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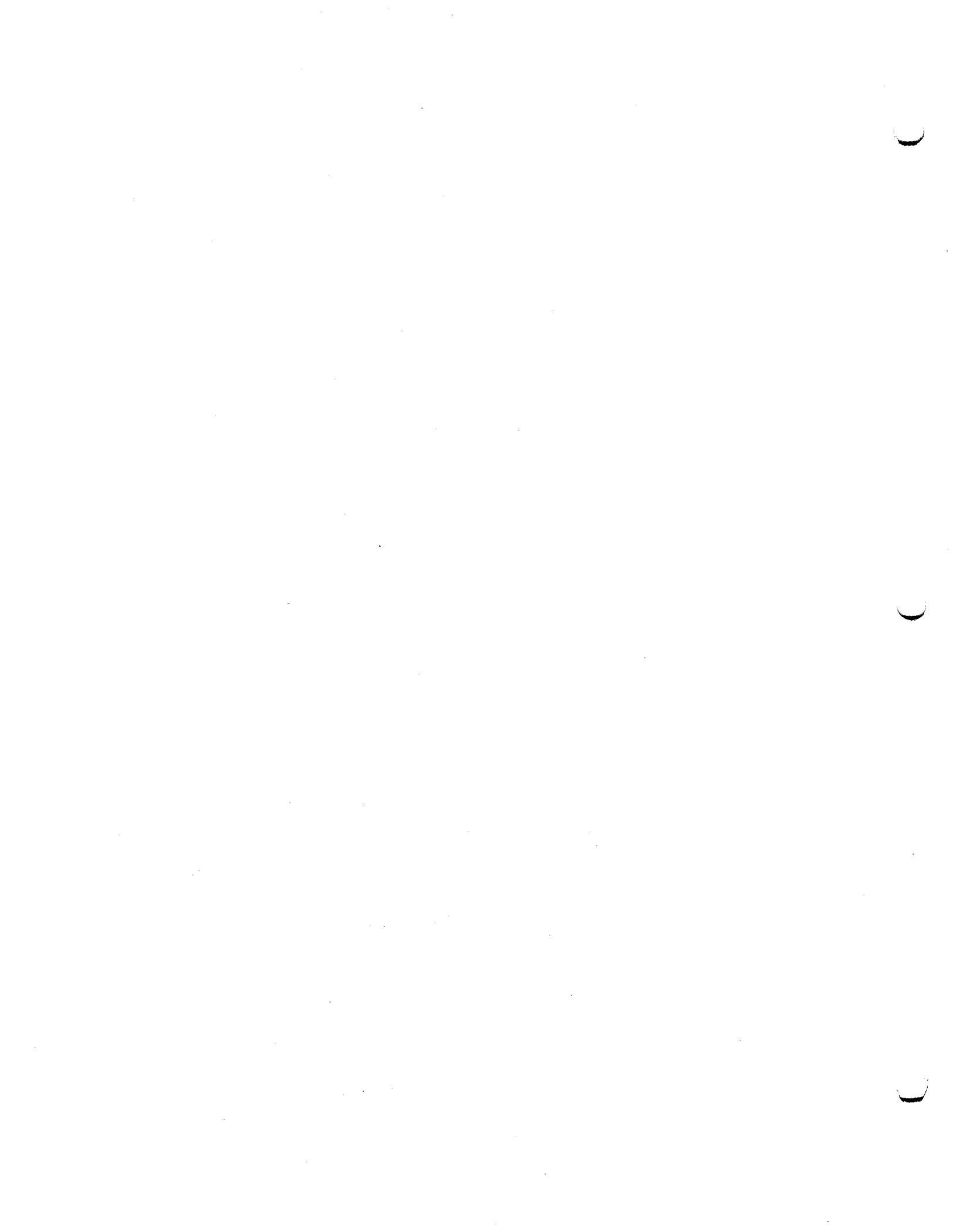
**ENVIRONMENTAL IMPACT STATEMENT
FOR
COAST OF FLORIDA EROSION AND STORM EFFECTS
STUDY, REGION III, PALM BEACH, BROWARD,
AND DADE COUNTIES, FLORIDA**

Prepared for

**U.S. Army Corps of Engineers
Jacksonville District
Jacksonville, Florida**

Prepared by

**Gulf Engineers & Consultants, Inc.
Baton Rouge, Louisiana**



October 1996

Final Report

Contract No. DACW17-94-D-0018
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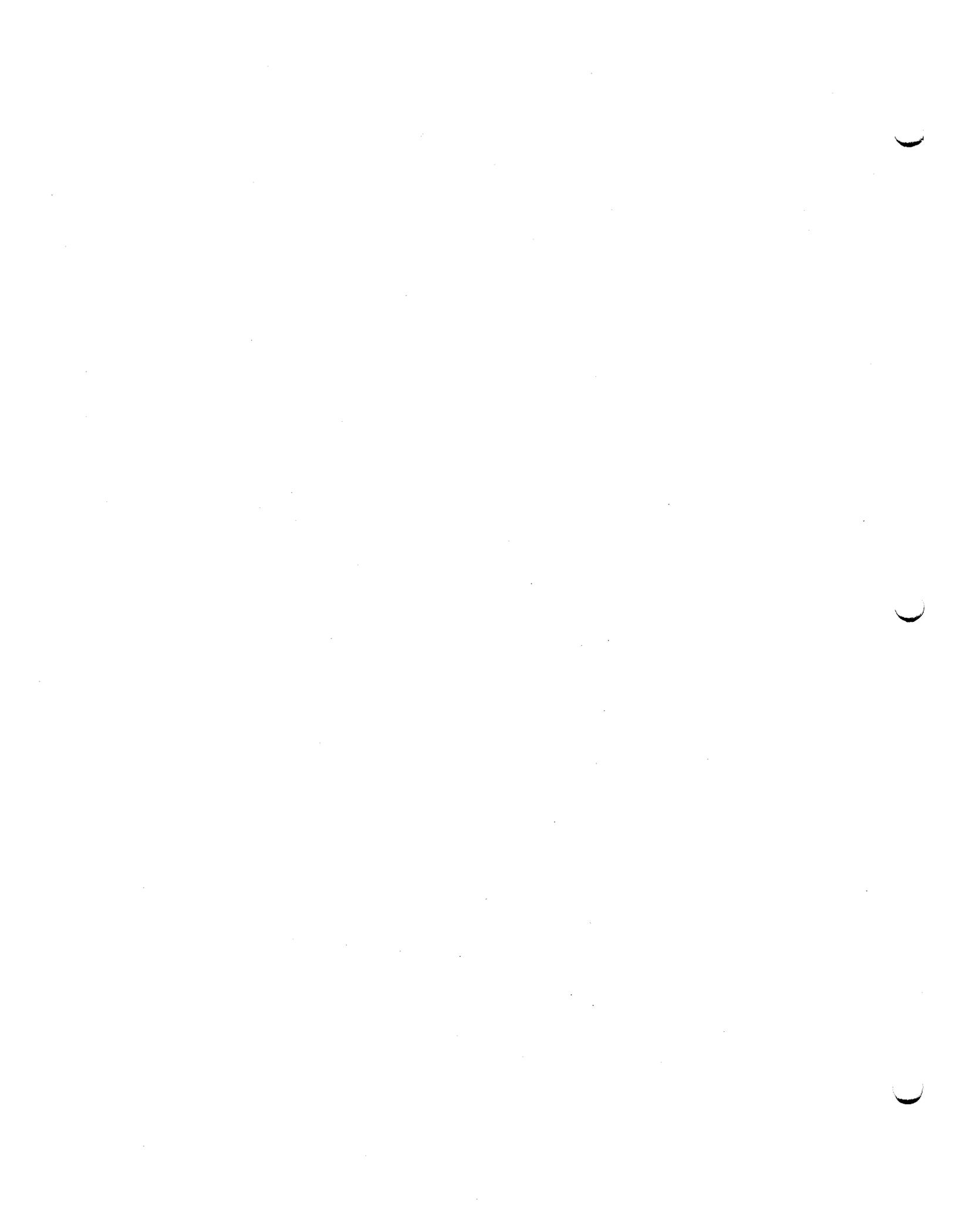
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**FINAL ENVIRONMENTAL IMPACT STATEMENT FOR THE
COAST OF FLORIDA EROSION AND STORM EFFECTS STUDY,
REGION III, PALM BEACH,
BROWARD, AND DADE COUNTIES, FLORIDA**

