PALM BEACH COUNTY, FLORIDA SHORE PROTECTION PROJECT

Jupiter Carlin Segment

FINAL INTEGRATED SECTION 934 REPORT AND ENVIRONMENTAL ASSESSMENT

AUGUST 2018

US Army Corps of Engineers ®
Jacksonville District

US Army Corps of Engineers
JACKSONVILLE DISTRICT

FINDING OF NO SIGNIFICANT IMPACT

JUPITER CARLIN SEGMENT OF THE PALM BEACH COUNTY SHORE PROTECTION PROJECT, FINAL INTEGRATED SECTION 934 REPORT AND ENVIRONMENTAL ASSESSMENT
PALM BEACH COUNTY, FLORIDA

The U.S. Army Corps of Engineers, Jacksonville District (Corps) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The final Integrated Section 934 Report and Environmental Assessment (report), dated August 2018, for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project addresses reducing storm damages to infrastructure opportunities and feasibility in Palm Beach County, Florida. The final recommendation is contained in the Director's Report dated 28 August 2018.

The report, incorporated herein by reference, evaluated various alternatives that would reduce storm damages to infrastructure in the study area. The recommended plan is the National Economic Development (NED) Plan and includes:

- A recommended beach fill template defined as a 0-foot extension of the project baseline (the 1990 mean high water line) at an elevation of +7.5 ft-NAVD88. Project slopes include a foreshore slope of 1V:1OH above mean low water (MLW) that transitions to a nearshore slope of 1V:25H from MLW to the intersection with the existing profile. Planned project nourishments consist of a 30-foot advance/sacrificial berm placed at an average periodic nourishment interval of every six years. The average volume of each nourishment interval was calculated to be approximately 193,300 cubic yards for the four nourishment events expected throughout the remaining 26-year period of analysis.

- This is a smaller template than the projects previously built by Palm Beach County. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the recommended plan would have no additional impact on hardbottom resources lying within the equilibrium toe of fill. Therefore, no additional mitigation is proposed.

In addition to a "no action" plan, three alternatives were evaluated. The alternatives included a 10 to 20-foot berm, 30-foot berm, 30 to 100-foot berm, and a no action plan. Section 3.6.1 of the report provides a summary of the plan formulation evaluation.

For all alternatives, the potential effects to the following resources were evaluated:

	In-depth evaluation conducted	Brief evaluation due to minor effects	Resource unaffected by action
Aesthetics	☐	☒	☐
Air quality	☒	☐	☐
Aquatic resources/nearshore habitat	☒	☐	☐
Coastal Barrier Resources	☒	☐	☐
Invasive species	☐	☒	☐
Fish and wildlife habitat	☒	☐	☐
Threatened/endangered species	☒	☐	☐
Historic properties	☒	☐	☐
Other cultural resources	☒	☐	☐
Floodplains	☐	☒	☐
Hazardous, toxic & radioactive waste	☐	☒	☐
Hydrology	☒	☐	☐
Land use	☒	☐	☐
Navigation	☐	☐	☒
Noise levels	☒	☐	☐
Public infrastructure	☒	☐	☐
Recreation	☐	☒	☐
Socio-economics	☒	☐	☐
Environmental justice	☐	☒	☐
Soils	☒	☐	☐
Tribal trust resources	☐	☒	☐
Water quality	☒	☐	☐
Climate change	☒	☐	☐

All practical means to avoid or minimize adverse environmental effects were analyzed and incorporated into the recommended plan. Best management practices (BMPs) as detailed in the report will be implemented to minimize impacts. BMPs shall include protection measures for nearshore hardbottom, threatened and endangered species, and water quality. Section 6.5 of the report provides a summary of BMPs or environmental commitments. No compensatory mitigation is required.

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service issued biological opinions, dated 13 March 2015 and 29 October 1997, which determined the recommended plan will not jeopardize the continued existence of the following federally listed species or adversely modify designated critical habitat: nesting sea turtles and sea turtles in the water. All terms and conditions, conservation measures, and reasonable and prudent alternatives and measures resulting from these consultations shall be implemented in order to minimize take of endangered species and avoid jeopardizing the species.

Pursuant to section 7 of the Endangered Species Act of 1973, as amended, the Corps determined that the recommended plan may affect but is not likely to adversely affect the following federally listed species or their designated critical habitat:

loggerhead sea turtle designated critical habitat, manatees, smalltooth sawfish, piping plover, rufa red knot, whales, and beach jaquemontia. The FWS concurred with the Corps' determination on 07 February 2017. The recommended plan is compliant with the South Atlantic Regional Biological Opinion issued 29 October 1997.

Pursuant to section 106 of the National Historic Preservation Act of 1966, as amended, the Corps determined that historic properties would not be adversely affected by the recommended plan. The Florida State Historic Preservation Office concurred with the determination on 16 March 2017.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the recommended plan has been found to be compliant with section 404(b) (1) guidelines (40 CFR 230). The Clean Water Act Section 404(b) (1) guidelines evaluation is found in Appendix G, Attachment 1 of the report.

A water quality certification pursuant to section 401 of the Clean Water Act was obtained from the Florida Department of Environmental Protection. All conditions of the water quality certification shall be implemented in order to minimize adverse impacts to water quality.

A determination of consistency with the Florida Coastal Zone Management program pursuant to the Coastal Zone Management Act of 1972 was obtained from the Florida Department of Environmental Protection.

The consistency determination was issued with water quality certification. All conditions of the consistency determination shall be implemented in order to minimize adverse impacts to the coastal zone.

Public review of the draft report was completed on 10 April 2017. All comments submitted during the public comment period were responded to in the Final report.

Technical, environmental, economic, and cost effectiveness criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on these report, the reviews by other federal, state and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the recommended plan would not significantly affect the human environment; therefore, preparation of an Environmental Impact Statement is not required.

A copy of this finding and the report will be made available to the public on the following website: http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

24 October 2018
Date

Andrew D. Kelly, Jr.
Colonel, Corps of Engineers
District Commander

FINAL INTEGRATED SECTION 934 REPORT AUGUST 2018

& ENVIRONMENTAL ASSESSMENT

PALM BEACH COUNTY, FLORIDA SHORE PROTECTION PROJECT

Jupiter Carlin Segment

Section 934 of Water Resources Development Act of 1986

Shore Protection Project

RESPONSIBLE AGENCIES: U.S. Army Corps of Engineers, Jacksonville District

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EXECUTIVE SUMMARY

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STUDY SCOPE

Infrastructure along the Jupiter Carlin, Palm Beach County, Florida shoreline, is subject to damage from wave attack, erosion, and inundation caused by coastal storms (REF-1). It is projected that, without extending the period of Federal participation in periodic beach nourishment, storm-induced erosion in the study area will continue damaging infrastructure, limiting habitat, and jeopardizing storm evacuation and relief efforts. This study evaluates the extension of Federal participation in beach nourishment efforts for the authorized Project through 2045, and its optimization. This Project addresses coastal storm damage reduction, as well as incidental opportunities for maintenance of environmental and recreation resources for the Jupiter Carlin Segment of shoreline in Palm Beach County, Florida.

STUDY AUTHORITY

This report is being prepared according to the authority provided by Section 156 of the Water Resources Development Act (WRDA) of 1976 (PL 94-587), as amended by Section 934 of WRDA 1986 (PL 99-662). Section 156 of WRDA 1976 states:

> *The Secretary of the Army, acting through Chief of Engineers, is authorized to provide periodic beach nourishment in the case of each water resources development project where such nourishment has been authorized for a limited period for such additional period as he determines necessary, but in no event such additional period extend beyond the fifteenth year which begins after the date of initiation of construction of such project.*

Under the authority, the Secretary of the Army, acting through the Chief of Engineers, was granted discretionary authority to extend Federal participation to the fiftieth year after the date of initial construction of a project, per Section 506 of WRDA 1996 (PL 104-303).

> *If the Secretary determines under paragraph (1) that periodic beach nourishment is necessary for a project, the Secretary shall carry out periodic beach nourishment for the project for a period of 50 years beginning on the date of initiation of construction of the project…*
>
> *(B) PALM BEACH COUNTY, FLORIDA.—Project for shoreline protection, Jupiter/Carlin, Ocean Ridge, and Boca Raton North Beach segments, Palm Beach County, Florida.*

STUDY AREA

The Project is located in Palm Beach County on the southeast coast of Florida, approximately 80 miles north of Miami, in northern Palm Beach County. The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is bounded on the north by Jupiter Inlet and by Carlin Park to the south. The Project length is 1.1 miles in length and spans Florida Department of Environmental Protection (FDEP) reference monuments R-13 south to R-19.

PURPOSE AND NEED

In accordance with Section 506 of WRDA 1996, the primary purpose of this report is to evaluate whether an extension of Federal participation in cost sharing of periodic beach nourishment remains economically justified, given current conditions, to the year 2045, which is fifty years from the date of initial construction of the Jupiter Carlin Segment of the Palm Beach County, Florida Shore Protection Project. Federal participation in cost sharing concluded in 2005, ten calendar years after initial construction began in 1995. Palm Beach County, the non-Federal sponsor, formally requested an extension of Federal participation in the Project in 2007.

PROBLEMS AND OPPORTUNITIES

Problems within the Jupiter Carlin study area include:

- Storm damages to property and infrastructure due to wave attack, inundation, and erosion
- Loss of natural dune and beach habitat
- Shoreline erosion threatening recreational opportunities

Opportunities within the Project area are positive conditions that may result from implementation of a Federal project. The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project's main opportunity is related to infrastructure protection:

- Reduce storm damages to infrastructure: Future without-project (FWOP) damages (modeled over 100 life-cycle iterations in Beach *FX*) are estimated at $1,005,000 in average annual terms.

Incidental opportunities are defined as other ancillary benefits that may be achieved from implementing the Project, and are supplementary to the Project purpose. Any improved environmental conditions are incidental to the primary purpose of reducing damages to infrastructure. Incidental opportunities for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project are listed below:

- Protect/enhance habitat/environmental resources: High-density turtle and shore bird nesting areas; near shore hardbottom resources
- Protection of the hurricane evacuation route in the down drift reach
- Retain recreation: Area depends on tourism, as well as aesthetic quality for recreation experience. Recreation benefits are estimated at $1,721,000 in average annual terms.

ENVIRONMENTAL CONSIDERATIONS

In accordance with permits issued by the State of Florida and USACE, Palm Beach County constructed a berm consisting of beach quality material from R-13 to R-19 in 1995, 2002, and 2015. The permits required that the County construct 4.0 acres of artificial reef to mitigate for impacts to naturally occurring hardbottom. The USACE Regulatory Division has determined that the beach placement, mitigation, and monitoring have been performed in compliance with the County's permit No. SAJ-1990-00902. The compliance letter dated 23 September 2015 can be found in Appendix H. The USACE Recommended Plan consists of a 30 foot berm and would be constructed from R-13 and R-19. This is a smaller template than the projects previously built by Palm Beach County. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the recommended plan would have no additional impact on hardbottom resources lying within the equilibrium toe of fill. Therefore, no additional mitigation is proposed.

