continued intrusion of salt water along the coast; the project must also define long-term management options; detected levels of contaminants should be evaluated for potential risks; and the design of the project should incorporate polishing wetland components and should allow for maximum restoration of freshwater and coastal wetlands, including restoration of the coastal gradient.

Similar issues, as well as new concerns, were raised in response to the public and agency review and comment of the Biscayne Bay Coastal Wetlands Draft PIR and EIS, which was published in the Federal Register on 19 March 2010. Concurrent to the 45-day review period, a project overview was presented and questions answered during the public meeting held at Deering Estate in Miami-Dade County on 21 April 2010. While there was tremendous support for the project, additional concerns included flood protection; the need to maintain adequate groundwater and surface water in the project area; and the desire to implement Phase II of the BBCW project.

A copy of the meeting flyer and electronic announcement are contained in ***Section B.6.1*** and ***Section B.6.2***; while all comments and responses are contained in ***Tables B-3*** and ***B-4*** within Annex B (***NEPA Information***). Upon submittal of a Record of Decision, the NEPA process will be completed and in full compliance with this Act.

9.7 FISH AND WILDLIFE COORDINATION ACT OF 1958

The central objective of the Fish and Wildlife Coordination Act of 1958 (FWCA) is to allow for equal consideration of wildlife resources. The Biscayne Bay Coastal Wetlands project is in full compliance with this Act.

This project has been coordinated with the USFWS and the FWC. From the onset of the Biscayne Bay Coastal Wetlands project, representatives from both agencies have been involved in the project planning, development and evaluation, with particular interests in effects to fish and wildlife resources and natural wildlife management areas. The project team continues to coordinate with the USFWS and the FWC.

Transfer funds have been made available to the USFWS in order to participate in PDT meetings and workshops scheduled in conjunction with USACE's planning, implementation and evaluation process. Funding has been provided for the USFWS to conduct surveys and investigations necessary to determine impacts of the Biscayne Bay Coastal Wetlands project on wildlife resources, and to make recommendations to USACE on measures to prevent loss of or damage to wildlife resources. Recommendations for optimizing opportunities related to the conservation and enhancement of fish and wildlife resources have been provided through the submittal of Planning Aid Letters and Planning Aid Reports dated:

- March 25, 2002

- June 21, 2002
- December 24, 2002
- June 5, 2003
- October 23, 2003
- May 13, 2004
- June 21, 2004
- July 14, 2004
- January 27, 2005
- November 21, 2005
- June 9, 2005
- January 20, 2006
- September 26, 2006

A draft Coordination Act Report (CAR) was submitted July 09, 2008 and the final CAR received in June 2010. The final CAR is contained in Section A1 (Annex A) of this report.

9.8 MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

Because migratory birds are a public trust resource, and because shorebirds migrate along the Atlantic coast of Florida on their way to and from South America and use habitats found in the project area, migratory birds must be taken into consideration during project planning and design.

At this time project activities are not anticipated to negatively impact migratory birds and are anticipated to benefit migratory birds. The Biscayne Bay Coastal Wetlands project will be in full compliance with both the Migratory Bird Treaty Act and the Migratory Bird Conservation Act upon review of the Final PIR/EIS by the USFWS and the FWC.

9.9 ENDANGERED SPECIES ACT OF 1973

At the time of submittal of this PIR, the Biscayne Bay Coastal Wetlands project was in full compliance with the Endangered Species Act of 1973.

In a Planning Aid report dated May 13, 2004, the USFWS recommended several actions to be taken by USACE in determining an effect on potentially threatened species through the eventual submittal of a Biological Assessment.

In a letter dated December 14, 2004, USACE requested confirmation of a Federally threatened and endangered species list from the USFWS.

In a letter dated January 24 2005, the USFWS responded stating that eleven Federally listed endangered animal species and four threatened animal species are known to exist or could possibly exist in the general project area.

USACE continues to work with the USFWS in gathering more information on endangered species in the project area and toward creating design modifications that may actually benefit the species. Informal consultation with USFWS, FWC and NMFS has resulted in agency concurrence with the Corps' species determinations of "no affect", and "may affect not likely to adversely affect", as presented in the Biological Assessment of this report. The formal letter of concurrence from the USFWS is contained in Annex A, Section A4.12 of the FPIR/EIS.

9.10 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

Federal agencies that fund, permit or carry out activities that may adversely impact essential fish habitat (EFH) are required to consult with the National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH. In conformance with the 1996 amendment to the Magnuson-Stevens Fishery Conservation and Management Act, the information provided in this PIR/EIS would comprise the required EFH assessment and would be coordinated with NMFS.

Consultation for the Biscayne Bay Coastal Wetlands project was initiated in March 2003. The NMFS has been a participant of the Biscayne Bay Coastal Wetlands PDT and has indicated that beneficial effects to fish resources and EFH may occur as a result of this project. The NMFS requested an evaluation of potential impacts to living marine resources, including mangroves, seagrasses, live bottom communities, and the marine/estuarine water column that may be impacted by activities or operations of the project alternatives. An EFH assessment has been submitted to the NMFS for coordination as a part of this PIR/EIS. This EFH assessment is located in ***Annex B.2.2.8*** through ***Annex B.2.2.10***. The NMFS concurrence of minimal impacts to EFH is located in ***Section B.5.4*** in ***Annex B*** of this report.

9.11 MARINE MAMMAL PROTECTION ACT OF 1972

It is not anticipated that the project would result in takings as defined by Marine Mammal Protection Act of 1972. Incorporation of the safeguards used to protect threatened or endangered species during construction and operation should protect any marine mammals in the area.

The West Indian manatee does occur within the Biscayne Bay Coastal Wetlands project area. Manatee protection is managed by the USFWS. USACE will continue coordination and consultation with the USFWS to help insure effective and appropriate safeguards are maintained.

9.12 ESTUARY PROTECTION ACT OF 1968

The Biscayne Bay Coastal Wetlands project is designed to eliminate canal point source freshwater discharges to Biscayne Bay and re-route freshwater flows overland to the downstream estuaries. Freshwater flows would ultimately rehydrate the existing hyper-saline habitats and re-establish a salinity regime more suitable for the survivorship of estuarine communities. This project is anticipated to benefit coastal wetlands and associated estuarine habitats and is, therefore, in full compliance with the Estuary Protection Act of 1968.

9.13 NATIONAL HISTORIC PRESERVATION ACT OF 1966, AS AMENDED

Cultural resources coordination with the State Historic Preservation Officer, the Miccosukee Tribe of Florida, and the Seminole Tribe of Florida for Alternative O Phase 1 has been conducted. The State Historic Preservation Officer concurred on March 5, 2007 (DHR no. 2007-803) that the installation of four culverts along the L-31E Canal will have no effect on historic properties. In a letter dated January 11, 2008 (DHR no. 2007-7384-B) the State Historic Preservation Officer concurred with Janus Research's determination that the State's Expedited Construction project will have no effect on historical sites 8DA2815 (Deering Estate historic district), 8DA2815D (historic wall), 8DA6518 (historic road), or 8DA11247 (historic road). The proposed repairs to the Deering Estate Bridge (8DA2815C) and channel maintenance will prevent the rise in water levels from having an adverse effect on the bridge. In a letter dated July 16, 2008 (DHR no. 2009-3961) the State Historic Preservation Officer concurred with USACE's determination that additional Alternative O Phase I features along the C-103 and L-31E Canal and levee will have no effect on historic properties. The Seminole Tribe of Florida reviewed the proposed project and the cultural resources assessment survey, and in a letter dated October 19, 2007 they concurred with the recommendations and comments in the cultural resources survey report prepared by Janus Research. The Tribal Historic Preservation Officer also recommended that all sites near the Area of Potential Effect (APE), including those not listed in the National Register of Historic Places, should be monitored during the scheduled flooding of both flow-ways. The Miccosukee Tribe of Florida also reviewed the proposed project and the cultural resources survey report and in a letter dated November 8, 2007 determined that there are no cultural, historical, or religious sites of the Tribe in the APE.