The responsible lead agency is the U.S. Army Corps of Engineers (USACE), Jacksonville District. The non-Federal sponsor is the State of Florida, Department of Environmental Protection.

ABSTRACT: In response to authority granted in Section 104, Public Law 98-360, the USACE instituted a study to review past projects and studies pertaining to shoreline erosion to develop a plan for future shoreline erosion mitigation projects. The Coast of Florida Erosion and Storm Effects Study (COFS) is a regional plan to address shoreline erosion and storm damage through beach nourishment, dune stabilization, and construction of sand transfer plants. The entire Florida coastline was divided into planning regions based on distinct morphologic and climate differences. Region III includes Palm Beach, Broward, and Dade counties and is the focus of this Environmental Impact Statement (EIS). The current combination of alternatives was developed based on logistical, political, and economic feasibility.

Under the currently proposed combination of alternatives, beaches would be restored through beach fill and nearshore berm placement. Permanent sand transfer plants are proposed for Lake Worth and South Lake Worth inlets. The use of Bahamian sand for sand starved areas in Broward and Dade counties is proposed as a sand source alternative. Sea turtles, primarily the loggerhead sea turtle, should benefit from the 215 additional acres of new beach that can be used for nesting, although appropriate pre- and post-mitigation of nourishment activities may be required. Adverse encounters with other endangered species is possible but unlikely. Impacts to approximately 61 acres of nearshore hardground would occur from their burial during nourishment activities, and temporary impacts to beach fill and borrow site soft bottom communities would occur as well. Turbidity and sedimentation impacts are likely in the short-term for all borrow and fill zones; however, buffer zones around borrow sites should minimize impacts in these areas. Water, air, noise, cultural resources, and recreation should not be significantly affected from any COFS action alternatives; however, minor temporary impacts during alternative implementation is likely. Additional recreational benefits attributable to the projected 215 acres of new beach created by the recommended plan could have an average annual benefit of approximately \$8.7 million. While possible, mechanical damage to offshore reefs is unlikely with the use of buffer zones within which dredging activity would not be allowed. The regional economy would generally be unaffected by COFS activities; however, avoided storm damages for the 10 to 20-year storm from COFS alternative implementation could equal as great as \$33 million. Energy requirements would be insignificant, and no significant irretrievable or irreversible commitments to resources are likely under the proposed combination of alternatives.

Of the proposed alternatives addressed, only three project segments are recommended for Federal participation at this time. These are sand transfer plants at Lake Worth and South Lake Worth Inlets and beach nourishment at Dania, Florida. This reflects the President's commitment to focus limited Federal budgetary resources on the development of water resources projects and purposes that have national significance.

The no-action alternative would allow beach erosion to continue, further decreasing available nesting habitat and recreational beach acreage in Region III. Storm damages in excess of \$33 million would be realized over that which would be expected under the proposed combination of alternatives.

**PLEASE SEND COMMENTS
TO THE DISTRICT ENGINEER
WITHIN 30 DAYS OF PUBLICATION
OF THE DRAFT EIS IN THE
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If you would like further information on this statement, please contact:
Mr. Michael Dupes, CESAJ-PD-ER
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P.O. Box 4970
Jacksonville, Florida 32232-0019
Telephone: (904) 232-1689

NOTE: Information, displays, maps, etc. discussed in the COFS Report are incorporated by reference in the EIS.

1.0 SUMMARY

1.1 Major Conclusions

Beaches along the Region III shoreline are in differing stages of erosion that require specific plans of action to reestablish beaches and protect them from storm damages. To economize in the planning and implementation of these projects, they have been aggregated into a regional plan that is presently analyzed in reference with the no-action alternative, which assumes that no nourishment operations would be completed outside of those already funded and in operation. The currently proposed combination of alternatives (selected plan) involves several types of actions including beach nourishments, nearshore berm placements, and sand transfer plants. These projects have the collective goal of reestablishing the beaches that have been degraded through anthropogenically disturbed littoral movement and storm damage. At this time however, only the sand transfer plants at Lake Worth and South Lake Worth Inlets and the beach nourishment at Dania are being recommended for Federal participation. Refer to section 2.4 of the EIS.