The beneficial effects of periodic nourishment along the proposed Project area include establishing a larger buffer beach to protect upland infrastructure against coastal storm inundation, erosion, and wave attack, and additional habitat for beach flora and fauna, as well as more space for recreational activities. The proposed Project would likely produce more favorable environmental conditions than exist at present, although construction operations would produce some temporary adverse effects. The affected resources would return to pre-construction conditions either immediately after dredging, with respect to resources such as aesthetics and noise, or within one or two years, with respect to sea turtle nesting and benthic resources.

The Project area includes parts of two Coastal Barrier Resource System (CBRS) Units — FL-16P and FL-17P. The two units encompass Jupiter Beach Park and Carlin Park. Both areas represent "Otherwise Protected Areas" (OPAs). The Coastal Barrier Improvement Act of 1990 expanded the CBRS and created a new

category of lands known as OPAs. OPA designations add a layer of Federal protection to coastal barriers already held for conservation or recreation, such as national wildlife refuges, national parks and seashores, state and county parks, and land owned by private groups for conservation or recreational purposes. The Federal government may spend Federal funds on projects within OPAs as long as the funds do not go toward Federal flood insurance.

DESCRIPTION OF RECOMMENDED PLAN

The Jupiter Carlin segment of the authorized Project was originally 1.2 miles long with an approximate 100-foot sacrificial berm seaward extension of from the 1990 mean high water (MHW) and a seven year nourishment interval. The length of the authorized Project was reduced from 1.2 miles to 1.1 miles in the 1994 General Design Memorandum (GDM) Addendum.

The recommended plan presented in this document is an optimization of the authorized Project. The recommended plan has a smaller sacrificial berm width than the authorized Project. The optimized sacrificial berm width of the recommended plan is an approximate 30-foot seaward extension from the 1990 mean high water (MHW) line. The 1990 MHW line is the authorized design berm for this analysis. The initial nourishment volume is estimated to be approximately 191,900 cy placed between R-13 and R-19. Following the initial event, the average periodic nourishment interval is approximately every six years and the average periodic nourishment volume per event is approximately 193,300 cy placed between R-13 to R-19. The primary differences between the last analysis (1994 GDM Addendum) and the current analysis are:

- Two different models have been used to calculate storm risk management benefits, originally the Storm Damage Model and now Beach-*fx*
- Two different models have been used to calculate recreation benefits, originally the Travel Cost Method and now the Unit Day Value Method
- Local nourishment fill events that have been occurring regularly since 1947 and are now incorporated into the background erosion rates in the current analysis
- The existing Jupiter Inlet south jetty was extended by 175 feet in 1998. This jetty work occurred after the Federal Project was initially constructed in 1995. The jetty is a non-Federal structure located north and outside of the Project area. The extended jetty is included as a current condition in this analysis.

Table ES-1 provides an overview of the optimization of the authorized Project at FY18 price levels.

Table ES-1: Pertinent Project Information for the Optimization of the Authorized Project.

Optimization of the Authorized Project Description	The optimization of the authorized Project provides restoration and periodic nourishment of 1.1 miles of shoreline between the Florida Department of Environmental Protection (FDEP) reference monuments R-13 and R-19 (down drift benefits assess to R-26). The nourishment template consists of a 0-foot extension of the 1990 mean high water shoreline, with a 30-ft sacrificial berm.
Average # Nourishment Events	Four nourishment events are expected throughout the remaining period of analysis through 2045
Average Volume of Each Periodic Nourishment	First nourishment: 191,900 cubic yards Second nourishment: 193,300 cubic yards Third nourishment: 193,300 cubic yards Fourth nourishment: 225,500 cubic yards
Average Periodic Nourishment Interval	Approximately every 6 years
Nourishment Construction Duration	Approximately 3 months
Total Project Cost of Section 934 Extension for Four Nourishment Events (including contingency)	$47,551,000 (FY18 price levels, 25.0% overall average contingency)
Cost sharing	63% Federal / 37% non-Federal
Benefit-to-Cost Ratio (BCR)	1.49 (FY18 price levels, 2.75%)
Benefit-to-Cost Ratio (BCR) @7%	1.17 (FY18 price levels)

COST ESTIMATE AND IMPLEMENTATION

Total Project first costs and cost share breakdown are tabulated in Tables ES-2 and ES-3 in FY18 price levels. The Total Project fully funded cost is also presented Table ES-2 (bottom row), this is the cost used for budgeting purposes. Table ES-4 provides the annualized economic cost and benefits, net benefits, and benefit-to-cost ratio (BCR) for the Project. The average annual net benefits for the recommended plan are $1,014,000 and the BCR is 1.49 to 1.

There are currently five suitable parking and access points within the study area of R-13.5 to R-19. From north to south: Dubois and Jupiter Inlet Parks located at R-13; Jupiter Beach Park is located at R-14; and West Carlin and Carlin parks located between R-18 and R-19.

USACE policy in ER-1105-2-100 states: "Lack of sufficient parking facilities for the general public (including nonresident users) located reasonably near and accessible to the project beaches may constitute a restriction on public access and use, thereby precluding eligibility for USACE participation…Generally, parking on free or reasonable terms should be available within a reasonable walking distance of the beach…Reasonable access is access approximately every one-half mile or less." Based on existing information, there is one gap larger than one-half mile between the existing access points and this 400-ft long area is not federally cost-shared. Periodic nourishment events will be cost shared at 63% Federal and 37% non-Federal, but the periodic nourishment cost sharing may be adjusted based on the conditions of shore ownership and use at the time of construction. Additional information may be found in Plan Formulation and Recommended Plan chapters.

Table ES-2: Recommended Plan Cost Summary (FY18 Price Levels).

Recommended Plan Cost Summary (Project First Costs) (FY18 Price Levels) Palm Beach County SPP - Jupiter Carlin Segment R-13 and R-19 (total placement area, including tapers)		
	2020 Event	**Remaining Three Nourishments**
Item	**Total Item Cost**	**Total Item Cost**
Mob/Demob	$3,992,000	$11,976,000
Beach Fill	$3,919,000	$12,291,000
Associated General Items	$283,000	$864,000
Subtotal	$8,195,000	$25,131,000
Real Estate		
- Administrative		
-Federal Admin	$15,000	$45,000
-non-Federal Admin	$15,000	$45,000
PED	$1,170,000	$2,598,000
Construction Management	$206,000	$619,000
Subtotal	$1,407,000	$3,308,000
Contingency (25%)	$2,400,000	$7,110,000
Total	**$12,002,000**	**$35,549,000**
Total Project Cost (fully funded) for 50 year period of Federal participation (Including Spent Costs and the first costs escalated to the mid-point of construction)		**$71,325,000**

Note: Figures are rounded

Table ES-3: Recommended Plan Cost Sharing (Project First Cost) (FY18 Price Levels).

Palm Beach County, Florida Shore Protection Project					
Summary of Project Cost Sharing (Project First Costs) (FY18 Price Levels)					
R-13 to R-19 (total placement area, including tapers)					
Item	**Project First Cost**	**Federal Cost Share**	**Federal Cost**	**Non-Federal Cost Share**	**Non-Federal Cost**
Storm Damage Reduction Costs	$47,398,000	63.0%	$29,861,000	37.0%	$17,537,000
Administrative Costs	$153,000	63.0%	$96,000	37.0%	$57,000
Subtotal	$47,551,000		$29,957,000		$17,594,000
NOTE: Dollar values are rounded					

Note: Figures are rounded

Table ES-4: Economic Summary of the Recommended Plan.

Economic Summary	Primary Storm Damage Reduction Benefits	Primary Storm Damage Reduction + Incidental Recreation Benefits
Price Level	FY18	FY18
FY18 Water Resources Discount Rate	2.75%	2.75%
AAEQ Damage Reduction Benefits	$1,041,000	$1,041,000
AAEQ Land Loss Benefits	$192,000	$192,000
AAEQ Recreation Benefits	$0	$1,864,000
AAEQ Total Benefits	$1,233,000	$3,097,000
AAEQ Costs	$2,082,000	$2,082,000
AAEQ Net Benefits	**($846,000)**	**$1,014,000**
Benefit to Cost Ratio (BCR)	**0.59**	**1.49**

Note: Figures are rounded

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CHAPTER 1
INTRODUCTION

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1 INTRODUCTION*

This report evaluates the Federal interest in extending Federal participation in future nourishments of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project to the year 2045. This report incorporates the current Federal guidelines and policies, including Policy Guidance Letter (PGL) Number 22, (USACE, 1991), used for the evaluation. According to PGL 22, environmental documentation for Section 934 studies should verify the impacts presented in the original project's environmental documentation, address the environmental implications of any unanticipated or unforeseen impacts, and address project impacts relative to any changed conditions or requirements.

1.1 FEDERAL PROJECT PURPOSE*

Congress authorized Federal participation in Shore Protection Projects (SPP) for the purpose of providing beach erosion control, shoreline protection, and hurricane and storm damage reduction for vulnerable populations, infrastructure, ecosystems, and properties considering future sea-level and climate-change scenarios. Public Law 84-826, approved July 28, 1956, expanded the Federal role in shore protection by authorizing Federal participation in the cost of works for protection and restoration of the shores of the United States, if such protection would result in public benefits. The Water Resources Development Act (WRDA) of 1986 assigns costs of Federal projects to appropriate project purposes. Project reaches that provide hurricane and storm damage reduction are assigned a maximum of 65% Federal cost share for initial construction. Participation in the protection of private properties is permitted only if such protection is incidental to the protection of public areas, or if the protection of private property would result in public benefits. Policy guidance precludes Federal funds to support construction of SPPs which depend on separable recreation benefits for economic justification, or for which incidental recreation benefits are greater than 50% needed for justification (Engineer Regulation (ER) 1105-2-100 Section 3-4.b.(4)(a)). The Federal government does not participate in work realizing separable recreation benefits such as constructing a beach only for recreational purposes (and not hurricane and storm damage reduction purposes) or constructing recreation facilities (ER 1105-2-100, Appendix E., Section I.E-25.b.(2))

1.2 PROJECT AUTHORITY

The Jupiter Carlin Segment of the Palm Beach County, Florida, Shore Protection Project was authorized by Section 101 of the Rivers and Harbors Act of 1962 (Public Law 87-874) as follows:

> *Palm Beach County from Martin County line to Lake Worth Inlet and from South Lake Worth Inlet to Broward County line, Florida: House Document Numbered 164, Eighty-seventh Congress, at an estimated cost of $128,800.*

1.3 STUDY SPONSOR

The non-Federal sponsor for the Jupiter Carlin Segment of the Palm Beach County, Florida, Shore Protection Project is Palm Beach County, represented by the chairperson from the Palm Beach County Board of Commissioners. The Project is being administered by the Palm Beach County Department of Environmental Resources Management. Federal participation in cost-sharing of periodic beach nourishment of the Project concluded in 2005. The non-Federal sponsor formally requested, in writing, an extension of Federal participation in cost-sharing of periodic beach nourishment in the Project in 2007.