9.14 RESOURCE CONSERVATION AND RECOVERY ACT OF 1976; TOXIC SUBSTANCES CONTROL ACT OF 1976

This project is in compliance with the Resource Conservation and Recovery Act of 1976 and the Toxic Substances Control Act Of 1976. Detailed discussions of known HTRW conditions and residual agricultural chemicals are located in ***Section 7***, ***Environmental Effects***.

9.15 FARMLAND PROTECTION POLICY ACT OF 1981

The Biscayne Bay Coastal Wetlands project is in full compliance with the Farmland Protection Policy Act of 1981.

Coordination with the Natural Resources Conservation Service (NRCS) was initiated through a letter dated April 30, 2008 providing project information regarding farmland conversion. Submittal of Form AD-1006 was sent to the NRCS for their evaluation and a determination of no impact to Unique Farmland was provided by the NRCS through a letter on May 09, 2008 (see ***Appendix E***).

9.16 EXECUTIVE ORDER 11988, FLOOD PLAIN MANAGEMENT

The Biscayne Bay Coastal Wetlands project has been evaluated in accordance with Executive Order (E.O.) 11988, Flood Plain Management and is in compliance.

9.17 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

The areas proposed for restoration are a combination of freshwater and coastal wetlands. Habitat mapping and other analysis of wetlands have been conducted. As a result of these analyses, a net functional “lift” to wetlands within and adjacent to the project is expected. This project is in compliance with the goals of E.O. 11990, Protection of Wetlands.

9.18 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE

The Biscayne Bay Coastal Wetlands project is in compliance with E.O. 12898, Environmental Justice, which requires the Federal government to achieve environmental justice by identifying and addressing disproportionately high adverse effects of its activities on minority or low-income populations, and by involving potentially affected minorities in the public coordination process. No minority or economically disadvantaged population clusters have been identified in the immediate southern Miami-Dade County region where project features are proposed. Additionally, this project would not result in adverse human health or environmental effects. Stakeholder meetings with minority groups took place in 2003 to address concerns.

9.19 EXECUTIVE ORDER 13089, CORAL REEF PROTECTION

This project is in compliance with E.O. 13089, Coral Reef Protection. The Biscayne Bay Coastal Wetlands restoration project is designed to reduce extreme discharges of fresh water and nutrients to Biscayne Bay and return it to a more natural regime. Seagrasses and nearshore habitats would benefit from this restoration plan. However, the proposed action may indirectly affect some coral reef ecosystems, as defined by E.O. 13089, just outside of the project area. This effect should be a reduction of freshwater inputs, which should serve to benefit these coral reef ecosystems.

9.20 EXECUTIVE ORDER 13112, INVASIVE SPECIES

The Biscayne Bay Coastal Wetlands project is expected to reduce the abundance and variety of invasive plant species in the project area by restoring the area's natural hydrology. Restored hydroperiods, and the restoration of more natural sheet flow are changes that would benefit native vegetation to the detriment of exotic species. This project would not authorize, fund or carry out any action that might spread or introduce invasive species. Therefore, the Biscayne Bay Coastal Wetlands project complies with the E.O. 13112.

9.21 FLORIDA STATUTES 373.1501 AND 373.026 (AMENDED)

During the 1999 legislative session, Florida lawmakers created Section 373.1501 Florida Statutes (F.S.) and amended Section 373.026 F.S. Section 373.1501 F.S. provides a legislative finding that the Comprehensive Review Study is important for restoring the Everglades ecosystem and for sustaining the environment, economy and social well-being of south Florida. Legislative intent was to facilitate and support the CERP through a process concurrent with Federal government review and Congressional authorization. Further legislative intent was to ensure that all project components are implemented through appropriate processes and are consistent with the balanced policies and purposes of Chapter 373 F.S. Specifically, Section 373.026(8)(b) F.S. directs the FDEP to collaborate with the SFWMD in the CERP and to approve each project component, with or without amendments prior to submission of such components to Congress for authorization.

The criteria upon which the FDEP is to base its approval of project components is contained within Section 373.1501(5) F.S. and is incorporated below:

Section 373.1501 (5) In its role as local sponsor for the project, the District shall comply with its responsibilities under this chapter and implement project components through appropriate provisions of this chapter. In the development of project components, the District shall:

(a) Analyze and evaluate all needs to be met in a comprehensive manner and consider all applicable water resource issues, including water supply, water quality, flood protection, threatened and endangered species, and other natural system and habitat needs;

(b) Determine with reasonable certainty that all project components are feasible based upon standard engineering practices and technologies and are the most efficient and cost-effective of feasible alternatives or combination of alternatives, consistent with restudy purposes, implementation of project components, and operation of the project;

(c) Determine with reasonable certainty that all project components are consistent with applicable law and regulations, and can be permitted and operated as proposed. For purposes of such determination:

1. The District shall convene a pre-application conference with all state and Federal agencies with applicable regulatory jurisdiction;

2. State agencies with applicable regulatory jurisdiction shall participate in the pre-application conference and provide information necessary for the District's determination; and

3. The District shall request that Federal agencies with applicable regulatory jurisdiction participate in the pre-application conference and provide information necessary for the District's determination;

(d) Consistent with Chapter 373, the purposes for the restudy provided in the Water Resources Development Act of 1996, and other applicable Federal law, provide reasonable assurances that the quantity of water available to existing legal users shall not be diminished by implementation of project components so as to adversely impact existing legal users, that existing levels of service for flood protection will not be diminished outside the geographic area of the project component, and that water management practices will continue to adapt to meet the needs of the restored natural environment;

(e) Ensure that implementation of project components is coordinated with existing utilities and public infrastructure and that impacts to and relocation of existing utility or public infrastructure are minimized.

The PIR would include a State Compliance Report, to be submitted by the SFWMD to the FDEP for approval, pursuant to Sections 373.1501(5) and Section 373.026(8)(b) F.S., for the selected plan features of the Biscayne Bay Coastal Wetlands project. The compliance report is intended to provide the FDEP with the technical information necessary to make a determination of compliance with state law for CERP projects.

9.22 LIST OF AGENCIES, ORGANIZATIONS AND PERSONS TO WHOM COPIES OF THE PIR/EIS WILL BE SENT

The following agencies, groups, and individuals will be sent copies of the PIR/EIS:

Native American Tribes

- Miccosukee Tribe of Indians of Florida
- Seminole Tribe of Florida
- Muscogee (Creek) Nation of Oklahoma
- Seminole Nation of Oklahoma
- Poarch Creek Indian Nation

Federal Agencies

- Federal Emergency Management Agency
- U.S. Army Corps of Engineers
- U.S. Center for Environmental Health
- U.S. Environmental Protection Agency
- U.S. Department of Agriculture
  - Forestry Service
- U.S. Department of Commerce
  - National Oceanic and Atmospheric Administration
    - Florida Keys National Marine Sanctuary
    - National Marine Fisheries Service
- U.S. Department of Housing and Urban Development
- U.S. Department of the Interior
  - Bureau of Indian Affairs
  - U.S. Fish and Wildlife Service
  - U.S. Geological Survey
  - National Park Service
  - Office of Environmental Policy and Compliance
- U.S. Department of Justice
- U.S. Department of Transportation
  - Federal Highway Administration
- U.S. Senate
- U.S. House of Representatives

State Agencies

- Office of the Governor
- Florida House of Representatives, Environmental Protection Committee