The selected plan would generally have only temporary impacts due to the nature of the activities. However, some impacts would have more enduring effects than others. Water turbidity in the vicinity of operations would generally increase during the borrow and nourishment activities; however, these impacts would be temporary and insignificant. Some turbidity associated impacts to hardgrounds near borrow areas may also occur, but mitigation efforts, namely buffer zones, should minimize these effects. Nourishment activities would avoid sensitive turtle nesting windows as well as be operated per the prescribed constraints of the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS); thus, impacts to sea turtles should be minimal and within allowable "taking" levels. An estimated 100, 91, and 24 acres of new beach would be created in Palm Beach, Broward, and Dade counties, respectively, which could benefit nesting sea turtles. Borrow operations would be conducted according to NMFS guidelines, minimizing the potential for takes of sea turtles in the borrow site area. Impacts to the endangered Indian manatee would likewise be minimal, with the implementation of operational requirements dictated by the USFWS. It is unlikely that other endangered species would be significantly impacted in an adverse manner from borrow or nourishment operations.

Preliminary estimates suggest that approximately 31, 25, and 5 acres of hardgrounds, in Palm Beach, Broward, and Dade counties, respectively, would be buried or otherwise impacted from nourishment activities associated with the recommended plan. However, mitigation measures would negate any habitat losses realized from hardground coverage associated with nourishment activities. Mechanical damage to hardgrounds is possible with borrow operations, although unlikely with the use of buffer zones and state-of-the-art navigation and positioning equipment. Temporary impacts associated with turbidity and sedimentation are likely in hardground areas flanking borrow sites, although efforts to minimize these impacts will be made through the establishment of buffer zones and other measures.

Direct effects on the regional economy from the implementation of proposed combination of alternatives (borrow, nourishment, or other associated activities) should be minor; however, projected 10- and 20-year storm damages as great as \$33 million could be avoided. Cultural resources should not be affected by the proposed action; however, in the event that underwater

archaeological remains are discovered during operations, appropriate action will be taken to minimize disturbance and insure integrity of the finding. Recreational resources should generally benefit with greater beach widths for beach activities. An estimated 100, 91, and 24 acres of additional beach would be created in Palm Beach, Broward, and Dade counties, respectively under the recommended plan. Benefits from this additional beach have been estimated to have an average annual equivalent recreational benefit as great as a \$8.7 million in Region III. However, increased turbidity levels may temporarily affect some hardground areas presently used by recreational divers. Long-term coverage of some hardground areas would be replaced with other habitat areas that could also be used by divers after colonization.

1.2 Areas of Controversy

Several areas of controversy exist for the COFS project. These are discussed below:

Use of Bahamian Sand for Nourishment Activities in Broward and Dade Counties.

Bahamian sand has been proposed as a compatible nourishment sand for beaches in Broward and Dade counties. Only one nourishment project to date has been studied (Fisher Island renourishment, Lutz *et al.*, 1993), and some entities believe that the lighter color of the sand that yields slightly cooler temperatures in sea turtle nests could lead to a proportionally greater number of male hatchlings. To date, no definitive studies on this issue have been documented.

Impacts on Sea Turtles. In addition to the issues surrounding the use of Bahamian sand, there is general concern that nourishment and borrow activities could lead to an unacceptable number of sea turtle "takes." This concern relates to the timing of activities, the compaction and slope of nourished beaches, and the operation plans (lighting and dredge-type) for borrow and nourishment operations. Consultation with the USFWS and the NMFS has resulted in a set of operational guidelines that will minimize "takes" of sea turtles.

Impacts on Sea Grass Beds. Although dense and relatively dense sea grass bed locations have been well mapped by the Florida Marine Research Institute (FMRI), sparse grass beds located in inlets and nearshore softbottoms are not fully mapped. There is a concern that unmapped, sparse beds near borrow or nourishment areas may be affected by increased turbidity levels and direct coverage associated with nourishment activities. Prior to borrow and nourishment activities, site reconnaissance will reveal any significant unmapped sea grass beds. Information from reconnaissance surveys will help in operational plans to avoid significant adverse impacts to these beds.

Impacts on Hardgrounds. Several concerns exist over the projected impacts to hardground areas in the nearshore and vicinity of the borrow areas. Generally, there is a concern that associated turbidity and sedimentation impacts to hardgrounds are not fully understood and that they may be understated herein. The available literature has been reviewed and suggests that although impacts are likely, they are not likely to be permanent. Furthermore, with the observance of buffer zones, associated turbidity and sedimentation, and mechanical impacts should be minimized.

1.3 Unresolved Issues

As noted in the section 1.2, Areas of Controversy, several of these controversial issues are unresolved. Specifically, impacts associated with the use of Bahamian sand are not fully documented for south Florida beaches. More specifically, the effects of Bahamian sand on sea turtle nesting are not definitively documented at this time. In addition to the unresolved concerns regarding Bahamian sand, the effects of increased turbidity and sedimentation on hardgrounds in both the nearshore and borrow areas are not fully understood. Although impacts would occur to hardgrounds from nourishment activity burial and can definitively be projected, the relationships among turbidity, sedimentation, and mortality are not definitive for all species in nearshore and borrow area hardgrounds. Therefore, although estimates of hardground impacts are provided herein, the precise amount of hardground mitigation needed for the implementation of the recommended plan is unresolved at this time.

1.4 Environmental Impact Tiering

Although location-independent and general impacts associated with the proposed action are discussed in this report, location-specific impacts with regard to borrow areas and nourishment activities are reserved for future tiered documentation (40 CFR §1508.28) that will be developed as project-specific details become available.

TABLE OF CONTENTS

Section		Page
1.0	NEED AND OBJECTIVE OF ACTION	EIS-1
	1.1 Authority	EIS-1
	1.1.1 Section 104, PL 98-360	EIS-1
	1.1.2 House Resolution	EIS-1
	1.2 Public Concerns	EIS-1
	1.3 Planning Objectives	EIS-2
2.0	ALTERNATIVES	EIS-3
	2.1 Alternative Selection Process	EIS-3
	2.2 Alternatives Eliminated From Further Discussion	EIS-4
	2.3 No-Action Alternative	EIS-5
	2.4 Currently Proposed Combination Alternatives	EIS-5
	2.4.1 Palm Beach County	EIS-5
	2.4.2 Broward County	EIS-12
	2.4.3 Dade County	EIS-15
	2.5 Comparative Impact of Alternatives	EIS-16
	2.6 Mitigation Summary and Plan	EIS-16
3.0	AFFECTED ENVIRONMENT	EIS-20
	3.1 Physical Setting	EIS-20
	3.1.1 Climate	EIS-20
	3.1.2 Storm Events	EIS-20
	3.1.3 Winds	EIS-20
	3.1.4 Waves	EIS-21
	3.1.5 Currents	EIS-21
	3.1.6 Tides	EIS-22
	3.1.7 Storm Surge	EIS-22
	3.1.8 Sea Level Rise	EIS-23
	3.1.9 Air Quality and Noise	EIS-23
	3.2 Geology	EIS-23
	3.2.1 Geology and Geomorphology of Study Area	EIS-23
	3.2.2 Water Quality	EIS-24