1.4 STUDY AUTHORITIES*

This report is being prepared according to the authority provided by Section 156 of the Water Resources Development Act (WRDA) of 1976 (PL 94-587), as amended by Section 934 of WRDA 1986 (PL 99-662). Section 156 of WRDA 1976 states:

> *The Secretary of the Army, acting through Chief of Engineers, is authorized to provide periodic beach nourishment in the case of each water resources development project where such nourishment has been authorized for a limited period for such additional period as he determines necessary, but in no event such additional period extend beyond the fifteenth year which begins after the date of initiation of construction of such project.*

Under the authority, the Secretary of the Army, acting through the Chief of Engineers, was granted discretionary authority to extend Federal participation to the fiftieth year after the date of initial construction of a project, per Section 506 of WRDA 1996 (PL 104-303).

> *If the Secretary determines under paragraph (1) that periodic beach nourishment is necessary for a project, the Secretary shall carry out periodic beach nourishment for the project for a period of 50 years beginning on the date of initiation of construction of the project…*
>
> *(B) PALM BEACH COUNTY, FLORIDA.—Project for shoreline protection, Jupiter/Carlin, Ocean Ridge, and Boca Raton North Beach segments, Palm Beach County, Florida.*

1.5 STUDY BACKGROUND & LOCATION*

The Jupiter Carlin Segment of the Federal Palm Beach County, Florida Shore Protection Project is located on the east coast of Florida, approximately 80 miles north of Miami, in the northern portion of Palm Beach County. The Project spans Florida Department of Environmental Protection (FDEP) R-monuments[1] R-13 (just south of Jupiter Inlet) to R-19 (Carlin Park), restoring approximately 1.1 miles of shoreline.

Figure 1 provides a detailed Project map showing the authorized project limits. The county, with Federal government reimbursement, initially constructed this project in 1995, with the first and only Federal periodic nourishment event in 2001/2002. Federal cost-sharing in the authorized Project ended in 2005.

There are two Coastal Barrier Resource System Otherwise Protected Areas (OPA) within the Project area (FL-16P and FL-17P). OPA boundaries are generally intended to coincide with the boundaries of conservation or recreation areas such as state parks, as is the case here with Jupiter Beach Park and Carlin Park. The only Federal funding prohibition within OPAs is Federal flood insurance.

Development within the study area includes multi-story condominiums, a resort, a restaurant, a civic center, and park facilities, all located on the east (ocean) side of State Road (SR) A1A. SR A1A is a designated hurricane evacuation route. The two oceanfront county parks within the study area, Jupiter Beach Park and Carlin Park, provide public parking and beach access. These parks and their related parking and access are located within the Project area and are discussed further in Chapter 2.

[1] FDEP R-monuments are located approximately every 1000 feet along the shoreline and serve as geographic reference points for historic and contemporary shoreline monitoring. They are used as reference points throughout this report.

Figure 1: Project Location.

1.6 STUDY PURPOSE & NEED*

Section 934 of WRDA 1986 amended Section 156 of WRDA 1976 to allow the Secretary of the Army to extend the period of Federal participation up to 50 years. This report evaluates the Federal interest in extending Federal participation in future nourishments of the Jupiter Carlin segment to the year 2045, under current Federal policies, guidelines, and requirements. PGL 22, which gives guidance for placement of materials on beaches, states that:

> *Federal participation in periodic beach nourishment at existing projects may be extended if it is determined that, based on current evaluation guidelines and policies, the existing project is economically justified. Although no other alternatives are implementable under the authority of Section 934, an analysis of alternatives, similar in scope to an initial appraisal under Section 216 of the 1970 Flood Control Act should be included as part of the Section 934 study.*

For Section 934 studies, PGL 22 details the following two step process:

> *(1) identify (update, no indexing) current benefits of the existing project to determine if continued maintenance of the existing project is economically justified and consistent with current policies; and (2) develop alternatives (size & timing) for nourishment and recommend the most cost-effective nourishment scheme for the authorized project. Changes in project scope, such as increases in length, are not included in this study.*

A National Environmental Policy Act (NEPA) Environmental Assessment (EA), prepared in conjunction with this Section 934 study is integrated into this report, verified the effects presented in the original Project environmental documentation, addressed the environmental implications of any unanticipated or unforeseen effects, and addressed project effects relative to any changed conditions or requirements.

This Report serves as the decision document to extend Federal participation in cost-sharing fifty years beyond the date of initial construction in 1995 and, if approved, will extend Federal participation to May 2045. The approval level for this Report is the Assistant Secretary of the Army for Civil Works (ASA (CW)). A generalized timeline of the Project history is depicted in Figure 2 from initial authorization.

1.7 HISTORY OF THE INVESTIGATION

The Beach Erosion Control Projects for Palm Beach County, Florida General Design Memorandum with Environmental Impact Statement (GDM) Report for all of Palm Beach was prepared in 1987. The Palm Beach County, Florida, From Martin County Line to Lake Worth Inlet and from South Lake Worth Inlet to Broward County Line Shore Protection Project GDM for Jupiter Carlin Segment with Supplement to the Environmental Impact Statement (GDM Addendum) for the Jupiter Carlin segment was completed in 1994 and outlined the project for initial construction, superseding the 1987 GDM, changing the authorized project length from 1.2 to 1.1 miles. The GDM Addendum was approved Feb 23, 1995. The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project initial construction began on April 13, 1995 and was completed May 4, 1995. A Project Cooperation Agreement (PCA) was executed March 21, 1995 for an authorized periodic nourishment period of 10 years following completion of initial construction. The PCA for periodic nourishment expired 10 years from the completion of initial construction, thus, on May 4, 2005.

At this time, the authorized period of Federal participation has ended. This report serves as the decision document to extend Federal participation until 2045, the 50th year after initial construction.

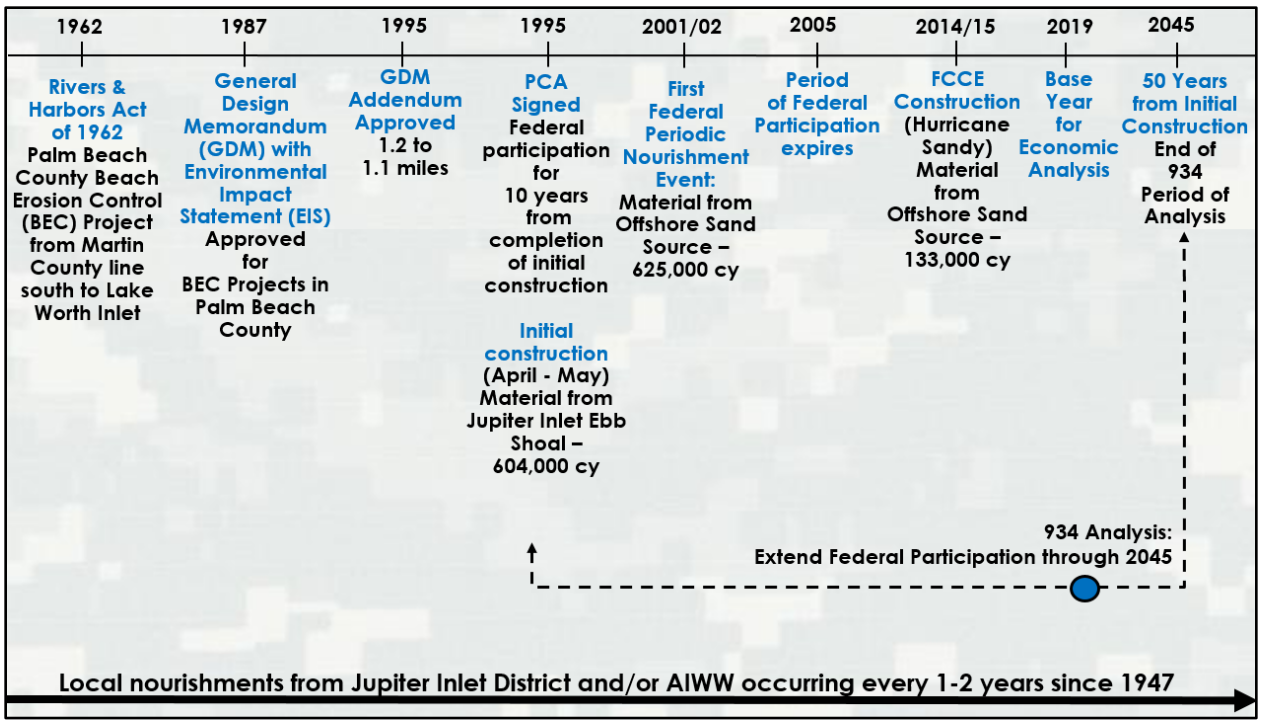

Figure 2: Jupiter Carlin Project and Authorization History.

1.8 RELATED DOCUMENTS*

1.8.1 RELATED USACE & NEPA STUDIES

- U.S. Army Corps of Engineers (USACE). 1961. *Beach Erosion Control Report on Cooperative Study of Palm Beach County, Florida, from Lake Worth Inlet to Martin County Line and from South Lake Worth Inlet to Broward County Line.*
- U.S. Army Corps of Engineers (USACE). 1979. *Palm Beach County Beach Erosion Control Special Report, Phase I, General Design Memorandum.* Addressed policy changes increasing Federal cost sharing.
- U.S. Army Corps of Engineers (USACE). 1987. *Beach Erosion Control Projects for Palm Beach County, Florida, General Design Memorandum with Environmental Impact Statement.* Specified a 1.2 mile segment of beach nourishment for the Jupiter Carlin study area.
- U.S. Army Corps of Engineers (USACE). 1994. *General Design Memorandum Addendum with Supplement to the Environmental Impact Statement for the Palm Beach County, Florida, Jupiter Carlin Shore Protection Project Segment.* Specified a shorter 1.1 mile segment of beach nourishment for the Jupiter Carlin study area with a modified design from the 1987 GDM.
- U.S. Army Corps of Engineers (USACE). 2013. *Project Information Report - Rehabilitation Effort for the Palm Beach County Shore Protection Project, Jupiter Carlin Segment.* Approved Flood Control and Coastal Emergency (FCCE) nourishment event totaling approximately 87,000 cubic yards of material along the 1.1 mile study area to restore the protective capability and benefits of the project.
- U.S. Army Corps of Engineers (USACE). 2015. Memorandum for Record. Supplement to the Department of the Army Environmental Assessment and Statement of Findings for Permit SAJ-1990-00902. Jupiter Carlin Park Restoration Project.

- U.S. Army Corps of Engineers (USACE). 2018. *Project Information Report and Addendum - Rehabilitation Effort for the Palm Beach County Shore Protection Project, Jupiter Carlin Segment.* The Project Information Report (PIR) was prepared at the request of the non-Federal sponsor in a letter dated September 13, 2017. The report recommends restoration of the Jupiter Carlin Segment of the Palm Beach County, Florida, Shore Protection Project to its authorized design template plus one and a half years of advance fill under the authority of Public Law (PL) 84-99. The work involves the rehabilitation of 246,000 cubic yards (cy) of material which restores the design template of the project immediately following physical completion through the next storm season. This PIR was approved January 24, 2018. Following the completion of the PIR, additional guidance from the Bipartisan Budget Act of 2018 (PL 115-123) prompted an analysis to be conducted to determine economic justification relating to the restoration of the full construction template. The analysis of the full construction template resulted in an economically justified project which includes the rehabilitation of 517,000 cy of material and is outlined in the PIR addendum approved May 30, 2018.

1.8.2 FEDERAL PROJECTS NEAR STUDY AREA

The St. Lucie Coastal Storm Rick Management (CSRM) project is located north of the study area and extends to the Martin County Line.