Florida Coastal Management Program
Florida Department of Agriculture and Consumer Services
Florida Department of Community Affairs
Florida Department of Environmental Protection
Florida State Clearinghouse
Florida Fish and Wildlife Conservation Commission
Florida Department of Transportation
Florida Division of Forestry
Florida Division of Historical Resources–SHPO
Florida Division of State Lands
Florida State Senate
South Florida National Parks Trust
South Florida Water Management District
Florida Geological Survey
University of Florida

County Governments

Miami-Dade County

Municipalities

City of Florida City
City of Homestead
City of Miami
City of Miami Beach
City of North Miami

Groups

Atlantic Gamefish Foundation
American Littoral Society
Audubon Society of the Everglades
Audubon of Florida
Center for Earth Jurisprudence
Clean Water Action
Citizens for a Better South Florida
Common Ground for Conservation
Environmental Coalition of Miami Beach
Environmental & Land Use Law Center
Everglades Coordinating Council
Everglades Foundation
Everglades Protection Society
Everglades Research Group, Inc.
Florida International University
Florida Atlantic University

Florida Biodiversity Project
Florida Wildlife Federation
Friends of the Everglades
Institute for Regional Conservation
International Gamefish Association
Izaac Walton League
Marine Animal Rescue Society
Marine Council
Miami River Commission
National Parks Conservation Association
National Resources Defense Council
Pelican Harbor Seabird Station, Inc.
Reef Relief
Save the Manatee Club
Sierra Club Miami
Sierra Club of South Florida
Southeast Florida Coral Reef Initiative
South Florida Ecosystem Restoration Task Force
Southwest Florida Regional Planning Council
SPCA Wildlife Care Center
Trail Glades Bassmasters
Treemendous Miami, Inc.
The Nature Conservancy
The Trust for Public Land
Tropical Audubon Society
World Wildlife Fund, South Florida Program
1000 Friends of Florida

Individuals

A list of individuals who will receive the PIR/EIS is on file in the Jacksonville District of USACE at the address shown on the cover page of this document.

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SECTION 10

RECOMMENDATIONS

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10.0 JACKSONVILLE DISTRICT ENGINEER'S RECOMMENDATIONS

The Biscayne Bay Coastal Wetlands (BBCW) Project will utilize fresh water currently discharged to Biscayne Bay to rehydrate wetlands adjacent to the Bay to achieve freshwater and estuarine restoration benefits in Biscayne Bay, which is integral to achieving system-wide benefits in the south Florida ecosystem. The Biscayne Bay Coastal Wetlands Project will help reduce wet season high volume flows to Biscayne Bay by redistributing water to previously impacted freshwater and saltwater wetlands. In addition, the plan achieves the benefits of the Project as previously developed for the Comprehensive Everglades Restoration Plan (CERP).

This Project is integral to achieving restoration of the nearshore bay and adjacent wetlands in the Biscayne Bay Coastal Wetlands study area. Moreover, the Project plays an important role in meeting the CERP system-wide ecosystem restoration goals and objectives, and other water-related needs of the region. Fish and wildlife habitat benefits of the Biscayne Bay Coastal Wetlands Project include: increasing habitat for the eastern oyster, blue crab, and other fish and marine organisms, improving seagrass beds in the estuary, and re-establishing more natural hydropatterns within existing natural wetland areas and providing an improved salinity range suitable for a healthy estuarine ecosystem by improving the timing of freshwater deliveries to the estuary. The Project is expected to produce 9,276 average annual Habitat Units (HUs). Further, this Project is a critical building block upon which a subsequent study will be able to evaluate and achieve even broader ecosystem restoration benefits in Biscayne Bay.

I have given consideration to all significant aspects in the overall public interest, including engineering feasibility, economic, social and environmental effects.

I find that the Biscayne Bay Coastal Wetlands Project, located in eastern Miami-Dade County, is an integral part of the CERP. The Biscayne Bay Coastal Wetlands selected plan includes:

1. Deering Estate – 500-foot extension of C-100A Spur Canal, pump station to withdraw water from C-100A Spur Canal (100 cubic feet per second [cfs]), 538 linear feet of 60" pipe south of new pump station, and spreader structure to discharge to coastal wetlands to Deering Estate;
2. Cutler Wetlands – pump station on C-1 Canal (400 cfs), 7000 +/- linear feet of lined conveyance canal to deliver water from pump station to proposed spreader, box culverts under SW 97 Ave, SW 87 Ave and L-31E, 13,160 linear feet of spreader canal, and plugging (2500 linear feet) remnant mosquito ditches;
3. L-31 East Flow Way – pump station (50 cfs) with outlet spreader to deliver water to saltwater wetlands, pump station (100 cfs) to discharge south

to L-31E borrow canal, inverted siphon to isolate Military Canal from L-31E, 10 riser structures with flap gated culverts to discharge from L-31E to saltwater wetlands east of L-31E, pump station (40 cfs) to discharge from C-103 north into L-31E, pump station (40 cfs) and spreader canal to deliver water to freshwater wetlands south of C-103, and a pump station (40 cfs) and spreader structure to deliver water to freshwater wetlands south of C-103.

The Selected Plan is described in greater detail in ***Section 7.***

Therefore, I recommend that the Biscayne Bay Coastal Wetlands Project as described in the section of the report entitled "The Selected Plan," with such modifications thereof as in the discretion of the Chief of Engineers, may be advisable, be authorized for construction. The amount requested for authorization is **$191,018,000** (FY 11). The total project first cost is $168,023,000 and the spent through, sunk PIR costs total $22,995,500. Biscayne Bay Coastal Wetlands Project includes recreation features totaling $2,316,000. The estimated total annual cost of Operation, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R) of the ecosystem restoration elements is $1,898,000 with an estimated Federal annual OMRR&R cost of $936,500 and an estimated Non-Federal annual OMRR&R cost of $936,500. The estimated cost for OMRR&R of the recreation elements is $25,000, which is a 100 percent Non-Federal Sponsor responsibility.

The above recommendations are made with the provision that the Non-Federal Sponsor and the Secretary of the Army shall enter into a binding Project Partnership Agreement (PPA) defining the terms and conditions of cooperation for implementing the Biscayne Bay Coastal Wetlands Project, and that the Non-Federal sponsor agrees to perform the following items of local cooperation:

a) Provide 50 percent of total Project costs consistent with the provisions of Section 601(e) of the WRDA 2000 including authority to perform design and construction of Project features consistent with Federal law and regulation.

b) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or assure the performance of all relocations that the Government and Non-Federal Sponsor jointly determine to be necessary for the construction, operation, and maintenance, repair, replacement and rehabilitation of the Project and valuation of the lands shall be in accordance with the CERP Master Agreement, August 13, 2009.

c) Shall not use the ecosystem restoration features or lands, easements, and rights-of-way required for such features as a wetlands bank or mitigation credit for any other Non-CERP projects.

d) Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land that the Non-Federal Sponsor owns or controls for access to the Project for the purpose of inspection, and, if necessary, for the purpose of constructing, completing, operating, maintaining, repairing, replacing, or rehabilitating the Project.

e) Assume responsibility for operating, maintaining, repairing, replacing, and rehabilitating (OMRR&R) the Project or completed functional portions of the Project, including mitigation features, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal and State laws and specific directions prescribed in the OMRR&R manuals and any subsequent amendments thereto. Cost sharing for OMRR&R will be in accordance with Section 601 of WRDA 2000:

> (e) COST SHARING -
> (4) Operations & Maintenance: Notwithstanding section 528(e)(3) of the WRDA 1996 (110 Stat. 3770), the Non-Federal Sponsor shall be responsible for 50 percent of the cost of OMRR&R activities authorized under this section…

f) The Non-Federal Sponsor shall operate, maintain, repair, replace and rehabilitate the recreational features of the Project and is responsible for 100 percent of the costs in accordance with Section 103(j) of WRDA 1986.