TABLE OF CONTENTS (cont'd)

Section	Page
3.2.3 Sand Source Location	EIS-25
3.2.4 Sand Quality	EIS-26
3.2.5 Hazardous, Toxic, and Radioactive Waste	EIS-28
3.3 Biological Resources	EIS-28
3.3.1 Endangered Species	EIS-28
3.3.2 Sea Grass	EIS-29
3.3.3 Nearshore Communities	EIS-29
3.3.4 Offshore Communities Potentially Found in or Near the Proposed Borrow Sites	EIS-34
3.3.5 Inlet Communities	EIS-36
3.3.6 Dune Communities	EIS-37
3.3.7 Migratory Birds	EIS-38
3.4 Socioeconomic Resources	EIS-38
3.4.1 Demographics	EIS-38
3.4.2 Employment/Income	EIS-38
3.4.3 Coastal-Dependent Industries	EIS-39
3.4.4 Land Use	EIS-40
3.4.5 Storm Damages	EIS-40
3.5 Cultural Resources	EIS-40
3.6 Recreational Resources	EIS-40
3.6.1 Beach Activities	EIS-40
3.6.2 Water Related Activities	EIS-41
4.0 ENVIRONMENTAL CONSEQUENCES	EIS-43
4.1 Physical Setting	EIS-43
4.1.1 Impacts	EIS-43
4.1.2 Mitigation	EIS-44
4.2 Geology/Hydrology	EIS-44
4.2.1 Impacts	EIS-44
4.2.2 Mitigation	EIS-46

TABLE OF CONTENTS (cont'd)

Section	Page
4.3	Biological Resources EIS-46
4.3.1	Impacts EIS-46
4.3.2	Mitigation EIS-53
4.4	Socioeconomic Resources EIS-56
4.4.1	Impacts EIS-56
4.4.2	Mitigation EIS-57
4.5	Cultural Resources EIS-57
4.5.1	Impacts EIS-57
4.5.2	Mitigation EIS-58
4.6	Recreational Resources EIS-58
4.6.1	Impacts EIS-58
4.6.2	Mitigation EIS-59
4.7	Other Considerations EIS-59
4.7.1	Cumulative Impacts EIS-59
4.7.2	Coastal Barrier Resource Act EIS-59
4.7.3	Florida Coastal Zone Management Program EIS-59
4.7.4	Irretrievable and Irreversible Commitments of Resources EIS-60
4.7.5	Energy Requirements EIS-60
4.7.6	Future Renourishment Impacts EIS-60
4.7.7	Compliance with Federal Statutes, Executive Orders, and Policies EIS-60
5.0	LIST OF PREPARERS EIS-62
6.0	PUBLIC INVOLVEMENT, REVIEW AND COORDINATION EIS-63
6.1	Public Involvement Program EIS-63
6.2	Required Coordination EIS-63
6.3	Statement Recipients EIS-63
7.0	REFERENCES EIS-66
8.0	INDEX EIS-79

LIST OF TABLES

Table Number		Page
2.1	Presently Proposed Combination of Alternatives: Palm Beach County	EIS-7
2.2	Presently Proposed Combination of Alternatives: Broward County	EIS-8
2.3	Presently Proposed Combination of Alternatives: Dade County	EIS-9
2.4	Comparative Impact of Alternatives	EIS-17
3.1	Rare, Threatened, and Endangered Species in the Coastal Study Areas of Palm Beach, Broward, and Dade Counties	EIS-30
4.1	Compliance with Federal Statues, Executive Orders, and Policies	EIS-61

1.0 NEED AND OBJECTIVE OF ACTION

1.1 Authority

The Coast of Florida Erosion and Storm Effects Study (COFS) is conducted in response to Section 104 of Public Law (PL) 98-360, an Appropriations Act for the fiscal year ending 30 September 1985, and a resolution dated 8 August 1984 by the Committee on Public Works and Transportation, of the U.S. House of Representatives, which provide for the following:

1.1.1 Section 104, PL 98-360. The Secretary of the Army, acting through the Chief of Engineers, is authorized to review, in cooperation with the State of Florida, its political subdivision, agencies and instrumentalities thereof, all previous published reports of the Chief of Engineers pertaining to shoreline erosion on the entire coast of Florida with a view to determining whether any modifications of the recommendations contained therein are advisable at this time, with particular reference to developing a comprehensive body of knowledge, information, and data on coastal area changes and processes.

1.1.2 House Resolution. Resolved by the Committee on Public Works and Transportation of the U.S. House of Representatives that the Secretary of the Army, acting through the Chief of Engineers, in accordance with the provisions of Section 110 of the River and Harbor Act of 1962, is hereby authorized to study, in cooperation with the State of Florida, its political subdivision and agencies and instrumentalities thereof, the entire coast of Florida, including a determination of whether any modifications of the recommendations contained in previously published reports of the Chief of Engineers pertaining to shoreline erosion on the coast of Florida are advisable, and also including the development of a comprehensive body of knowledge, information, and data on coastal area changes and processes for such entire coast.

1.2 Public Concerns

The primary public concern within Region III for COFS is the ongoing shoreline recession and corresponding vulnerability to storm damages. All of Florida's 8,400 miles of tidal shoreline are low-lying and vulnerable to storm surge and other storm associated damage. However, other concerns gleaned from initial scoping efforts include: (1) the potential impact of Bahamian sand on sea turtle nests; (2) the impacts of nearshore hardgrounds from nourishment burial; and (3) the need for certain projects.

Shoreline recession continues to be a problem along Florida's coastline. The net long-term sediment transport rate along the east coast of Florida is generally from north to south, with some localized flow reversals associated with complex hydrodynamic interactions at tidal inlets and/or some localized net long-term cross-shore (onshore or offshore) transport associated with localized bathymetric irregularities. In general, as a result of the reduced wave climate (shielding from the Bahama banks), the sediment transport rate is reduced from the north to the south. Based on current management strategies, shoreline recession will continue. Sea-level rise and other natural and man-induced activities that influence the natural sediment transport processes will tend to maintain shoreline recession.