The Palm Beach County Shore Protection Project includes the following constructed segments in addition to the Jupiter Carlin Segment:

- Palm Beach County Ocean Ridge Segment
- Palm Beach County Delray Beach Segment
- Palm Beach County North Boca Raton Segment

Federal projects located south of the Project include:

- Lake Worth Inlet Federal Navigation Project
- Lake Worth Inlet Sand Transfer Plant

1.8.3 NON-FEDERAL STUDIES & PROJECTS NEAR STUDY AREA

NON-FEDERAL STUDIES

- University of Florida, Department of Coastal and Oceanographic Engineering. 1969. *Coastal Engineering Study of Jupiter Inlet, Palm Beach County, Florida.* Sponsored by Jupiter Inlet Commission.
- Arthur V. Strock and Associates, Inc. 1974. *Coastal Restoration and Preservation Program Concept Development Report for Palm Beach County Board of County Commissioners.* The report sets priorities for segments of the beach erosion control projects in Palm Beach County to be implemented by the County for subsequent reimbursement of the Federal share of the costs
- State of Florida, Department of Natural Resources, Division of Marine Resources, Bureau of Beaches and Shores. 1978. *Palm Beach County Historical Shoreline Study.*
- University of Florida, Department of Coastal and Oceanographic Engineering. 1984. *Coastal Engineering Investigation at Jupiter Inlet, Florida.*

NON-FEDERAL PROJECTS

Jupiter Inlet began as a natural waterway connecting the Loxahatchee River with the Atlantic Ocean. The Atlantic Intracoastal Waterway (AIWW) crosses the Loxahatchee River immediately west of the inlet. The Florida Inland Navigation District (FIND) acts as the local sponsor for AIWW maintenance which disposes of material near Jupiter Inlet along the project shoreline (typically just south of the jetty in the vicinity of R-13 to R-17). The Jupiter Inlet District (JID) acts as the local sponsor for Jupiter Inlet and is responsible for periodically dredging a sand trap located in the inlet throat. Additional information on the activities and effects of Jupiter Inlet are discussed in Chapter 2.

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CHAPTER 2

EXISTING & FUTURE WITHOUT- PROJECT CONDITIONS

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2 EXISTING & FUTURE WITHOUT-PROJECT CONDITIONS

This chapter describes conditions as they currently exist, and as they are projected to exist, if continued Federal participation in this periodic beach nourishment project is not implemented within the Jupiter Carlin study area. Information gathered in this chapter helps to describe the problems and opportunities and forecast future conditions. The future without-project (FWOP) condition is the most likely condition of the study area without continued construction of a Federal project through 2045, 50 years from the date of initial construction.

2.1 GENERAL SETTING*

Located in northern Palm Beach County, the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project totals approximately 1.1 miles of shoreline consisting of a naturally narrow sandy beach, bounded along the landward side by a thin line of dunes. The natural beach berm width along the majority of the study area is relatively thin. The natural beach slope is fairly steep, about 1V:10H, sloping directly from the sand dunes downward to the waterline with very little flat berm width. This type of beach is common along southeast Florida and has relatively coarse grained, carbonate rich, beaches. Several areas of environmentally sensitive nearshore limestone and worm rock formations exist within the littoral zone throughout the study area, and in various densities. Nearshore limestone and worm rock formations occur within the study area.

There are two county parks within the study area at the northern and southern termini, Carlin Park and Jupiter Beach Park, which provide public parking and beach access. The two parks are encompassed by Coastal Barrier Resource System (CBRS) units, FL-16P and FL-17P, classified as Otherwise Protected Areas, which comprise about 64% of the study area. Of the approximate 1.1 miles of shoreline within the study area, roughly 0.7 miles of shoreline is in the CBRS. The non-CBRS excluded shoreline area is located in the central portion of the study area, spanning from approximately FDEP R-monument R-14.5 to R-17 for an approximate length of 0.4 miles. The majority of the vertical infrastructure is located in this central portion of the study area to include five condominium buildings and a resort.

There is existing armoring in the study area as well as the down drift reaches, and it is anticipated that under the FWOP condition, more will be constructed in the coming years. The precedent in Palm Beach County has been set that property owners have constructed armor to protect their assets in the past and therefore, it is reasonable to assume they would continue to do so in the future.

Under the FWOP condition, storm damages, especially erosion, throughout most of the project area could jeopardize Florida State Road A1A (SR A1A) in the down drift reach, which is a designated hurricane evacuation route for the population in this region. It is projected that storm-induced erosion, inundation, and wave attack in the study area will continue damaging infrastructure, limiting habitat, and jeopardizing storm evacuation and relief efforts. Without a Federal project, it is likely that the sponsor and property owners would take steps to combat erosion and loss of property, increasing the risk that these individual responsive efforts may not be coordinated in a holistic fashion, adversely impacting the regional movement of sediments in the system and the environmental setting.

2.2 NATURAL (GENERAL) ENVIRONMENT*

EXISTING CONDITIONS

The biological communities found in the general Project area are comprised of the sandy beach shoreline and the open waters of the Atlantic Ocean. The sand substrate is dominated by crustaceans, mollusks, and polychaete worms, in relatively low concentrations, typical of nearshore and surf zone sand habitats. Nesting sea turtles as well as shore and seabirds use the sandy beach shoreline within the project area. The nearshore waters of the project area are composed of sand bottom with mapped hardbottom resources. Additional hardbottom occurs north and south of the project area. Hardbottom habitats identified in the general nearshore project area are differentiated by the amount of relief above the floor of the ocean and the diversity and density of flora and fauna inhabitants. This hardbottom habitat may serve as developmental and foraging habitat for juvenile sea turtles and Essential Fish Habitat (EFH) for coral/hardbottom biota and reef fishes. The offshore Project area is primarily sand bottom. Typical inhabitants include polychaete worms, bivalves, and nematodes, with some echinoids and small crustaceans. Existing upland sand quarries may also be utilized to nourish the project beach. These upland sources contain sufficient sand reserves to support the entire project.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Under FWOP, the risk of cumulative impacts due to erosion increase, which would eventually threaten the existence of the beach, dunes, adjacent uplands, and any development in those areas. Loss of sand from the Project area would ultimately result in reduced sand transport to down drift areas and thus significantly reduce or eliminate sea turtle nesting habitat in the project area and beyond. Indirect effects may include loss of recreational opportunities and reduced local economy from reduced beach uses. This risk is minimized such that the local nourishments from Jupiter Inlet and the AIWW continue on an approximate annual basis as they have since 1947.

2.2.1 DUNE & BEACH

EXISTING CONDITIONS

The primary dune within the Project area varies in height between about 10 feet to 25 feet North American Vertical Datum of 1988 (NAVD88). Pedestrian-caused erosion and erosion due to natural forces have reduced dune quality in many areas to a relatively poor condition. The beach at Jupiter Beach Park is highly eroded. The foredune at Ocean Trail is eroding rapidly. A single storm could eliminate the foredune in that area. Species such as salt grass, sand spur, bay bean, sea oats, and sea grape vegetate the dunes along a significant portion of the Project reach. Wildlife is limited to small mammals, reptiles, invertebrates, and a variety of shore and sea birds. The beach, moderately sloped (approximately 1V:10H), primarily contains medium and fine sediments composed of quartz particles and carbonates. Analysis of available sand samples from the existing beach (collected from dune toe, berm crest, and mean high water at R-13, R-14, and R-15 in late spring 2009) revealed the following sand characteristics: Mean grain size (phi) = 1.39 (0.39 mm), sorting (phi) = 0.89, silt content = 0.97%, and 45% average carbonate content. Munsell Color evaluation reported Hues of 5Y, 10YR, Value 4 or lighter, and 1 – 2 Chroma (see Appendix D).

The beach provides foraging and resting habitat for numerous seabirds and shorebirds such as terns, gulls sandpipers, plovers, and skimmers. Fish and invertebrates within the intertidal zone are the staple diet

for these species. In the supralittoral zone, ghost crabs (*Ocypode quadrata*) and mole crabs (*Emeria talpoida*), are the most visible and motile inhabitants of the sandy substrate.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The FWOP would result in continued loss of dune and beach habitat from continuing erosion and increased risk of storm damages to infrastructure. These losses to the dune and beaches would in turn reduce available turtle nesting habitat, recreational opportunities, and revenues to the local economy from beach visitation and tourism. These risks to dune and beach habitats in the FWOP condition would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach.

2.2.2 NEARSHORE HABITAT

UNCONSOLIDATED SUBSTRATE

EXISTING CONDITIONS

The intertidal swash zone and the majority of the subtidal habitat in the Project area consist of unconsolidated sand substrate beginning in the beach swash zone and continuing in subtidal areas. These zones lack dense populations of sessile plant and animal species (FNAI, 1990). The intertidal and subtidal zones consist of sand of varying thickness overlying rock outcrop; occasional rock outcrop exposure occurs as the sand shifts. Inhabitants in the intertidal swash zone must cope with a tide that leaves many of these organisms aerially exposed for up to six hours at a time, as well as exposed to the high energy of the ocean waves. Typically, these habitats have low species diversity because of the harsh environmental conditions. Within the swash zone, a few mollusks (e.g., *Donax variabilis*), small crustaceans such as haustorid amphipods, and a variety of polychaete worms dominate the environment. Subtidal unconsolidated habitats are also typified by relatively low diversity communities.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Unconsolidated substrate within the intertidal and subtidal zones predicted for the FWOP conditions are similar to the existing conditions described above. No changes to fish and wildlife resources that reside within these zones are likely to occur.

HARDBOTTOM HABITAT

EXISTING CONDITIONS

Beginning at the shoreline, the nearshore hardbottom habitat in the project area runs in roughly shore-parallel zones (Figure 1). The first zone of intermittently exposed hardbottom typically occurs seaward of a short sandy zone containing the shoreline surf area. A sand and rubble zone is located between the first and second hardbottom zones, and abundant sand occurs between the second and third hardbottom zones. The hardbottom habitat at most locations in the project area undergoes cycles of sand coverage and exposure caused by tides and storm events.

The hardbottom habitat includes areas with patches of limestone outcropping with or without sessile floral and faunal populations, within the larger unconsolidated substrate habitat (FNAI, 1990). A variety of hardbottom habitats or reefs may occur along the coast of Florida. Many commercially, recreationally, and ecologically important fish species inhabit the nearshore hardbottom of the east coast of Florida. The biological and physical complexity of hardbottom habitats attracts both commercial and recreational fish species. Colonies of tube-building polychaete worms and other invertebrates and macroalgae species

increase the habitat complexity of these hardbottom communities. (Kirtley and Tanner, 1968; Goldberg, 1973; Nelson, 1989; Nelson and Demetriades, 1992). Nearshore and offshore limestone outcrops and ridges provide significant hardbottom habitat for a variety of invertebrate and vertebrate species. These habitats serve an important function as nurseries for fish and juvenile marine turtles (Bresette et al., 1998 and 2006; Gilmore, 2008).