g) Keep the recreation features, and access roads, parking areas, and other associated public use facilities, open and available to all on equal terms.

h) Unless otherwise provided for in the statutory authorization for this Project, comply with Section 221 of PL 91-611, Flood Control Act of 1970, as amended, and Section 103 of the WRDA of 1986, PL 99-662, as amended which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Non-Federal Sponsor has entered into a written agreement to furnish its required cooperation for the Project or separable element.

i) Hold and save the Government free from all damages arising from the construction, OMRR&R of the Project and any Project-related betterments, except for damages due to the fault or negligence of the Government or the Government's contractors.

j) Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project to the extent and in such detail as will properly reflect total project costs and comply with the provisions of the CERP Master Agreement between the Department of Army and the South Florida Water Management District for Cooperation in Constructing and Operating, Maintaining, Repairing, Replacing, and Rehabilitating Projects Authorized to be Undertaken Pursuant to the Comprehensive Everglades Restoration Plan, executed on August 13, 2009, including Article XI Maintenance of Records and Audit.

k) Perform, or cause to be performed, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 USC 9601-9675, that may exist in, on, or under lands, easements or rights-of-way necessary for the construction and operation and maintenance (O&M) of the Project; except that the Non-Federal Sponsor shall not perform such investigations on lands, easements, or rights-of-way that the Government determines to be subject to the navigation servitude without prior specific written direction by the Government.

l) Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or right-of-ways that the Government determines necessary for the construction and OMRR&R.

m) As between the Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the Project for the purposes of CERCLA liability. To the maximum extent practicable, the Non-Federal Sponsor shall OMRR&R the Project in a manner that will not cause liability to arise under CERCLA.

n) Prevent obstructions of or encroachments on the Project area (including prescribing and enforcing regulations to prevent such obstruction or encroachments) which might reduce ecosystem restoration benefits, hinder O&M, or interfere with the Project's proper function, such that as any new developments on Project lands or the addition of facilities which would degrade the benefits of the Project.

o) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended by the Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (PL 100-17), and Uniform Regulations contained in 49 CFR part 24, in acquiring lands, easements, and rights-of-way, and performing relocations for construction, operation & maintenance of the Project, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

p) Comply with all applicable Federal and State laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, PL 88-352, and Department of Defense Directive 5500.11 issued pursuant thereto, as well as Army Regulation 600-7, entitled, "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army," and all applicable Federal labor standards and requirements including, but not limited to, 40 U.S.C. 3141-3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantive change the provisions of the Davis-Bacon Act [formerly 40 U.S.C. 276a et seq.], the Contract Work Hours and Safety Standards Act [formerly 40 U.S.C. 327 et seq.] and the Copeland Anti-Kickback Act [formerly 40 U.S.C. 276c]).

q) Comply with Section 106 of the National Historic Preservation Act in completion of all consultation with Florida's State Historic Preservation Office and, as necessary, the Advisory Council on Historic Preservation prior to construction as part of the Pre-construction Engineering Design phase of the Project.

r) Provide 50 percent of that portion of total cultural resource preservation mitigation and data recovery costs attributable to the Project that are in excess of one percent of the total amount authorized to be appropriated for the Project.

s) Do not use Federal funds to meet the Non-Federal Sponsor's share of total Project costs unless the Federal granting agency verifies in writing that the expenditure of such funds is expressly authorized.

t) The Non-Federal Sponsor agrees to participate in and comply with applicable Federal floodplain management and flood insurance programs consistent with its statutory authority, including:

1) Not less than once each year the Non-Federal Sponsor shall inform affected interests of the extent of protection afforded by the Project.

2) The Non-Federal Sponsor shall publicize flood plain information in the area concerned and shall provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the Project.

3) The Non-Federal Sponsor shall comply with Section 402 of WRDA 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to have prepared, within one year after the date of signing a project partnership agreement for the Project, a floodplain management plan. The plan shall be

designed to reduce the impacts of future flood events in the project area, including but not limited to, addressing those measures to be undertaken by non-Federal interests to preserve the level of flood protection provided by the Project. As required by Section 402, as amended, the non-Federal interest shall implement such plan not later than one year after completion of construction of the Project. The Non-Federal Sponsor shall provide an information copy of the plan to the Government upon its preparation.

4) The Non-Federal Sponsor shall prescribe and enforce regulations to prevent obstruction of or encroachment on the Project or on the lands, easements, and rights-of-way determined by the Government to be required for the construction, operation, maintenance, repair, replacement, and rehabilitation of the Project, that could reduce the level of protection the Project affords, hinder operation or maintenance of the Project, or interfere with the Project's proper function.

The non-Federal sponsor shall execute under State law the reservation or allocation of water for the natural system as identified in the PIR for this authorized CERP Project as required by Sections 601(h)(4)(B)(ii) of WRDA 2000 and the non-Federal sponsor shall provide information to the Government regarding such execution. In compliance with 33 CFR 385, the District Engineer will verify such reservation or allocation in writing. Any change to such reservation or allocation of water shall require an amendment to the PPA after the District Engineer verifies in writing in compliance with 33 CFR 385 that the revised reservation or allocation continues to provide for an appropriate quantity, timing, and distribution of water dedicated and managed for the natural system after considering any changed circumstances or new information since completion of the PIR for the authorized CERP Project.

Section 601(e)(5)(B) of the WRDA 2000 authorizes the Secretary of the Army to provide credit to the Non-Federal Sponsor for work completed by it during the period of construction pursuant to a PPA and a determination by the Secretary that the work is integral to the CERP. As part of its initiative for early implementation of certain CERP projects, the Non-Federal Sponsor has stated that it will construct portions of the Biscayne Bay Coastal Wetlands Project consistent with this report, in advance of Congressional authorization and the signing of a PPA. Under the authority of Section 6004 of WRDA 2007, the Non-Federal Sponsor, on August 13, 2009, executed the required pre-partnership credit agreement (PPCA) to preserve its opportunity for credit for in-kind work completed in advance of execution of a PPA. The Non-Federal Sponsor is exploring alternative project delivery methods to expedite implementation of the Project through the State expedited program. Such delivery methods may include public-private partnerships in which the Non-Federal Sponsor contracts with a private or not-for-profit entity for services that may include designing, building, operating or financing these components. I believe that it would be in the public interest for this Project to be implemented expeditiously due to the early benefits to the surrounding habitat, as well as hydrologic benefits to Federal lands and estuaries in other portions of the south Florida ecosystem. Therefore, I recommend that should the Non-Federal Sponsor construct portions of the Biscayne Bay Coastal Wetlands Project prior to the execution of a PPA for this Project, and this work is covered by the executed PPCA, the Non-Federal Sponsor be credited for such construction costs at the time the PPA for the Biscayne Bay Coastal Wetlands Project is executed. Such credit would be applied toward the Non-Federal Sponsor's share of the costs associated with the implementation of the CERP as authorized by Section 601(e)(5)(C) of WRDA 2000, shall not include cash reimbursements, and shall be subject to: a) the authorization of the Biscayne Bay Coastal Wetlands Project by law; b) a determination by the Secretary of the Army that the work performed under the PPCA is integral to the authorized CERP restoration project; c) a certification by the District Engineer that the costs are reasonable, allowable, necessary, auditable, and allocable; and d) a certification by the District Engineer that the activities have been implemented in accordance with USACE design and construction standards and applicable Federal and State laws.