Tidal inlets have a tendency to interrupt the normal littoral transport of sediments along the coastline. If left to nature, these inlets would have a tendency over the long-term to restore

the natural bypassing of sediments along the coast. Conflicts occur as a result of the multi-purpose uses desired in the coastal zone. The need to maintain inlet channels for commercial and recreational navigation, improve water quality characteristics in the interior water bodies, and maintain recreational uses of the adjacent beaches often result in conflicting and competing interests. For a detailed discussion of the need of COFS, see the *Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III, October 1996*, U. S. Army Corps of Engineers (USACE), Jacksonville District.

1.3 Planning Objectives

The major Federal and state planning objectives for the COFS include: (1) reduction of expected storm damages through beach nourishment and other project alternatives; (2) reestablish beaches to a degree suitable for beach recreation; (3) maintain suitable beach habitat for nesting sea turtles, and invertebrate and shorebird species; and (4) maintain commerce associated with beach recreation in Region III.

The approach taken in the COFS is to investigate the coastal processes and natural resources on a regional basis, instead of a conventional project by project basis to develop enhanced and/or new storm damage reduction projects along the studied coastline. To effectively manage and support such a comprehensive and extensive study, the State has been divided into the following five coastal regions based on distinct differences between the areas, such as wave climate, coastal processes, and native beach characteristics: Region I - panhandle; Region II - peninsular gulf coast to the northern extent of the Keys; Region III - southern east coast; Region IV - central east coast; and Region V - northern east coast.

The focus of this report and the first region to be studied is Region III. This region includes northern Dade County from the southern end of Key Biscayne throughout Broward County, and to Jupiter Inlet in northern Palm Beach County. The remaining 1.9 miles of Palm Beach County, north of Jupiter Inlet, is part of the Region IV littoral zone and will be examined in detail during that portion of the COFS. Region III was identified as the first region for study since it is the most densely populated coastal region in Florida and has the largest local, state, and Federal investment in shore protection. Within the 91 miles of Region III shoreline, there are 61 miles of initial beach restoration authorized as part of Federal shore protection projects. The Federal Government, in cooperation with the State of Florida and local sponsors, has constructed approximately 35 miles of protective and recreational beach projects, and planning is underway for additional projects. For a detailed discussion of the purpose and objectives of COFS, see the *Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III, October 1996*, USACE, Jacksonville District.

2.0 ALTERNATIVES

2.1 Alternative Selection Process

The alternative plans considered were developed through a three-step process:

1. Identification and preliminary assessment of possible solutions. At this phase, benefits and costs had not been completed.
2. Development and assessment of intermediate-level-of-detail alternatives. Unit price cost estimates and benefits were computed. Includes general discussion of potential environmental impacts.
3. Development and assessment of detailed alternative plans. Cost code of account-level cost estimates were computed, including the costs of lands, easements, rights-of-way, and mitigation. Also, detailed benefits were computed, and Federal and non-Federal cost allocations were discussed in this phase.

Each step was iterative in the process of identifying and selecting the best course of action. Each alternative was considered in light of other projects within each reach or problem area. During the first step, the types of alternatives developed included traditional projects, programs that could be carried out by non-Federal interests, and all suggestions by participants in meetings and workshops. Each plan in the array was screened based on its ability to satisfy the planning objectives. The viable plans were carried forward into the intermediate level of detail and analysis and were developed sufficiently to assess generalized benefits, costs, and impacts. Those plans meriting closer evaluation were carried into the third step, development and analysis of alternative plans on a detailed level. The alternatives considered are listed below. (For a detailed discussion of the alternatives, see the *Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III, October 1996*, USACE, Jacksonville District.)

- No-action
- Rezoning of beach area
- Modification of building codes
- Construction of setback line
- Moratorium on construction
- Flood Insurance
- Evacuation planning
- Establish a no-growth program
- Condemnation of land and structures
- Various nonstructural combinations
- Revetment
- Beach fill with periodic nourishment

- Beach fill with periodic nourishment stabilized by an offshore breakwater or submerged artificial reef
- Beach nourishment with maintenance material from updrift inlet
- Beach fill and periodic nourishment stabilized by groins
- Seawalls
- Beach fill with periodic nourishment and hurricane surge protection sand dune
- Beach fill with periodic nourishment and hurricane surge protection - offshore breakwaters or submerged artificial reefs
- Nearshore berms
- Beach fill with nearshore berms
- Stabilization of beaches and dunes by vegetation
- Feeder beach
- Relocation of structures
- Flood proofing of structures
- Abandon or modify navigation projects
- Sand tightening of jetties
- Upgrading on construction of sand transfer plants for renourishment
- Use of sand from offshore borrow areas for beach fill
- Use of beach compatible sand from the maintenance dredging of navigational channels for beach
- Use of upland sand sources for beach fill
- Use of Bahamian sand for beach fill
- Various combinations of the above

2.2 Alternatives Eliminated From Further Discussion

Several alternatives were not evaluated further than the initial screening. Economic viability, effectiveness, political and social palatability, and combinations thereof made several options infeasible. Further information on the planning process of developing the present combination of alternatives is contained in the *Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III, October 1996*, U.S. Army Corps of Engineers (USACE), Jacksonville District. It should be emphasized that per 40 CFR §1502.14, the no-action alternative was not eliminated from further discussion. Projected trends and resulting conditions under the no-action alternative serve as valuable reference points from which proposed action impacts are gauged.

2.3 No-Action Alternative

The no-action alternative assumes that the existing trends will continue unabated into the future. This alternative assumes that no Federal nourishment activities would occur other than those already in operation, and those that have been approved under the National Environmental Protection Act (NEPA) process. Under the no-action alternative, beaches will continue to recede, decreasing the available area for beach recreational activities; however, additional nearshore hardgrounds would become exposed under this alternative, increasing hardground habitat and the corresponding potential for recreational diving resources in the nearshore area. Expected beach recession under the no-action alternative would also decrease the natural attenuation of wave damage during future storm events. Post-storm clean-up and repair activities would become correspondingly more expensive and labor intensive under the no-action alternative. Furthermore, expected beach recession under the no-action alternative might also endanger sea turtle nests through inundation, which would not be mitigated under Federal control.