The nearshore hardbottom is composed of "flat platforms and rounded boulders and fins" (USACE 1994) exposed within the larger bare sand bottom. The limestone hardbottom habitats are often referred to as "live bottoms" because they generally support a diversity of sessile invertebrates such as corals and sponges. The biological communities in and adjacent to hardbottom areas are relatively consistent, although species composition may vary from site to site based on physical parameters such as distance from shore, hardbottom profile, and burial history.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

In the FWOP, hardbottom resources would remain similar to the existing conditions described above. The no action alternative would not impact hardbottom resources.

WORM REEF

EXISTING CONDITIONS

Worm reef may occur in the shallow nearshore environment along the Atlantic coast of Florida, south of Cape Canaveral. Large colonial conglomerates of rigid sabellariid worm tubes of the species *Phragmatopoma lapidosa* comprise the worm reef community. This species constructs its tubes on a hardbottom substrate from grains of sand, which results in large structures that serve a larger community of other species. These shallow water "reefs" generally occur in the lower reaches of the intertidal zone or upper reaches of the subtidal zone. Worm reefs provide shelter for a diverse assortment of small benthic vertebrate and invertebrate organisms, which increases the faunal diversity of the area (FNAI, 1990).

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Worm reef resources predicted for the FWOP are similar to the existing conditions described above.

2.2.3 MITIGATION

EXISTING CONDITIONS

REEF/HARDBOTTOM MITIGATION

Palm Beach County first constructed the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project in April through May of 1995. The work was authorized by USACE permit number 19900902. According to the Jacksonville District's USACE Regulatory Division, the mitigation project was built in compliance with the permit (see Appendix H: Pertinent Correspondence). An estimated 603,779 cubic yards of beach quality sand were hydraulically dredged from the ebb shoal located 1,300 to 2,200 feet offshore and south of Jupiter Inlet. This material was placed on the beach between R-13.5 and R-19 (approximately 1.1. miles). It was determined that the project constructed in 1995 adversely affected an estimated eight acres of nearshore reef.

The impacted reef formation was present in the nearshore region from approximately Florida Department of Natural Resources (DNR) survey monument R-13 to R-18.5. This hardbottom habitat ranged from 3 to

12 feet in depth, and was located between 60 and 500 feet from the high water line. It was composed primarily of coquina, calcareous sandstone (Anastasia formation), and shell marl. The amount of exposed hardbottom was temporally variable depending upon the movement of sand in the nearshore environment. Continental Shelf Associates (CSA) first surveyed the reef in 1987; four joint surveys by CSA and Palm Beach County personnel were also completed between July of 1989 and April of 1995. These rock outcrops provided habitat for a wide variety of fishes and invertebrates (USFWS 1995; Palm Beach County 2000).

Based on a mitigation ratio of 0.5 to 1, the County was required to construct 4 acres of artificial reef (preferably, within two years of beach nourishment) to mitigate for impacts. Mitigation reef construction was delayed because of an unexpected lack of a sufficient amount of sub-surface rock formations on which to construct the reef. This required the County to search for alternative reef locations and evaluate different construction techniques. The mitigation reef was constructed between June 1998 and January 1999 at a location approximately 5,000 feet south of the south limit of the project area. Reef materials were placed about 1,000 feet offshore between the 17 and 25 foot depth contours and have an average relief of 2 to 3 feet with a maximum relief of 5 to 6 feet. The reef is composed of two types of structures. The first structure type, termed Cloth Reef, consists of 3.3 acres of limestone boulders resting on geotextile cloth strips. The second structure type, termed Concrete Reef, consists of concrete rubble from the demolition of the Donald Ross Bridge and concrete light poles placed on bare sand. The Concrete Reef covers 1.0 acres and is located 200 feet offshore of the southern end of Cloth Reef (Palm Beach County 2000). Pursuant to the USACE permit, a total of 4.3 acres of mitigation reef was constructed.

Palm Beach County staff conducted a biological survey of Cloth and Concrete Reefs in 2000. Considerable invertebrate and algal colonization was observed. On the limestone boulder section of Cloth Reef, worm rock had encrusted a large proportion of the substrate, and hydroids, sponges, and tunicates were also present. Worm rock appears to have increased the complexity of this portion of the reef forming an encrusting layer up to 6 inches thick in some areas. Mean coverage by invertebrate and algal taxa was estimated at approximately 60 %. In contrast, the Concrete Reef showed little signs of colonization by worm rock, but hydroids, sponges and tunicates were abundant on this material. Coverage by invertebrate and algal taxa was estimated at approximately 40 %. The number of fish species observed during surveys at Jupiter Carlin increased between 1999 and 2000 on both nearshore and artificial reefs. The number of species increased from 26 to 37 on the nearshore reef, from 35 to 56 on the Cloth Reef, and from 25 to 57 on the Concrete Reef (Palm Beach County 2000).

Between 2001 and 2005, CSA completed annual monitoring surveys of Cloth and Concrete Reefs with particular attention to the development of epibiotal and fish assemblages. Their surveys indicated that taxonomic and life stage compositions are broadly similar between natural and artificial reefs occurring in Palm Beach County. Artificial reefs, such as Cloth and Concrete Reefs, with their fish and epibiotal components, contribute to local ecosystem structure and function and, just as importantly, artificial reefs provide connections along the cross shelf continuum for young fishes that follow developmental pathways from inshore to offshore (Lindeman et al., 2000; CSA 2006).

FUTURE WITHOUT-PROJECT CONDITIONS (NO-ACTION ALTERNATIVE)

The no-action alternative would not affect artificial or mitigation reefs.

2.2.4 FISH & WILDLIFE RESOURCES (OTHER THAN THREATENED & ENDANGERED SPECIES)

EXISTING CONDITIONS

2.2.4.1 NEARSHORE SOFT BOTTOM COMMUNITIES

Soft bottom macrobenthic and infaunal communities located within the nearshore portion of the Project area experience highly dynamic conditions due to the high energy wave action in the intertidal surf zone. A portion of this environment comprises hardbottom (worm rock and exposed Anastasia rock formations). The remainder of the nearshore environment consists of medium to coarse quartz sand and shell hash coarse carbonate/quartz sand bottom with the assemblages of plants and animals that use these soft bottom habitats.

In tropical and subtropical areas, the ghost crab genus Ocypode typically dominates the upper beach area. Mole crabs (*Emerita*), haustoriid amphipods, and bivalves (*Donax*) are numerical dominants in the intertidal area, while polychaetes, other amphipod species, and bivalves increase in abundance in the subtidal nearshore areas (Pearse et al. 1942, Dahl 1952, Spring 1981). Gorzelany and Nelson (1987) studied the effects of beach nourishment on intertidal and subtidal infaunal communities in the Indialantic and Melbourne Beach area. The study listed 99 taxa with *Donax* spp. as the numerically dominant group followed by the polychaete *Happloscoloplos fragilis*, the amphipods *Parahaustorius longimerus* and *Bathyporeia parkeri*, and the polychaete *Paraonis fulgens*. Species richness and density decreased in winter, increased in spring and summer, and decreased in fall. These population shifts did not seem attributable to beach nourishment effects, but rather to natural seasonal variations.

2.2.4.2 OFFSHORE BORROW AREA SOFT BOTTOM COMMUNITIES

Infaunal organisms present in the soft bottoms offshore central east Florida are predominantly common invertebrates including crustaceans, echinoderms, mollusks, polychaetous annelids, and interstitial bryozoans. Infaunal populations exhibit both seasonal and spatial variability in distribution and abundance, due to temperature, sediment topography, bathymetry, and sediment composition, including particle size and organic content (Hammer et al. 2005).

Epifaunal invertebrates commonly occurring on the soft bottoms offshore central east Florida include lady crabs (*Ovalipes* spp.), calico scallop (*Argopecten gibbus*), calico box crab (*Hepatus epheliticus*), iridescent swimming crab (*Portunus gibbesii*), brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), striped sea star (*Luidia clathrata*), and arrowhead sand dollar (*Encope michelini*). The distribution on the epifaunal invertebrates listed above exhibit distributions that are depth-, temperature-, and sediment type-related (Hammer et al. 2005).

2.2.4.3 NEARSHORE HARDBOTTOM FISH ASSEMBLAGES

Continental Shelf Associates (2006) conducted fish surveys of natural and artificial reefs along this portion of the Palm Beach County coastline. A total of 121 species were observed on artificial reefs and 108 species on natural reefs. Numerical dominants on artificial reefs included tomtate (*Haemulon aurolineatum*), grunts (*Haemulon* spp.), and striped croaker (*Bairdiella sanctaelucidae*). Numerical dominants on natural reefs included sailors choice (*Haemulon parra*), silver porgy (*Diplodus argenteus*), round scad (*Decapterus punctatus*), and black margate (*Anisotremus surinamensis*). Abundant species

observed were mostly planktivores (tomtate, newly settled grunts, and round scad) or benthic omnivores (striped croaker, silver porgy, and sailors choice).

2.2.4.4 COASTAL PELAGIC FISH

The major coastal pelagic families occurring in inshore and coastal waters of the Project area include ladyfish, anchovies, herrings, mackerels, jacks, mullets, bluefish, and cobia. Coastal pelagic species migrate over the region's shelf waters throughout the year. Some species form large schools (e.g., Spanish mackerel), while others (e.g., cobia) travel alone or in smaller groups. Many coastal pelagic species inhabit the nearshore environment along beaches and barrier islands of eastern Florida (Gilmore et al., 1981; Peters and Nelson 1987). Commonly occurring species in the project area include anchovies (*Anchoa* spp.), menhaden (*Brevoortia* spp.), scaled sardine (*Harengula jaguana*), striped mullet (*Mugil cephalus*), hardhead catfish (*Ariopsis felis*), and Florida pompano (*Trachinotus carolinus*). Concentrations of anchovies, herrings, and mullets in nearshore areas may attract larger predatory species, particularly bluefish, blue runner, jack crevalle, sharks, and Spanish mackerel. The presence and density of most coastal pelagic fish species depend on water temperature and quality, which vary spatially and seasonally.

2.2.4.5 SEABIRDS AND SHOREBIRDS

A number of shore and seabirds, as well as other species, may occur along the beach and offshore the project area, including a number of species considered birds of conservation concern by the Migratory Bird Treaty Act of 1918 (MBTA). These species all use sandy beaches for foraging and/or nesting and, therefore, could occur along the Project area both onshore and offshore. Species of birds observed in the Project area are shown in Table 1.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Species that utilize the beach environment may decrease in number due to continued erosion of the beach and dune system in the FWOP Condition. No changes to fish and wildlife resources that reside within and below the intertidal zone are likely to occur in the FWOP Condition.

Table 1: Summary of Shorebird Monitoring Data by Month, Jupiter Carlin Survey Area, 2010 (Loggerhead Marinelife Center, 2010).