Consistent with the September 14, 2011 Memorandum from Jo-Ellen Darcy, Assistant Secretary of the Army (Civil Works), the Non-Federal Sponsor will be 100% responsible for the costs of all actions taken due to the presence of residual agricultural chemicals, at no expense to the Federal Government and any future costs associated with the presence of residual agricultural chemicals at the Federal project site are 100% a SFWMD cost and responsibility. As stated in the September 14, 2011 memorandum, normal project engineering and construction activities will remain part of total project cost provided that these are the same activities required to implement the project features absent the presence of residual agricultural chemicals.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the Non-Federal Sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

4/2/12

BALLARD C. BARKER
LTC, Corps of Engineers
Acting Commander

DEPARTMENT OF THE ARMY
JACKSONVILLE DISTRICT CORPS OF ENGINEERS
P.O. BOX 4970
JACKSONVILLE, FLORIDA 32232-0019

REPLY TO
ATTENTION OF

Executive Office

2 APR 2012

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Assumption of Command

By authority of paragraph 2-8, Army Regulation 600-20, the undersigned assumes command of the Jacksonville District, U. S. Army Corps of Engineers (W2SR02), Jacksonville, Florida 32207-8175, effective 2 April 2012 through 23 April 2012.

BALLARD C. BARKER
LTC, Corps of Engineers
Deputy Commander

DISTRIBUTION:
A

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SECTION 11

LIST OF REPORT PREPARERS

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Key:

DERM Miami-Dade County Department of Environmental Resources Management
EPJV Everglades Partners Joint Venture
FWS U.S. Fish and Wildlife Service
NPS National Park Service
SFWMD South Florida Water Management District
USACE U.S. Army Corps of Engineers

SECTION 12

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12.0 INDEX

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SECTION 13

GLOSSARY OF TERMS AND ACRONYMS

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13.0 GLOSSARY OF TERMS AND ACRONYMS

13.1 GLOSSARY OF TERMS

A

Acre — Area of land equal to 43,560 square feet. In the S.I. metric system, one acre is equal to 4,046.9 square meters or 2.471 hectares.

Acre-foot — The quantity of water required to cover 1 acre to a depth of 1 foot. Equal to 43,560 cubic feet (1,233.5 cubic meters).

Action Plan — A plan that describes what needs to be done and when it needs to be completed.

Activity — A specific project task that requires resources and time to complete.

Adaptive Assessment — A process for learning and incorporating new information into the planning and evaluation phases of the restoration program. This process ensures that the scientific information produced for this effort is converted into products that are continuously used in management decision-making.

Adverse Impact — The detrimental effect of an environmental change relative to desired or baseline conditions.

Affected Environment — Existing biological, physical, social, and economic conditions of an area subject to change, both directly and indirectly, as a result of a proposed human action.

Air Quality — Measure of the health-related and visual characteristics of the air, often derived from quantitative measurements of the concentrations of specific injurious or contaminating substances.

Aquatic — Consisting of, relating to or being in water; living or growing in, on or near the water; or taking place in or on the water.

Aquifer — An underground geologic formation, a bed or layer of earth, gravel or porous stone, that yields water or in which water can be stored.

Authorization — An act by the Congress of the United States, which authorizes use of public funds to carry out a prescribed action.

B

Baseline — The initial approved plan for schedule, cost or performance management, plus or minus approved changes, to which deviations will be compared as the project proceeds.

Best Management Practices (BMPs) — The best available land, industrial and waste management techniques or processes that reduce pollutant loading from land use or industry, or which optimize water use.

Borrow Canal — Canal or ditches where material excavated is used for earthen construction nearby. Also, typically denotes a canal with no conveyance or water routing purpose.

C

Canal — A human-made waterway that is used for draining or irrigating land or for navigation by boat.

Candidate Species — Plant or animal species not yet officially listed as threatened or endangered, but which is undergoing status review by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

Central and Southern Florida Project (C&SF) — A multi-purpose project, first authorized by Congress in 1948, which provides flood control, water supply protection, water quality protection and natural resource protection.

Channel — Natural or artificial watercourse, with a definite bed and banks to confine and conduct continuously or periodically flowing water.

Coastal Ridge — Area of land bordering the coast whose topography is elevated higher than land further inland.

Comprehensive Everglades Restoration Plan (CERP) — The plan for the restoration of the greater Everglades and to meet water supply and flood protection needs in the urban and agricultural regions of south Florida.

Comprehensive Plan — See Comprehensive Everglades Restoration Plan.

Control Structure — A human-created structure that regulates the flow of waters or the level of waters.

Conveyance Capacity — The rate at which water can be transported by a canal, aqueduct, or ditch. In this document, conveyance capacity is generally measured in cubic feet per second (cfs).

Cost-Benefit Analysis — An analysis, often stated as a ratio, used to evaluate a proposed course of action.

Critical Habitat — A description, which may be contained in a Biological Opinion, of the specific areas with physical or biological features essential to the conservation of a listed species and which may require special management considerations or protection; these areas have been legally designated via Federal Register notices.

Cubic feet per second (cfs) — A measure of the volume rate of water movement. As a rate of streamflow, a cubic foot of water passing a reference section in 1 second of time. One cubic foot per second equals 0.0283 meter /second (7.48 gallons per minute). One cubic foot per second flowing for 24 hours produces approximately 2 acre-feet.

Culvert — A concrete, metal or plastic pipe that transports water.

D

Discharge — The rate of water movement as volume per unit time, usually expressed as cubic feet per second.

Dissolved Oxygen (D.O.) — The concentration of oxygen dissolved in water, sometimes expressed as percent saturation, where saturation is the maximum amount of oxygen that theoretically can be dissolved in water at a given altitude and temperature.

Dry Season — Hydrologically, for south Florida, the months associated with a lower incident of rainfall, typically November through May.

Duration — The period of time over which a task occurs, in contrast to effort, which is the amount of labor hours a task requires; duration establishes the schedule for a project, and effort establishes the labor costs.

E

Ecology — The science of the relationships between organisms and their environments, also called bionomics; or the relationship between organisms and their environment.

Ecosystem — A functional group of animal and plant species that operate in a unique setting that is mostly self-contained.

Effectiveness — A measure of the quality of attainment in meeting objectives; this is distinguished from efficiency, which is measured by the volume of output achieved for the input used.

Endangered Species — Any species or subspecies of bird, mammal, fish, amphibian, reptile, or plant which is in serious danger of becoming extinct throughout all, or a significant portion of its range. Federally endangered species are officially designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service and published in the Federal Register.

Enhancement — Measures which develop or improve the quality or quantity of existing conditions or resources beyond a condition or level that would have occurred without an action; i.e., beyond compensation.

Environmental and Economic Equity (EEE) — A program-level activity, referred to in early phases of the program as Socioeconomic and Environmental Justice.

Environmental Consequences — The impacts to the Affected Environment that are expected from implementation of a given alternative.

Environmental Impact Statement (EIS) — An analysis required by the National Environmental Policy Act for all major Federal actions, which evaluates the environmental risks of alternative actions.

Evaluate — To appraise or determine the value of information, options or resources being provided to a project.

Exotic species — Introduced species not native to the place where they are found.

F

Fallowed Land — Cultivated land that lies idle during a growing season.

Feasibility Study — The second phase of a project. The purpose is to describe and evaluate alternative plans and fully describe recommended project.

Federally Endangered Species — An endangered species which is officially designated by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service and published in the Federal Register.

Flood Control Storage Capacity — Reservoir capacity reserved for the purpose of regulating flood inflows to reduce flood damage downstream [compare with reservoir storage capacity].

Flow — The volume of water passing a given point per unit of time.

> **Instream Flow Requirements** — Amount of water flowing through a stream course needed to sustain instream values.
>
> **Minimum Flow** — Lowest flow in a specified period of time.
>
> **Peak Flow** — Maximum instantaneous flow in a specified period of time.

G

Geospatial Data — Information, which includes, but is not limited to surveys, maps, aerial photography, aerial imagery, and biological, ecological and hydrological modeling coverages.

Goal — Something to be achieved. Goals can be established for outcomes (results) or outputs (efforts).