2.4 Currently Proposed Combination Alternatives (Selected Plan)

The COFS feasibility report examines alternatives for three Federal shore protection projects (Palm Beach County, Broward County, and Dade County) containing 21 project segment elements. These project segments are described below and illustrated in summary in tables 2.1 through 2.3. Information, displays, maps, etc. discussed in the COFS report are incorporated by reference in the EIS. However, of the 21 segments, actions within only three segments are recommended for Federal participation at this time. These are: 1) Lake Worth Inlet Sand Transfer Plant, 2) South Lake Worth Inlet Sand Transfer Plant (STP), and 3) beach nourishment along 0.6 miles of beach at Dania, Florida. The Lake Worth Inlet STP is recommended as a modification to the Federal navigation project at Palm Beach Harbor to mitigate for the adverse effects of the navigation project on the downdrift shoreline. The Dania beach nourishment and South Lake Worth Inlet STP would provide significant cost savings to future nourishments of existing shore protection projects. This reflects the President's commitment to focus limited Federal budgetary resources on the development of water resources projects and purposes that have national significance. Refer to the syllabus and to sections 315 and 315a of the COFS feasibility report.

2.4.1 Palm Beach County

2.4.1.1 Recommend that the project for Palm Beach County, Florida from Martin County Line to Lake Worth Inlet and South Lake Worth Inlet to Broward County Line, authorized by the River and Harbor Act of 1962 (PL 87-874), be modified and herein after called the Palm Beach County, Florida Shore Protection Project. The following paragraphs describe components of the recommended project segments.

2.4.1.2 Jupiter Inlet to Lake Worth Inlet Project Segment.

2.4.1.2.1 Jupiter/Carlin. This existing 1.1 mile beach restoration and periodic nourishment project component is located between Florida Department of Environmental Protection (DEP) monuments R-13 and R-19. The project consists of a beach restoration with a seven year nourishment interval. Initial construction of this project was completed during April 1995. Extension of Federal participation from 10 years to the economic life of the project is recommended. Nearshore berms are not feasible in association with this project area due to the presence of nearshore hardgrounds.

2.4.1.2.2 Ocean Cay/Juno. This 2.75 mile project component is currently authorized for periodic nourishment as needed and justified. The recommended modification includes adding initial restoration by construction of a design beach with a 55 foot berm, and periodic nourishment between DEP monuments R-27 and R-41. The renourishment interval is seven years. Approximately 18.3 acres of new beach would be created under this alternative. The equilibrium toe of fill, including initial fill plus advance nourishment, is 300 feet. Mitigation for approximately 1.7 acres of hardground impact may be necessary in association with this project component. A nearshore berm site, away from potential hardground impact, has also been identified for use as an alternative maintenance dredged material disposal site. Extension of Federal participation from 10 years to the economic life of this project component is also recommended.

Table 2.1. Presently Proposed Combination of Alternatives: Palm Beach County

Category	Jupiter/Carlin	Ocean Cay/Juno	Lake Worth Inlet	North Palm Beach Island	Palm Beach Island	South Palm Beach Island	South Lake Worth Inlet	Ocean Ridge	Delray Beach	Highland Beach	Boca Raton
Structural Protection Measures											
Revetment	A, C	A, M	PL	A	A	A	PL	A	A, C, M	A, M	A, C
Beach fill and periodic nourishment											
Maintenance nourishment from updrift inlet											
Seawalls											
Surge protection sand dune											
Nearshore berms		US			US			US	PL	US	PL, M
Stabilize beach and dunes with vegetation											
Feeder beach											
Relocate structures											
Flood proof structures											
Abandon/modify navigation project											
Sand tighten jetty											
Sand trap											
Upgrade/construct sand transfer plant			PL				PL				
Non-Structural Protective Measures											
Rezoning beach area											
Modify building codes											
Construction Setback											
Construction moratorium											
Flood insurance											
No growth program											
Condemnation of land and structures											

NOTES: A = Authorized
C = Constructed

PL = Planned
US = Under Study

M = Modification

Source: USACE, 1996, Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III, Jacksonville District: Jacksonville, Florida.

Table 2.2. Presently Proposed Combination of Alternatives: Broward County

Category	Deerfield Beach/Hillsboro	Pompano - Unincc. Laud. by the Sea	Fort Lauderdale	J.U. Lloyd	Dania	Hollywood/ Hallandale
Structural Protection Measures						
Revetment						
Beach fill and periodic nourishment	A	A,C,M	A,M	A,C	A,M	A,C,M
Maintenance nourishment from updrift inlet						
Seawalls						
Surge protection sand dune						
Nearshore berms	PL	PL		PL,M		US
Stabilize beach and dunes with vegetation						
Feeder beach						
Relocate structures						
Flood proof structures						
Abandon/modify navigation project						
Sand tighten jetty						
Sand trap						
Upgrade/construct sand transfer plant						
Non-Structural Protection Measures						
Rezoning beach area						
Modify building codes						
Construction Setback						
Construction moratorium						
Flood insurance						
No growth program						
Condemnation of land and structures						

NOTES: A = Authorized and not constructed PL = Planned M=Modification
 C = Constructed US = Under Study

Source: USACE, 1996, *Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III*, Jacksonville District: Jacksonville, Florida.

Table 2.3. Presently Proposed Combination of Alternatives: Dade County

Category	Golden Beach	Sunny Isles	Bal Harbor - Surfside, Miami Beach	Key Biscayne
Structural Protection Measures				
Revetment				
Beach fill and periodic nourishment	PL,M	A,C,M	A,C	A,C
Maintenance nourishment from updrift				
Seawalls				
Surge protection sand dune				
Nearshore berms	US	US	PL,M	
Stabilize beach and dunes with vegetation				
Feeder beach				
Relocate structures				
Flood proof structures				
Abandon/modify navigation project				
Sand tighten jetty				
Sand trap				
Upgrade/construct sand transfer plant				
Non-Structural Protection Measures				
Rezoning beach area				
Modify building codes				
Construction Setback				
Construction moratorium				
Flood insurance				
No growth program				
Condemnation of land and structures				

NOTES: A = Authorized and not constructed PL = Planned M=Modification
 C = Constructed US = Under Study

Source: USACE, 1996, *Feasibility Report, Coast of Florida Erosion and Storm Effects Study, Region III*,
 Jacksonville District: Jacksonville, Florida.

2.4.1.3 Lake Worth Inlet to South Lake Worth Inlet Project Segment.

Recommend that the project for Palm Beach County, Florida for Lake Worth Inlet to South Lake Worth Inlet (Palm Beach Island) authorized in 1958 (PL 85-500) be deauthorized. The following project components for Palm Beach Island would be added as project modifications to the Palm Beach County, Florida (1962) project. Extension of Federal participation from 10 years to the economic life of the project is also recommended for each project component.