Species	April	May	June	July	Aug	Overall
Black-Bellied Plover	14	2				16
Brown Pelican	61	17	5	12	28	123
Common Tern	1				2	3
Double-crested Cormorant	2					2
Great Egret			1	1		2
Laughing Gull	1	25	2		45	73

Least Sandpiper	1					1
Least Tern		10	29			39
Little Blue Heron			1	2		3
Mottled Duck			2	0		2
Osprey	1	1	1	1		4
Ring-Billed Gull	4					4
Royal Tern	16	1	2	1	6	26
Ruddy Turnstone	75	62			31	168
Sanderling	94	36		8	72	210
Sandwich Tern	3			1	32	36
Snowy Egret	1	1	3		3	8
Spotted Sandpiper				1		1
Tricolor Heron			1			1
Willet	2					2
Yellow-Crowned Night Heron			1	2	1	4
Activity	**April**	**May**	**June**	**July**	**August**	**Overall**
Courtship						0
Flying	75	56	44	16	107	298
Foraging/Feeding	138	96	4	12	93	343
Nesting						0
Resting	62	4		1	20	87
Grand Total	**275**	**156**	**48**	**29**	**220**	**728**

(http://www.pbcgov.com/parks/nature/green_cay_nature_center/birdchecklist.htm)

2.2.5 THREATENED & ENDANGERED SPECIES

A number of federally protected species may occur in the general Project area. Threatened and endangered species most likely to occur within the Project footprint include the following: loggerhead sea turtle, green sea turtle, hawksbill sea turtle, leatherback sea turtle, West Indian manatee, smalltooth sawfish, piping plover, rufa red knot, and beach jacquemontia (Table 2). Existing permitted sand mines, which may be used as a source of sand, do not support threatened and endangered species as the habitat at these locations has been previously removed.

Table 2: Federally Listed Species that may occur in the Project Area.

Scientific Name	Common	Federal Status	Habitat
Trichechus manatus	West Indian manatee	Threatened	Fresh and saltwater habitats
Eubalaena glacialis	Northern Right Whale	Endangered	Nearshore and offshore
Charadrius melodus	Piping Plover	Threatened	Sandy beaches, mudflats, sandflats, spoils islands, areas adjacent to inlets and passes
Calidris canutus rufa	Red Knot	Threatened	Shorelines
Chelonia mydas	Green Sea Turtle	Threatened	Beach dune/coastal strand, seagrass, nearshore reef
Eretmochelys imbricata	Hawksbill Sea Turtle	Endangered	Beach dune/coastal strand, seagrass, nearshore reef
Dermochelys coriacea	Leatherback Sea Turtle	Endangered	Beach dune/coastal strand, nearshore and offshore
Caretta caretta	Loggerhead Sea Turtle	Threatened	Beach dune/coastal strand, seagrass, nearshore reef
Lepidochelys kempii	Kemp's Ridley Sea Turtle	Endangered	Nearshore and offshore sand bottom
Pristis pectinata	Smalltooth Sawfish	Endangered	Nearshore, inlets, estuaries
Aphelocoma coerulescens	Florida Scrub-Jay	Threatened	Scrub, Scrubby flatwoods and adjacent areas
Drymarchon cooperi	Eastern Indigo Snake	Threatened	Scrub, Scrubby flatwoods and adjacent areas
Jacquemontia reclinata	Beach Jacquemontia	Endangered	Beach dune/coastal strand
Cladonia perforata	Florida Perforate cladonia	Endangered	Beach dune/coastal strand
Asimina tetramera	Four-petal Pawpaw	Endangered	Beach dune/coastal strand
Polygala smallii	Tiny Polygala	Endangered	Beach dune/coastal strand
Halophila johnsonii	Johnson's Seagrass	Endangered	Estuarine polyhaline/euhaline waters

2.2.5.1 WEST INDIAN MANATEE

EXISTING CONDITIONS

Assessments via routine aerial surveys during winter (when individuals concentrate in warm-water refuges) provide West Indian manatee numbers in Florida. Aerial surveys conducted in 2015 produced a preliminary abundance estimate of 6,063 individuals throughout Florida (FWC, 2016) including 3,333 manatees on Florida's East Coast (found during the count in estuarine and freshwater areas). The Project area does not contain designated manatee critical habitat. Manatees use Palm Beach County waters year-round, with increased sightings during the winter. Manatees occasionally swim in open ocean waters but they typically remain in more protected coastal waters such as estuaries.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of manatees under the FWOP is similar to the existing conditions described above.

2.2.5.2 SEA TURTLES

EXISTING CONDITIONS

The beaches of Palm Beach County provide nesting habitat for four (loggerhead, green, leatherback, and hawskbill) of the five sea turtle species identified by the USFWS and the state of Florida as threatened or endangered. Researchers and volunteers trained in identifying turtle tracks, nest shape, and nest size monitor sea turtle nesting in the project area. Palm Beach County provides one of the largest nesting habitats for the loggerhead sea turtle in the western hemisphere. Kemp's ridley sea turtle, the smallest of the five species and a shallow water benthic feeder, and while very rare, may occur in project waters.

Sea turtle nesting within this area usually occurs during March – September. Figure 3 provides annual (2011-2015) summaries of turtle nesting data collected by Palm Beach County within the Project and survey areas.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The FWOP condition would result in continuing beach erosion, which would reduce nesting habitat for threatened or endangered marine turtles, including loggerhead (*Caretta caretta*), green (*Chelonia mydas*), and leatherback (*Dermochelys coriacea*). Loss of nesting habitat may occur from reduced area of beach above mean high tide elevation. In addition, loss of nesting opportunities above the high tide line may result in turtle nesting at lower elevations where nests may wash out. These risks would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach on an annual to biennial basis, as they have been since 1947.

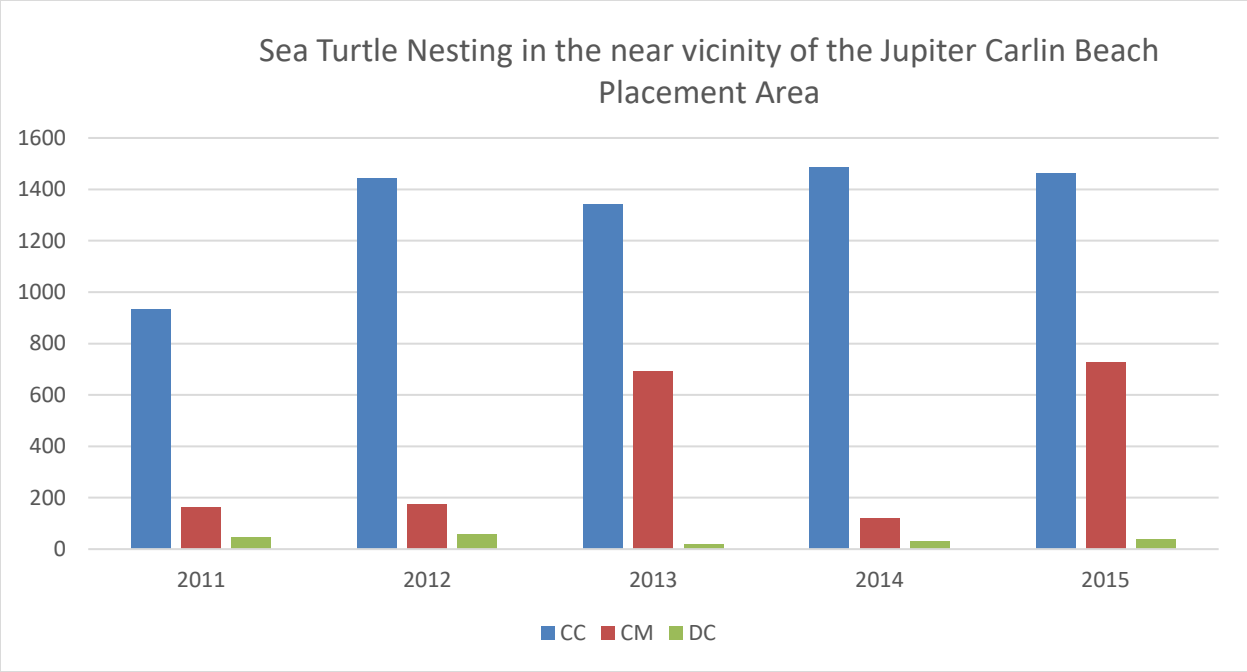


Figure 3: Sea turtle nesting data for the Jupiter Carlin beach placement area for loggerheads (CC), greens (CM), and leatherbacks (DC) from 2011 to 2015. This data is for the following area: Jupiter Inlet, South Jetty (26.94367, -80.07174) to 2.5 km (1.56 miles) south of Jupiter Inlet, southern boundary of Jupiter Reef Club (26.92049, -80.06561). Source Florida Fish and Wildlife Conservation Commission.

2.2.5.3 SMALLTOOTH SAWFISH

EXISTING CONDITIONS

Relatively little is known about the life history and distribution of smalltooth sawfish (*Pristis pectinata*), but the species occurs most commonly in shallow waters less than 25 m in depth (Adams and Wilson, 1995) and may occur in the nearshore adjacent to the Project beach placement area and in the proposed offshore sand source.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of smalltooth sawfish under the FWOP is similar to the existing conditions described above.

2.2.5.4 PIPING PLOVER

EXISTING CONDITIONS

The piping plover (*Charadrius melodus*), a state and federally listed species, generally winters in a variety of areas of Florida, including the Atlantic coast. Piping plovers migrate south to Florida as early as late July and remain as late as early April (non-breeding season). This small shorebird may be found inland but prefers sandy beaches and tidal mudflats where it forages along the waterline or high up the beach along the wrack line. Piping plovers primarily use intertidal habitats within estuaries, but sightings along the Atlantic Coast intertidal area have occurred (Robert Ernest, Ecological Associates, Inc., personal communication, June 2009). Piping plovers feed within the intertidal zone on invertebrates such as marine

worms, insect larvae, crustaceans, and mollusks (Atlantic Coast Piping Plover Recovery Team, 1995). Piping plover foraging and resting habitat may occur within the project area. Tagged piping plover observations have occurred on Juno Beach (August 2009) and in the Town of Palm Beach (January 2011) (personal communication, Kimberly Miranda, February 2011).

The piping plover is listed as an endangered species in Canada (by the Canadian Government) and the inland United States (by the U.S. Fish and Wildlife Service), and is listed as threatened along the United States Atlantic coastline. Declines in population result from direct and unintentional harassment by people, dogs, and vehicles; destruction of beach habitat for development; and changes in water level regulation (Haig, 1992). The project area does not contain designated piping plover critical habitat.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Under the FWOP, the risk of erosion would increase threatening the existence of beach and dune habitats. Intertidal foraging habitat for the piping plover would remain relatively constant, although shifting spatially as the beach eroded. Roosting habitat higher up on the beach, may be reduced; however, the infrequent usage of this area by this species suggests that the FWOP Conditions would be similar to the existing conditions with respect to the piping plover. Risk of beach and dune erosion would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach on an annual to biennial basis, as they have been since 1947.

2.2.5.5 RUFA RED KNOT

EXISTING CONDITIONS

The rufa subspecies of the red knot (*Calidris canutus rufa*), listed as threatened, is a small shorebird that can occur along the Atlantic and Gulf coasts during migration. It is also known to overwinter in low numbers along both coasts. Florida is home to the largest concentration of wintering *rufa* in the United States, with the main concentration occurring in the greater Tampa Bay region (A.C. Schwarzer et al. 2012). In migration and winter, it prefers coastal mudflats, tidal zones, and sometimes open sandy beaches where it feeds on small invertebrates such as small mollusks, marine worms, and crustaceans (Kaufman 1996). The *rufa* population has declined primarily due to reduced food availability from increased harvests of horseshoe crabs (USFWS 2015). Their numbers appear to have stabilized in the past few years, but they remain at low levels relative to earlier decades (USFWS 2015). Critical Habitat has not been designated for this species. According to the USFWS Geographic Information System database, no red knots have been documented in the Project area; however, eBird documented 2 red knots at approximately DEP reference monument R-14 +600 ft in 2008 (eBird 2017).