Groundwater — Water stored underground in pore spaces between rocks and in other alluvial materials and in fractures of hard rock occurring in the saturated zone.

Groundwater Level — Refers to the water level in a well, and is defined as a measure of the hydraulic head in the aquifer system.

Groundwater Pumping — Quantity of water extracted from groundwater storage.

Groundwater Seepage — Groundwater flow in response to a hydraulic gradient.

Groundwater Table — The upper surface of the zone of saturation, except where the surface is formed by an impermeable body.

H

Habitat — Area where a plant or animal lives.

Hammock — Localized, thick stands of trees that can grow on natural rises of only a few inches in the land.

Hectare — A unit of measure in the metric system equal to 10,000 square meters or 2.47 acres.

Hydraulic Gradient — Denotes slope of watercourse, above or below ground water level. Typically, defines energy loss or consumption in the conveyance process.

Hydraulic Head (Lift) — Denotes relative comparison of water stages for gravity flow. Pump stations generally provide lift or increase water level elevations.

Hydrologic Condition — The state of an area pertaining to the amount and form of water present. For example, saturated ground (water table at surface), lake stage and river flow rate.

Hydrologic Response — An observed decrease or increase of water in a particular area.

Hydrology — The scientific study of the properties, distribution and effects of water on the earth's surface, in the soil and underlying rocks, and in the atmosphere.

Hydropattern — Refers to depth as well as hydroperiod is hydropattern. Hydropatterns are best understood by a graphic depiction of water level (above as well as below the ground) through annual cycles.

Hydroperiod — For non-tidal wetlands, the average annual duration of flooding is called the hydroperiod, which is based only on the presence of surface water and not its depth.

I

Impoundment — An above ground reservoir used to store water.

Independent Technical Review Team — A group autonomous of the Project Team established to conduct reviews to ensure that design products are consistent with established criteria, guidance, procedures and policies.

Indicator Species — Organism, species, or community which indicates presence of certain environmental conditions.

Invertebrate — A small animal that does not have a backbone, examples include crayfish, insects and mollusks, which can be indicators of ecosystem status.

J

K

L

Lag — The amount of time after one task is started or completed before the next task can be started or completed.

Land Classification — An economic classification of variations in land reflecting its ability to sustain long-term agricultural production.

Levee — A human-created embankment that controls or confines water.

Littoral Zone — The shore of land surrounding a water body that is characterized by periodic inundation or partial saturation by water level. Typically defined by species of vegetation found.

Local Sponsor — The South Florida Water Management District.

M

Macrophytes — Visible plants found in aquatic environments, including sawgrass, sedges and lilies.

Marsh — An area of low-lying wetland.

Master Program Management Plan (MPMP) — A document which describes the framework and processes to be used by the USACE and the SFWMD for managing and monitoring implementation of the Comprehensive Everglades Restoration Plan.

MIKE SHE — An integrated surface water/ground water model, which includes a module for estimating supplemental irrigation requirements based upon land use, soil type, crop type, rainfall, and evapotranspiration.

Mitigation — To make less severe; to alleviate, diminish or lessen; one or all of the following may comprise mitigation: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating or restoring the affected environment; (4) reducing or eliminating an impact over time by preservation and maintenance operations during the life of an action; and (5) compensating for an impact by replacing or providing substitute resources or environments.

Model — A tool used to mathematically represent a process which could be based upon empirical or mathematical functions. Models can be computer programs, spreadsheets, or statistical analyses.

Monitoring — The capture, analysis and reporting of project performance, usually as compared to plan.

Muck lands — Fertile soil containing putrid vegetative matter.

N

National Economic Development (NED) — Corps of Engineers benefit evaluation process used to justify Recretion expenditures.

O

Objective — A goal expressed in specific, directly measurable terms.

Off-peak — Less than peak design flow rate during storm runoff producing events.

Operation, Maintenance, Repair, Rehabilitation, Replacement (OMRR&R) — 100% local sponsor responsibility to OMRR&R recreation facilities and amenities.

Other Program Element (OPE) — One of twelve components identified in the Comprehensive Plan which will be implemented through programs other than CERP, including the Critical Restoration Projects Authority, or which will be implemented with an appropriate local sponsor under separate Design Agreements and Project Management Plans.

Outreach — Proactive communication and productive involvement with the public to best meet the water resource needs of south Florida.

Oxygen Demand — The biological or chemical demand of dissolved oxygen in water. Required by biological processes for respiration.

P

Performance Measure — A desired result stated in quantifiable terms to allow for an assessment of how well the desired result has been achieved.

Periphyton — The biological community of microscopic plants and animals attached to surfaces in aquatic environments, for example algae.

Phosphorus (P) — Element or nutrient required for energy production in living organisms. Distributed into the environment mostly as phosphates by agricultural runoff (fertilizer) and life cycles. Frequently the limiting factor for growth of microbes and plants in south Florida.

Program — A group of related projects managed in a coordinated manner; programs usually include an element of on-going activity.

Program Management — A structure and set of strategies to be used during the implementation phase, which build upon the interagency partnership, implementation guidelines and successful strategies developed during the Restudy's feasibility planning phase.

Programmatic Environmental Impact Statement (PEIS) — An environmental impact statement prepared prior to a Federal agency's decision regarding a major program, plan or policy, which usually is broad in scope and followed by subsequently more narrowly focused National Environmental Policy Act compliance documents.

Programmatic Regulations — Section 601(h) of WRDA 2000 states that the overarching purpose of the Comprehensive Plan is the restoration, preservation and protection of the south Florida ecosystem while providing for the other water related needs of the region, including water supply and flood protection. The purpose of the regulations is to ensure that the goals and objectives of CERP are achieved. The regulations will contain: (1) processes for the development of Project Implementation Reports, Project Cooperation Agreements and operating manuals that ensure the goals and objectives of the plan are achieved; (2) processes that ensure new scientific, technical, or other information such as that developed through adaptive management is integrated into the implementation of the plan; and (3) processes to establish interim goals to provide a means by which the restoration success of the plan may be evaluated throughout the implementation process.

Project — A sequence of tasks with a beginning and an end that uses time and resources to produce specific results. Each project has a specific, desired outcome, a deadline or target completion date and a budget that limits the amount of resources that can be used to complete the project.

Project Cooperation Agreement (PCA) — A document that describes the roles and responsibilities of the USACE and SFWMD for real estate acquisition, construction, construction management and operations and maintenance.

Project Team — An interdisciplinary group formed from the resources of the implementing agencies, which develops the products necessary to deliver the project.

Project Duration — The time it takes to complete an entire project from starting the first task to finishing the last task.

Project Implementation Report (PIR) — A decision document that will bridge the gap between the conceptual design contained in the Comprehensive Plan and the detailed design necessary to proceed to construction.

Project Management — A discipline of combining systems, techniques and people to complete a project within established goals of time, budget and quality.

Project Management Information System — A system used to chart activities and data and to track progress and information flow in a project.

Project Management Plan (PMP) — A document which establishes the project's scope, schedule, costs, funding requirements and technical performance requirements, including the various functional area's performance and quality criteria that will be used to produce and deliver the products that comprise the project.

Project Manager — A person who takes overall responsibility for coordinating a project to ensure the desired result comes in on time and within budget.

Project Phase — A collection of logically related project activities, usually culminating in the completion of a major deliverable.

Proposed Action — Plan that a Federal agency intends to implement or undertake and which is the subject of an environmental analysis. Usually, but not always, the proposed action is the agency's preferred alternative for a project. The proposed action and all reasonable alternatives are evaluated against the no action alternative.

Public Involvement — Process of obtaining citizen input into each stage of the development of planning documents. Required as a major input into any EIS.