2.4.1.3.1 Lake Worth Inlet. The recommended plan for Lake Worth Inlet requires the construction of a new fixed sand transfer plant to be located north of the inlet with three discharge points located along the dry beach 750, 1,250, and 1,750 feet south of the south jetty on Palm Beach Island. This system would be designed for a target bypassing rate of about 160,000 cubic yards per year to the south, across the inlet, through a 12-in pipeline.

2.4.1.3.2 The recommended plan for the sand bypassing plant would include:

- a. A deposition area north of the north jetty,
- b. An array of jet pumps suspended from a pier oriented perpendicular to the shoreline, or a single jet pump deployed by a crane from the north jetty,
- c. A clear water pump and pipeline providing water to the jet pumps,
- d. An on shore pumphouse containing the clear water pump and a booster pump for transferring the dredged material past the inlet,
- e. A slurry pit to ensure the proper ratio of solids to water,
- f. An drilled tunneled pipeline under the inlet from north of the north jetty to the south side of the south jetty, and
- g. All associated pipe, valves, instruments, and controls required for operation of the system, including three remote controlled discharge valves located within the first 2,250 feet south of the south jetty.

The detailed sand transfer plant design would be determined within a Feature Design Memorandum (FDM) to be prepared during preconstruction, engineering, and design (PED).

2.4.1.3.3 North-End Palm Beach Island. The 1.95 mile beach restoration and periodic nourishment project component located between DEP monuments R-76 and R-85 is authorized (1958), but not constructed. The optimal berm width is 10 feet at elevation +9.0 feet NGVD and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial project design volume is 100,000 cubic yards with a 190 foot toe of fill. The recommended renourishment interval is four years. Approximately 2.3 acres of new beach would be created under this alternative. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment, is 281 feet with a total volume of 239,400 cubic yards. Mitigation for approximately 18 acres of hardground impact may be necessary in association with this project

segment. Nearshore berms are not feasible in association with this project component due to the presence of nearshore hardgrounds.

2.4.1.3.4 Palm Beach Island (Mid-town). The 3.1 mile beach restoration and periodic nourishment project component located between DEP monuments R-91 and R-105 is authorized (1958), but not constructed. The optimal berm width is 25 feet at elevation +9.0 feet NGVD and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial project design volume is 568,400 cubic yards with a 390 foot toe of fill. The recommended renourishment interval is four years. Approximately 9.3 acres of new beach would be created under this alternative. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment is 455 feet with a total volume of 1,025,7800 cubic yards. Mitigation for approximately 3.65 acres of hardground impact may be necessary in association with this project component. Three potential nearshore berm sites have been identified for use as an alternative maintenance dredged material disposal site for the Federal navigation project at Palm Beach Harbor.

2.4.1.3.5 South-End Palm Beach Island. This 3.25 mile beach restoration and periodic nourishment project component located between DEP monuments R-116 and R-132 is authorized (1958), but not constructed. The optimal berm width is 35 feet at elevation +9.0 feet NGVD and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial project design volume is 248,900 cubic yards with a 350 foot toe of fill. The recommended renourishment interval is four years. Approximately 13.8 acres of new beach would be created under this alternative. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment, is 432 feet with a total volume of 674,500 cubic yards. Mitigation for approximately 5.4 acres of hardground may be necessary in association with this project component.

2.4.1.4 South Lake Worth Inlet to Boca Raton Inlet Segment:

2.4.1.4.1 South Lake Worth Inlet. The recommended plan for South Lake Worth Inlet requires the construction, operation and maintenance of a new sand transfer plant to be located north of the inlet with one discharge point located approximately 2,000 feet south of the south jetty. This system would be designed for a target bypassing rate of about 120,000 cubic yards per year. The design would be similar to the Lake Worth Inlet sand transfer plant and would similarly be determined within a FDM during PED studies.

2.4.1.4.2 Ocean Ridge. The 1.35 mile beach restoration and periodic nourishment project component located between DEP monuments R-152 and R-159 is authorized (1962), but not constructed. This project is scheduled for construction by Palm Beach County during 1996. The optimal berm width is 60 feet at elevation +9.0 feet NGVD and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial design volume is 770,000 cubic yards and includes 8 years of advance nourishment. The annual advance nourishment is 62,600 cubic yards. Two nearshore berm sites, however, have been recommended as potential dredged material disposal sites. Extension of Federal participation from 10 years to 50 years is recommended.

2.4.1.4.3 Delray Beach. The recommended 2.7 mile beach restoration and periodic nourishment project component located between DEP monuments R-175 and R-188 is

authorized and constructed. This project is recommended for modification with an additional 20 feet optimal berm width at elevation +9.0 feet NGVD and slopes of 1:20 berm to MLW and 1:30 from MLW to existing bottom. The recommended additional design volume is 155,300 cubic yards with a 290 foot equilibrium toe of fill. Approximately 6.5 acres of new beach would be created under this alternative. No hardgrounds exist in the vicinity of this project so no mitigation will be required. Although this project component is a considerable distance from either inlet, an extensive nearshore berm site offshore of this project component is recommended as a potential dredged material disposal site. Extension to 50 years of Federal participation was approved by Assistant Secretary of Army (Civil Works) under Section 934.

2.4.1.4.4 Highland Beach. The 3.4 mile beach restoration and periodic nourishment project component located between DEP monuments R-188 and R-205 is a modification to the authorized (1962) periodic nourishment project. It would fill in a gap between two authorized projects for lessening end losses. The optimal berm width of this project component is 120 feet at elevation +9.0 feet NGVD, and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial project design volume is 944,999 cubic yards with a 350 foot toe of fill. The recommended renourishment interval is seven years. Approximately 49.5 acres of new beach would be created under this alternative. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment, is 450 feet with a total volume of 1,765,287 cubic yards. Mitigation for approximately 1.9 acres of hardground impact may be necessary in association with this project component. One nearshore berm site has been identified offshore of this project coastline. Extension of Federal participation from 10 years to 50 years is recommended.

2.4.1.4.5 Boca Raton. The 1.65 mile beach restoration and periodic nourishment project component located between DEP monuments R-205 and R-213 is authorized and constructed. The only recommended modification to this project segment is a nearshore berm site as an alternative maintenance dredged material disposal site. The Boca Raton project has been extended to 50 years of Federal participation by Assistant Secretary of Army (Civil Works) under Section 934.