FUTURE WITHOUT-PROJECT CONDITIONS (NO-ACTION ALTERNATIVE)

In the FWOP, the risk of erosion would increase threatening the existence of beach and dune habitats. Intertidal foraging habitat for the rufa red knot would remain relatively constant, although shifting spatially as the beach eroded. Roosting habitat higher up on the beach, may be reduced; however, the infrequent usage of this area by this species suggests that the FWOP Conditions would be similar to the existing conditions with respect to the red knot. Risk of beach and dune erosion would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach on an annual to biennial basis, as they have been since 1947.

2.2.5.6 WHALES (NORTH ATLANTIC RIGHT WHALE)

EXISTING CONDITIONS

The North Atlantic right whale *(Eubalaena glacialis)* is the rarest of the world's baleen whales, with a North Atlantic population of 440 individually recognized whales (NMFS 2017). They range from Iceland to eastern Florida and are seasonal "residents" in inner shelf and mid-shelf waters (Hammer et al., 2005). Southward migration to calving grounds within inner shelf waters off southeastern Georgia and northeastern Florida occurs from mid-October to early January (Kraus et al., 1993). Calving occurs from December through March (Silber and Clapham, 2001). The ESA designates one calving and two feeding areas in U.S. waters as critical habitat for North Atlantic right whales (http://www.nmfs.noaa.gov/pr/species/criticalhabitat.htm). The project area does not contain designated North Atlantic right whale critical habitat. An observer spotted and photographed a right whale offshore the Juno Beach Pier on January 1, 2010 (Palm Beach Post News) and a right whale also appeared several days later near the Juno Beach project pumpout location (USACE Turtle Data Warehouse, http://el.erdc.usace.army.mil/seaturtles/project.cfm?Id=639&Code=Project). Such visitations, though unusual, suggest that caution and constant vigilance are necessary to make sure that encounters do not occur.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of whales under the FWOP is similar to the existing conditions described above.

2.2.5.7 BEACH JACQUEMONTIA

EXISTING CONDITIONS

Beach jacquemontia *(Jacquemontia reclinata),* or beach clustervine, is a coastal dune plant endemic to the southeastern coast of Florida. This low-growing, creeping vine typically inhabits the lee side of stable, vegetated dunes, disturbed openings in maritime hammocks, coastal strand, and coastal scrub. The species produces somewhat fleshy leaves up to 3 cm long and white, star-shaped flowers. Currently, only a few populations remain along the east coast of Florida from Martin County south to Dade County. The primary threats to its continued existence include habitat loss and fragmentation from coastal development and erosion, and displacement from non-native, invasive species such as Brazilian pepper (*Schinus terebinthifolius*). The potential location(s), quantity, and current vegetative state are unknown for beach jacquemontia. This species may occur within the Project area. Critical Habitat has not been designated for this species.

FUTURE WITHOUT-PROJECT CONDITIONS (NO-ACTION ALTERNATIVE)

In the FWOP Condition, the risk of erosion would increase threatening the existence of beach and dune habitats. This may reduce the habitat for beach jacquemontia. Risk of beach and dune erosion would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach on an annual to biennial basis, as they have been since 1947.

2.2.6 ESSENTIAL FISH HABITAT (EFH)

The Magnuson-Stevens Fishery Conservation and Management Act requires identification of habitats necessary for sustainable fisheries and comprehensive fisheries management plans. The Act also requires preparation of an EFH assessment when impacts to EFH are likely to occur.

EXISTING CONDITIONS

Nearshore and Offshore

The South Atlantic Fisheries Management Council (SAFMC) has designated the entire nearshore hardbottom of southeastern Florida (including the project area) as EFH habitat areas of particular concern (EFH -HAPC) (SAFMC, 1998). Fish compositions on nearshore hardbottom habitats are dominated by juvenile reef-associated species (Lindeman and Snyder, 1999). Outside of patchily distributed hardbottom reefs, nearshore marine areas of mainland east Florida show no natural, high relief, three-dimensional structures that support fish, algae, and macroalgae assemblages. Energetically, hardbottom areas are nutrient-rich patches in among large sand plains (CSA, 2009b).

Managed species that commonly inhabit the project area include pink shrimp (*Penaeus duorarum*) and spiny lobster (*Panularis argus*). Members of the 73-species snapper-grouper complex that commonly use the hardbottom habitats during their adult life include blue stripe grunts (*Haemulon sciurus*), French grunts (*Haemulon flavolineatum*), mahogany snapper (*Lutjanus mahogoni*), yellowtail snapper (*Ocyurus chysurus*), red grouper (*Epinephelus morio*), gray triggerfish (*Balistes capriscus*), and hogfish (*Lachnolaimus maximus*). Coastal migratory pelagic species also commonly use the offshore area adjacent to the project area, and may occur in the project area. In particular, the king mackerel (*Scomberomorus cavalla*) and the Spanish mackerel (*Scomberomorus maculatus*) are the most common. As many as 60 species of corals can occur off the coast of Florida (SAFMC, 1998) and are under the Coral Fishery Management Plan.

Gilmore (2008) developed a regional fisheries resource literature review of existing fisheries information for the southeast Florida area from Cape Canaveral to Jupiter Inlet. The following paragraph from that review also summarizes the fisheries community habitat in the project area.

> *The most diverse continental shelf fish assemblage within the United States occurs south of Cape Canaveral to Jupiter Inlet. A wide variety of factors produces this rich local fish fauna. The relatively small area, only 24,426 sq nm, between the beach to the upper end of the Florida-Hatteras slope, to roughly 100 m depths along 80º 00' W longitude, contains a wide variety of habitats from sabellariid worm reef, rock and coral reefs to sand, shell and mud bottoms, troughs, small canyons, 20-30 m pinnacles, ridges and shoals. Numerous artificial reefs from bridge pilings to sunken ships add to this habitat diversity. More importantly, this complex continental shelf topography is gradually reduced in size toward St. Lucie Inlet and Jupiter as the Florida coastline angles toward the deep (700-1000 m depths) Florida Straits.* (Gilmore 2008)

The proposed borrow area, however, may best be described as a surface deposit of sand, characterized as a gently sloping area with relatively little vertical relief. The EFH functions of such areas are less understood than locations such as shoals — underwater sand "dunes" with significant vertical relief. Shoals with significant vertical relief present a variety of microhabitats that may not occur in the surface deposit area proposed for use in this project.

Water Column

SAFMC (1998) states that gradients and discontinuities in temperature, salinity, density, nutrients, light, etc., define specific habitats within the water column. The marine water column is defined as the open water (ocean) environment. It extends vertically from the water surface to the ocean bottom. The water column provides habitat for phytoplankton to carry out the processes of primary productivity. Zooplankton also utilize the water column for habitat, thus creating the foundation of the ocean food web and ecosystem. Some benthic invertebrates living on or in the ocean floor filter the water column to collect suspended food particles. Most marine fish and shellfish broadcast spawn pelagic eggs; thus, most species use the water column during some portion of their early life history (e.g., egg, larvae, or juvenile stages). Higher vertebrates (fishes, marine mammals, and sea turtles) use the water column for foraging, migration, and breeding.

Turbidity is a key water quality factor in coastal waters of South Florida. Turbidity may result from planktonic organisms in the water column and from fine materials suspended in the water column from wave and current action. Turbidity levels typically follow a seasonal pattern of low (clearer water) levels during low-wind early summer months and increasing to annual maxima during windier winter months.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of EFH under the FWOP is similar to the existing conditions described above.

2.2.7 COASTAL BARRIER RESOURCES

EXISTING CONDITIONS

According to the USFWS website, Congress recognized that certain actions and programs of the Federal Government have historically subsidized and encouraged development on coastal barriers, resulting in the loss of natural resources, threats to human life, health, and property, and the expenditure of millions of tax dollars each year. To remove the Federal incentive to develop these areas, the Coastal Barrier Resources Act (CBRA), Public Law 97-348 (96 Stat. 1653; 16 U.S.C. 3501 et seq.), enacted October 18, 1982, designated relatively undeveloped coastal barriers along the Atlantic and Gulf coasts as part of the John H. Chafee Coastal Barrier Resources System (CBRS), and made these areas ineligible for most new Federal expenditures and financial assistance.

CBRA encourages the conservation of hurricane prone, biologically rich coastal barriers by restricting Federal expenditures that encourage development, such as Federal flood insurance. Areas so designated are ineligible for direct or indirect Federal financial assistance that might support development, including flood insurance, except for emergency life-saving activities. The Act includes exceptions for activities such as fish and wildlife research. The Act also excludes National Wildlife Refuges and other, otherwise protected areas from the system.

The Project area includes parts of two CBRS Units — FL-16P and FL-17P. (Figure 1) The two units encompass Jupiter Beach Park and Carlin Park. Both areas represent “Otherwise Protected Areas” (OPAs). The Coastal Barrier Improvement Act of 1990 expanded the CBRS and created a new category of lands known as OPAs. OPA designations add a layer of Federal protection to coastal barriers already held for conservation or recreation, such as national wildlife refuges, national parks and seashores, state and county parks, and land owned by private groups for conservation or recreational purposes. The Federal

government may spend Federal funds on projects within OPAs as long as the funds do not go toward Federal flood insurance.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

In the FWOP conditions, the risk of diminution or elimination of coastal barrier resources due to continued beach erosion. Risk of loss of coastal barrier resources would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach on an annual to biennial basis, as they have been since 1947.

2.2.8 OFFSHORE SAND SOURCE

EXISTING CONDITIONS

Jupiter Carlin A lies in water depths of approximately 60 to 70 feet, centered about two miles offshore, beginning at the Palm Beach County line south to R-10. Irregular in shape, the sand source encompasses approximately 700 acres. Figure 4 illustrates the location of the proposed offshore sand source. Palm Beach County collected 29 vibracores within the proposed sand source in 1995 and 1996 and performed grain size analyses on selected samples. Based on historical data, the thickness of potential beach-compatible material ranges from 4 to 20 feet, with an average thickness of more than 10 feet. Conservative dredge cut depths and a 15-year-old bathymetric survey were used to estimate an available volume of approximately 5 million cubic yards. This should allow for plenty of material in the sand source for the initial beach fill, which is anticipated to be less than 200,000 cubic yards. The sand source does contain rock and large shell that will require screening. Vibracores were typically collected at a spacing greater than 1,000 feet, which is the minimum distance required for borrow area design. As such, it is expected that additional core borings will be collected and laboratory analyses performed to ensure that the material is compatible with the beach placement area and is in compliance with FDEP's "Sand Rule" guidelines.

Boring logs and laboratory testing results are available in Appendix D.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of the offshore sand source under the FWOP is similar to the existing conditions described above. However, other beach nourishment projects may utilize this source. The last bathymetric survey estimated the available volume of suitable to be approximately 5 million cubic yards, sufficient quantity to support this Project and others for the foreseeable future.