Public Outreach — A program-level activity with the objectives of keeping the public informed of the status of the overall program and key issues associated with restoration implementation and providing effective mechanisms for public participation in the restoration plan development.

Pump Station — A human constructed structure that uses pumps to transfer water from one location to another.

Q

Quality Assurance (QA) — The process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards.

Quality Control (QC) — The process of monitoring specific project results to determine if they comply with relevant quality standards, and identifying means of eliminating causes of unsatisfactory performance.

R

Recharge — The processes of water filling the voids in an aquifer, which causes the piezometric head or water table to rise in elevation.

Reconnaissance Study — The first phase of a project. It has four phases (1) to define problem, (2) asses sponsor's level of interest and support, (3) decide to progress to feasibility phase based on Federal interest, (4) estimate time and money to complete feasibility study.

Record of Decision — Concise, public, legal document which identifies and publicly and officially discloses the responsible official's decision on the alternative selected for implementation. It is prepared following completion of an Environmental Impact Statement.

Regional Water Supply Plan — Detailed water supply plan developed by the District under Ch. 373.0361, F.S.

Reservoir — Artificially impounded body of water.

Reservoir Storage Capacity — Reservoir capacity normally usable for storage and regulation of reservoir inflows to meet established reservoir operating requirements.

Flood Control Storage Capacity — Reservoir capacity reserved for the purpose of regulating flood inflows to reduce flood damage downstream.

Restoration — The recovery of a natural system's vitality and biological and hydrological integrity to the extent that the health and ecological functions are self-sustaining over time.

Restoration Coordination and Verification (RECOVER) — A program-level activity whose role is to organize and apply scientific and technical information in ways that are most effective in supporting the objectives of the Comprehensive Everglades Restoration Plan.

Restudy — The Central and South Florida Project Comprehensive Review Study, authorized by the Water Resources Development Act of 1992, which examined the Central and Southern Project to determine the feasibility of modifying the project to restore the south Florida ecosystem and provide for other water-related needs of the region, and which resulted in The Final Integrated Feasibility Report and Programmatic Environmental Impact Statement, which was transmitted to Congress on July 1, 1999.

Risk Analysis — An evaluation of the feasibility or probability that the outcome of a project or policy will be the desired one; usually conducted to compare alternative scenarios, action plans or policies.

S

Scoping — The process of defining the scope of a study, primarily with respect to the issues, geographic area, and alternatives to be considered. The term is typically used in association with environmental documents prepared under the National Environmental Policy Act.

Scrub — A community dominated by pinewoods with a thick understory of oaks and saw palmetto, and which occupies well-drained, nutrient-poor sandy soils.

Seepage — Water that escapes control through levees, canals or other holding or conveyance systems.

Sheet Flow — Water movement as a broad front with shallow, uniform depth.

Slough — A depression associated with swamps and marshlands as part of a bayou, inlet or backwater; contains areas of slightly deeper water and a slow current; can be thought of as the broad, shallow rivers of the Everglades.

South Florida Ecosystem — An area consisting of the lands and waters within the boundary of the South Florida Water Management District, including the Everglades, the Florida Keys and the contiguous near-shore coastal waters of South Florida.

South Florida Water Management Model (SFWMM) — An integrated surface water groundwater model that simulates the hydrology and associated water management schemes in the majority of south Florida using climatic data from January 1, 1965, through December 31, 2000. The model simulates the major components of the hydrologic cycle and the current and numerous proposed water management control structures and associated operating rules. It also simulates current and proposed water shortage policies for the different subregions in the system.

Spatial Extent — Area that is continuous without non-integrating internal barriers or land usage.

Spillway — Overflow structure of a dam.

Stakeholders — People or organizations having a personal or enterprise interest in the results of a project, who may or may not be involved in completing the actual work on that project.

Stormwater — Surface water resulting from rainfall that does not percolate into the ground or evaporate.

Success Indicator — A subset of performance measures selected as a good representation of overall performance.

Surficial Aquifer — An aquifer that is closest to the surface and is unconfined; the water level of a surficial aquifer is typically associated with the groundwater table of an area.

Sustainability — The state of having met the needs of the present without endangering the ability of future generations to be able to meet their own needs.

Swamp — A generally wet, wooded area where standing water occurs for at least part of the year.

T

Threatened species — Legal status afforded to plant or animal species that are likely to become endangered within the foreseeable future throughout all or a significant portion of their range, as determined by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service.

Tiering — Procedure which allows an agency to avoid duplication of paperwork through incorporation by reference of the general discussions and relevant specific discussions from an environmental impact statement (EIS) of broader scope into a subsequent EIS of narrower scope.

Trade-Off — Allowing one aspect of a project to change, usually for the worse, in return for another aspect of the project getting better.

Tributary — A stream feeding into a larger stream, canal or waterbody.

U

V

W

Water Budget — An account of all water inflows, outflows and change in storage for a pre-specified period of time.

Water Conservation Areas (WCAs) — Marshland areas that were designed for use as storage to prevent flooding, to irrigate agriculture and recharge well fields and as input for agricultural and urban runoff; the Water Conservation Areas WCA-1, WCA-2A, WCA-2B, WCA-3A and WCA-3B comprise five surface water management basins in the Everglades; bounded by the Everglades Agricultural Area on the north and the Everglades National Park basin on the south, the WCAs are confined by levees and water control structures that regulate the inflows and outflows to each one of them.

Watershed — A region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water.

Wetlands — Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wet Season — Hydrologically, for south Florida, the months associated with a higher than average incident of rainfall, June through October.

Wildlife Corridor — A relatively wide pathway used by animals to transverse from one habitat arena to another.

Wildlife Habitat — An area that provides a water supply and vegetative habitat for wildlife.

X

Y

Yellow Book — See “Restudy”

Z

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13.2 GLOSSARY OF ACRONYMS

A

AAHTO	American Association of Highway and Transportation Officials
ADaPT	Automatic Data Processing Tool
ADCP	Acoustic Doppler Current Profiler
AFB	Alternative Formulation Briefing
Ag	Silver
Al	Aluminum
AM	Adaptive management
Homestead ARB	Homestead Air Reserve Base
As	Arsebuc
ASA(CW)	Assistant Secretary of the Army for Civil Works
ASR	Aquifer Storage and Recovery
ASTM	American Society for Testing and Materials
ATV	All Terrain Vehicle

B

BBCW	Biscayne Bay Coastal Wetland
BBCWP	Biscayne Bay Coastal Wetland Preserve
BBPI	Biscayne Bay Partnership Initiative
BEBR	Bureau of Economic and Business Research
BKH	Burger King Headquarters
BMP	Best Management Practice
BNP	Biscayne National Park
BODR	Basis of Design Report
bpf	blows per foot

C

CAR	Coordination Act Report
C&SF	Central and Southern Florida
CBEEM	Criterion-Based Ecological Evaluation Methodology
CCV	Continuing Calibration Verification
CDOM	Color Dissolved Organic Matter
CE/ICA	Cost-Effective/Incremental Cost Analysis
CECW-AG	US Army Corps of Engineers, Civil Works, Policy Division
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CERP	Comprehensive Everglades Restoration Plan
CFA	Core Foraging Area
CFR	Code of Federal Regulation

cfs	cubic feet per second
CGM	CERP Guidance Memorandum
Cr	Chromium
CSSS	Cape Sable seaside sparrow
CSV	Comma-Separated Values
CVM	Contingent Valuation Method
CWCCIS	Civil Works Construction Cost Index System
CWRB	Civil Works Review Board

D

DCM	Design Criteria Memorandum
DDD	Dichloro-Diphenyl-Dichloroethane
DDE	Dichloro-Diphenyl-Dichloroethylene
DDT	Dichloro-Diphenyl-Trichloroethane
DERM	Miami-Dade Department of Environmental Resource Management
DOC	Dissolved Organic Carbon
DOI	Department of Interior
DQO	Data Quality Objectives