2.4.1.5 Other Palm Beach County Project Segment Alternatives.

As previously discussed, specific recommendations for the 1.9 miles of northern the Palm Beach County shoreline, north of Jupiter Inlet, will be addressed in the Region IV COFS study. In addition to the above specific project segments, periodic nourishment as necessary and justified is an existing project feature for Palm Beach County, Florida. No modification of this project feature is recommended for the economic life of the project. Dune grassing, as necessary and justified is also recommended for the Palm Beach County shoreline as a cost effective project feature.

2.4.2 Broward County

2.4.2.1 Boca Raton Inlet (Palm Beach County) to Hillsboro Inlet (Broward County) Segment.

2.4.2.1.1 Deerfield Beach/Hillsboro Beach (Segment I). The 4.4 mile beach restoration and periodic nourishment project segment located between DEP monuments R-1 and

R-24 is authorized, but not constructed. The optimal berm width is 30 feet at elevation +9.0 feet NGVD and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial project design volume is 746,700 cubic yards with a 300 foot toe of fill. The recommended renourishment interval is seven years. Approximately 16.0 acres of new beach would be created under this alternative. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment, is 406 feet with a total volume of 1,055,820 cubic yards. Mitigation for approximately 4.65 acres of hardground may be necessary in association with this project segment. A nearshore berm dredged material disposal site has been identified and recommended offshore this project shoreline. It is also recommended that Federal participation in this project segment be extended from 10 years to the economic life of the project.

2.4.2.1.2 Hillsboro Inlet. Navigation improvements are being considered for the outer channel at this inlet to provide additional advanced maintenance for the entrance channel as part of the Hillsboro Inlet, Florida, Federal navigation project. Two alternatives are being evaluated. One alternative is as designed and contained within a permit request by the local sponsor. The other is an alternative designed by Jacksonville District. The recommendations for this navigation project will be addressed in a separate navigation report which will address related potential impacts to the adjacent shorelines.

2.4.2.2 Hillsboro Inlet to Port Everglades Inlet Segment (Segment II).

2.4.2.2.1 Pompano/Lauderdale-By-The-Sea. The 5.2 mile beach restoration and periodic nourishment project segment located between DEP monuments R-24 and R-53 is authorized and constructed. This project is recommended for modification with an additional 35 feet optimal berm width at elevation +9.0 feet NGVD and slopes of 1:20 berm to MLW and 1:30 from MLW to existing bottom. The recommended additional design volume is 600,000 cubic yards with a resulting equilibrium toe of fill of 365 feet. Approximately 22.0 acres of new beach would be created under this alternative. Mitigation for approximately 12.25 acres of hardground may be necessary in association with this project segment modification. A nearshore berm dredged material disposal site has been identified and recommended off this project shoreline. Extension of Federal participation in this project segment from 10 years to the economic life of the project is also recommended.

2.4.2.2.2 Fort Lauderdale. This 4.0 mile project segment area located between DEP monuments R-53 to R-74 is authorized for periodic nourishment. A beach restoration and periodic nourishment project segment modification is recommended. The recommended optimal berm width is 25 feet at elevation +9.0 feet NGVD and slopes of 1:10 berm to MLW and 1:30 from MLW to existing bottom. The initial project design volume is 437,024 cubic yards. The recommended renourishment interval is six years. Approximately 12.1 acres of new beach would be created under this alternative. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment, is 500 foot with a total volume of 792,108 cubic yards. Federal participation to the 50 year economic life of this project segment is recommended. Mitigation for approximately 8.0 acres of hardground impact may be necessary in association with this project segment. Nearshore berms are not feasible in association with this project segment due to the presence of nearshore hardgrounds.

2.4.2.3 Port Everglades Inlet (Broward County) to Bakers Haulover Inlet (Dade County).

2.4.2.3.1 Broward County (Segment III). Segment III of the Broward County project includes two authorized beach restoration and periodic nourishment project sections, J.U. Lloyd and Hollywood/Hallandale. Extension of Federal participation to the 50 year economic life of these projects was approved by Assistant Secretary of Army (Civil Works) under Section 934 in September 1992.

2.4.2.3.2 J.U. Lloyd. The 2.3 mile beach restoration and periodic nourishment project segment located between DEP monuments R-86 and R-98 is authorized and constructed. The optimal berm width in the reanalysis of this project remains at 100 feet at elevation +10 feet NGVD and slopes of 1:15 berm to MLW and 1:30 from MLW to existing bottom. The design volume, including initial fill and advance nourishment is 1,032,000 cubic yards. The renourishment interval is six years. The only recommended modification to this project segment is a nearshore berm site as an alternative maintenance dredged material disposal site.

2.4.2.3.3 Hollywood/Hallandale. The 5.25 mile beach fill project located between DEP monuments R-101 and R-128 is authorized and constructed. This project is recommended for modification with an additional 50 feet optimal berm width at elevation +7.0 feet NGVD and slopes of 1:15 berm to MLW and 1:40 from MLW to existing bottom. The recommended additional design volume is 720,000 cubic yards resulting in a project equilibrium toe of fill of 230 feet. The renourishment interval is six years. Approximately 31.8 acres of new beach would be created under this alternative. No hardgrounds exist in the immediate vicinity of this project so no mitigation will be required. A nearshore berm dredged material disposal site has been identified offshore of this project segment.

2.4.2.3.4 Dania. This 0.6 mile reach of beach is presently authorized for periodic nourishment. A modification to a beach restoration and periodic nourishment project is recommended for this project segment component located between DEP monuments R-98 and R-101. Initial restoration of the beach at Dania would fill in the gap between J.U. Lloyd and Hollywood/Hallandale. Due to the small project length, the fill would be designed as a transition between these two all ready constructed projects and help reduce end losses in Segment III. The optimal berm width transition between J.U. Lloyd and Hollywood/Hallandale is 125 feet, on the average (i.e., between 100 and 150 feet), with a transition berm height between elevation +10.0 feet and +7.0 NGVD and slopes of 1:15 berm to MLW and 1:40 from MLW to existing bottom. The initial design volume is 208,300 cubic yards. The recommended renourishment interval is six years. The distance to the equilibrium toe of fill, including initial fill plus advance nourishment, is 220 feet with a total volume of 460,840 cubic yards. Approximately 9.1 acres of new beach would be created. Federal participation in the economic life of this transition project component is recommended.

2.4.2.3.5 Other Broward County Project Segments. In addition to the above specific project segments, periodic nourishment as necessary and justified is an existing project feature to the Broward County, Florida project. No change in this project feature is recommended at this time. Dune grassing, as necessary and justified is also recommended for the Broward County shoreline as a cost effective project feature.