E

EB	Equipment Blank
EC	Engineering Circular
ECC	East Coast Canal
EDD	Electronic Data Deliverables
EFH	Essential Fish Habitat
EGM	Economic Guidance Memorandum
EHZ	Estuarine Habitat Zone
EI	Engineering Instructions
EIS	Environmental Impact Statement
EM	Engineering Manual
EMB	Everglades Mitigation Bank
ENP	Everglades National Park
E.O.	Executive Order
EPA	Environmental Protection Agency
EQ	Environmental Quality
ER	Engineering Regulations
ERDC	Engineering Research and Development Center
ERP	Environmental Resource Permit
ERRA	Everglades Restoration Resource Area
ETL	Engineering Technical Lead

F

F.A.C.	Florida Administrative Code
FCEB	Field Cleaned Equipment Blank
FDEP	Florida Department of Environmental Protection
FDOH	Florida Department of Health
FDOT	Florida Department of Transportation
Fe	Iron
FIFRA	Federal Insecticide, Fungicide and Rodenticide ACT
FIU	Florida International University
FKNMS	Florida Keys National Marine Sanctuary
FMP	Fisheries Management Plan
FONSI	Finding of No Significant Impact
FPL	Florida Power and Light
F.S.	Florida Statute
FSQM	Field Sampling Quality Manual
FWC	Florida Fish and Wildlife Conservation Commission
FWCA	Fish and Wildlife Coordination Act of 1958
FWO	Future Without Project Conditions

G

GM	Guidance Memorandum
GOMFMC	Gulf of Mexico Fishery Management Council
GPS	Global Positioning System

H

H&H	Hydrology and Hydraulics
HAFB	Homestead Air Force Base
HCl	Hydrochloric acid
HDPE	High Density Polyethylene
HDS	Horizontal Doppler System
HEP	Habitat Evaluation Procedures
HSI	Habitat Suitability Index
HTRW	Hazardous, Toxic, and Radioactive Waste
HU	Habitat Unit
HW	Headwater

I

IAR	Incremental Adaptive Restoration
IDC	Interest During Construction
IEEE	Institute of Electrical & Electronics Engineers
IESNA	The Illuminating Engineering Society of America
IMC	Interagency Model Center
ITR	Independent Technical Review

IWR	Impaired Water Rule

J

K

kg/L	kilograms per liter
ksi	1,000 psi (pounds per square inch)
kVA	kilo volt amperes

L

LCS	Laboratory Control Spike
LEC	Lower East Coast
LER	Lands, Easements, Rights-of-Way
LERR	Lands, Easements, Rights-of-Way, and Relocations
LIMS	Laboratory Information Management System
LOS	Level of Service
LOSFP	Level of Service for Flood Protection
LPG	Liquified Petroleum Gas

M

M&I	Municipal and Industrial
MAP	Monitoring and Assessment Plan
MCACES	Micro-Computer Aided Cost Engineering System
MCC	Motor Control Center
MDL	Method Detection Limit
MDS	Multi-dimensional Sediments
Mg	Magnesium
mg/L	Milligrams per Liter
MGD	Million Gallons per Day
MIS 1.0	Master Implementation Schedule
MISP 1/0	Master Implementation Sequencing Plan 1.0
Mn	Manganese
Modwaters	Modified Water Deliveries
MPMP	Master Program Management Plan
MPO	Metropolitan Planning Organization
MS	Microsoft
MWD	Modified Water Deliveries

N

NAI	Next-Added Increment
NEC	National Electrical Code
non-ECP	Non-Everglades Construction Project
NELAP	National Environmental Laboratory Accreditation Program

NED	National Economic Development (Plan)
NEPA	National Environmental Policy Act
NER	National Ecosystem Restoration
NFPA	National Fire Protection Association
NGVD	National Geodetic Vertical Datum
Ni	Nickel
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOX	Nitrogen Oxide
NPDES	National Pollutant Discharge Elimination System
NPL	National Priority List
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NSRS	Northeast Shark River Slough

O

O&M	Operations & Maintenance
OFW	Outstanding Florida Waters
OMRR&R	Operation, Maintenance, Rehabilitation, Repair, and Replacement
OPE	Other Project Elements
OSE	Other Social Effects
OWRN	Other Water Related Needs

P

PA	Planning and Assessment
P&S	Plans and Specifications
PAH	poly-cyclic aromatic hydrocarbons
PCA	Project Cooperation Agreement
PCB1	Pre-CERP Baseline
PCCD	Parallel Canal Collector Ditches
PDF	portable Document Format
PDT	Project Delivery Team
PEC	Probable Effects Concentrations
PED	Planning, Engineering, and Design
PEIS	Programmatic Environmental Impact Statement
PIR	Project Implementation Report
PL	Public Law
PM	Performance Measure
PMP	Project Management Plan
POM	Project Operating Manual
Ppt	parts per thousand
PSI	Pounds per Square Inch

Q

QA/QC	Quality Assurance / Quality Control
QASR	Quality Assurance Systems Requirement
QC	Quality Control
QM	Quality Manual

R

RCC	Reinforced Cement Concrete
RCRA	Resource Conservation and Recovery Act
RECOVER	Restoration, Coordination, and Verification
RED	Regional Economic Development
REP	Real Estate Plan
RPM	Revolutions per Minute
Restudy	Central and Southern Florida Project Comprehensive Review Study
ROD	Record of Decision

S

S&A	Supervision & Administration
SAD	South Atlantic Division
SAFMC	South Atlantic Fishery Management Council
SAV	Submerged Aquatic Vegetation
SCADA	Supervisory Control and Data Acquisition
SCC	Station Control Center
SCORP	State Comprehensive Outdoor Recreation Plan
SDA	Stormwater Detention Area
SDCS	South Dade Conveyance System
SDW	South Dade Wetlands
SEEP2D	2 Dimensional Seepage Analysis
SFWMD	South Florida Water Management District
SFWMM	South Florida Water Management Model
SHPO	State Historic Preservation Officer
SOP	Standard Operating Procedure
SPF	Standard Project Flood
SPT	Standard Penetration Test
SQAG	Sediment Quality Assessment Guidelines
STA	Stormwater Treatment Area
STDA	Stormwater Treatment and Detention Area
SWIM	Surface Water Improvement and Management

T

TCE	Trichloroethylene
TCM	Travel Cost Method

TDS	Total Dissolved Solid
TEC	Threshold Effects Concentrations
TIA/EIA	Telecommunications Industry Association/Electronic Industries Association
TKN	Total Kjehldahl Nitrogen
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TPC	Total Project Cost (Fully Funded)
TPCS	Total Project Cost Summary
TSDF	Treatment, Storage, and Disposal Facilities
TSP	Tentatively Selected Plan

U

U.S.	United States
UDB	Urban Development Boundary
UDV	Unit Day Value
UEA	Urban Expansion Area
UFGS	Unified Facilities Guide Specifications
UMAM	Uniform Mitigation Assessment Method
USACE	United States Army Corps of Engineers
USCOE	United States Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
USNMFS	U.S. National Marine Fisheries Service
UST	Underground Storage Tanks

V

VE	Value Engineering
VEO	Value Engineering Officer
VDS	Vertical Doppler System

W

WASD	Water and Sewer Department (Miami-Dade County)
WCA	Water Conservation Area
WQ	Water Quality
WQC	Water Quality Certification
WPA	Water Preserve Area
WRDA	Water Resources Development Act
WWR	Wastewater Reuse
WWTP	Wastewater Treatment Plant

X

Y

YB	Yellow Book

Z

ZSI	Zones of Similar Influence

SECTION 14

REFERENCES

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14.0 REFERENCES

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