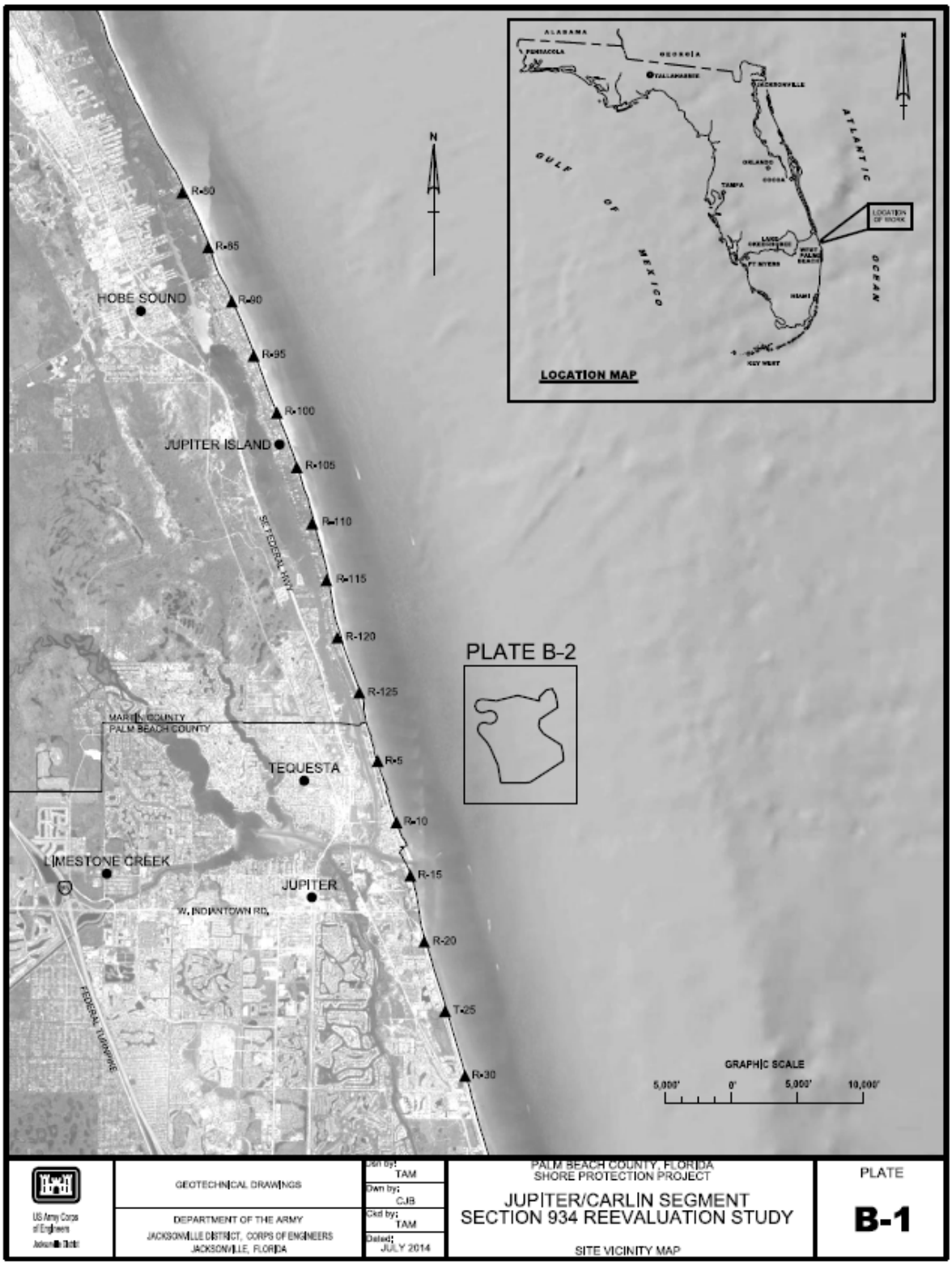


Figure 4: Jupiter Carlin A Offshore Sand Source.

2.2.9 UPLAND SAND SOURCES

EXISTING CONDITION

All upland sand mines in Florida are required to obtain the appropriate permits from the FDEP, the USACE, and local governments. Other Federal laws, State statutes, and local ordinances may also apply. There are several permitted existing sand mines in south Florida that could be used to nourish the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project (Figure 5). Based on information provided by these mines, the USACE has determined that they contain sufficient sand reserves for the life of the Project. Generally, sand mines in Florida consist of an open pit, haul roads, and structures and equipment located on the perimeter or in the near vicinity of the pit. Mines that could be used for this Project include, but are not necessarily limited to the following:

Stewart Mining Industries – Immokalee and Ft. Pierce: The Stewart Mine at Immokalee is located just northwest of the City of Immokalee in northwestern Collier County, approximately 130 miles from the project area. The Stewart Mine in Ft. Pierce is located approximately 40 miles northwest of the Project area in St. Lucie County. For both mines, the sand is extracted from a lake pit by hydraulic dredge and pumped through pipes to a sand processing plant.

Vulcan Materials – Witherspoon: The Vulcan Witherspoon Mine is located in southern Glades County, near the city of LaBelle, approximately 120 miles from the project area. The Witherspoon Mine claims to have the deepest dredge in the western hemisphere. The sand is extracted from the lake pit by hydraulic dredge and pumped to a sand processing plant.

E.R. Jahna – Ortona: The E.R. Jahna Ortona Mine is also located in southern Glades County, adjacent to the Witherspoon mine and approximately 120 miles from the project area. Sand from the Ortona Mine has been used extensively for beach fill projects throughout southeast Florida. Sand is extracted from the mine pit using one of two cutter-head dredges and pumped to a central processing plant.

Atlantic Civil, Inc. – Homestead: The ACI Mine is located in southern Miami-Dade County, in the city of Homestead and approximately 120 miles from the project area. Sand is extracted using either a dragline or gantry dredge.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of upland sand sources under the FWOP condition is similar to the existing conditions described above. Additionally, other projects are likely to utilize these sources. Palm Beach County has used at least one of the potential upland sand sources for local fill events.

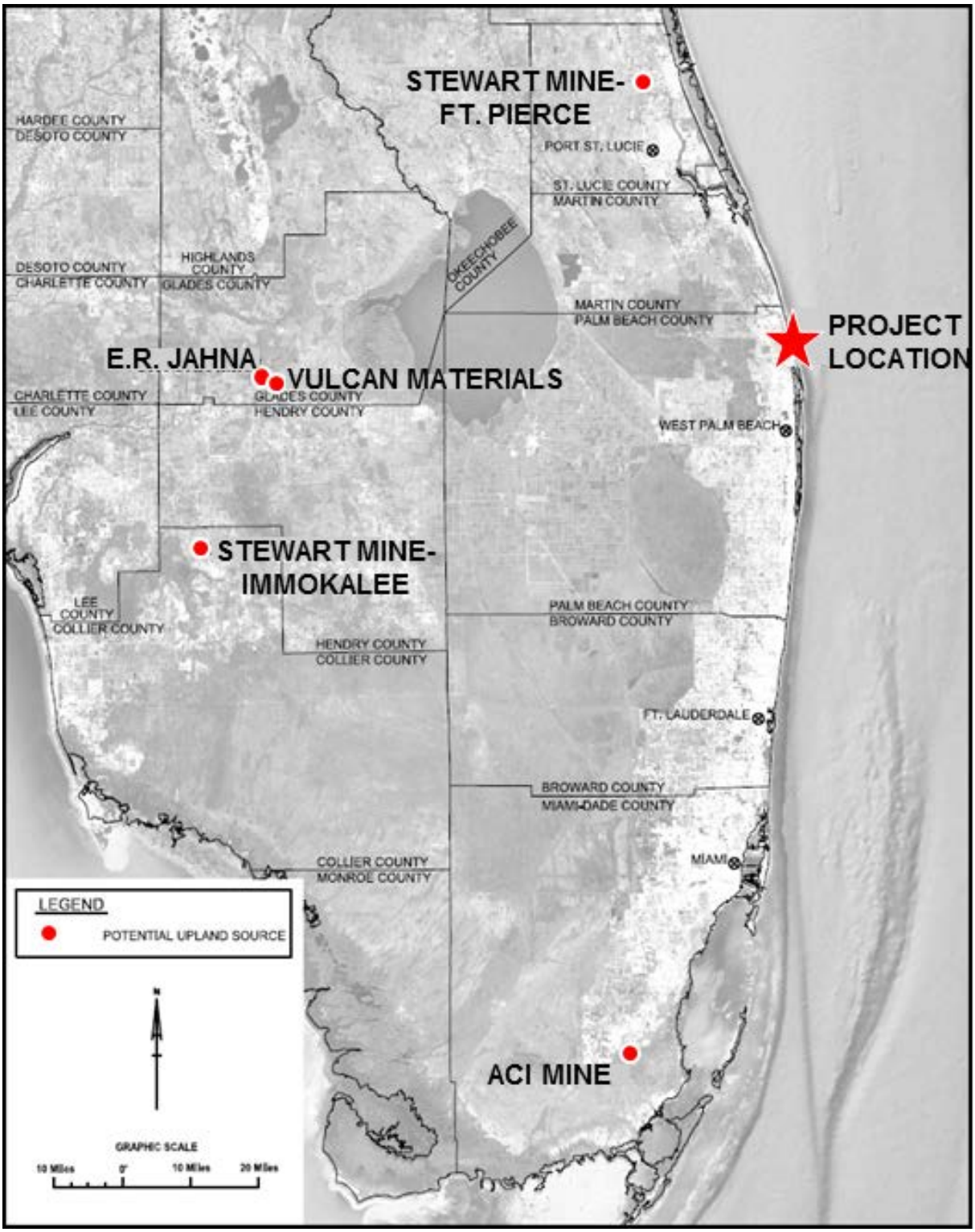


Figure 5: Potential Upland Sand Sources for Jupiter Carlin

2.2.10 WATER QUALITY

EXISTING CONDITIONS

The beach and nearshore environment in the Project area is influenced by several factors including ebb and flood tidal waters through the Jupiter Inlet with a mean tidal range of 2.9 ft.; waves averaging 2.7 ft. in height; water temperatures ranging from 65° – 86° F (18.3° – 30° C). Long-term records of turbidity in Jupiter Inlet, the most relevant long-term dataset for the project area (1998 and 2008) showed a median turbidity of about 2.5 Nephelometric Turbidity Units (NTU) with a range of <1 to >12 NTU (Arrington, 2008). The ebb and flood of the tidal waters through Jupiter Inlet alternately flush the project area with oceanic and estuarine waters with varying degrees of velocity associated with tidal currents. The tides also create daily changes in the location and extent of wave impact on the bottom. These factors and the shifting sand of the nearshore and ebb tidal shoal create an environment in a constant state of change.

The FDEP classifies the coastal waters in the project area as Class III Marine defined as waters suitable for recreation and the propagation of fish and wildlife. The project waters do not have contaminants in excess of numeric or non-numeric water quality standards and are available for their intended uses.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of water quality under the FWOP is similar to the existing conditions described above.

2.2.11 HAZARDOUS, TOXIC & RADIOACTIVE WASTE (HTRW)

EXISTING CONDITIONS

Residential and public land uses have fully developed the shoreline, with a substantial portion dedicated to publicly owned and accessible open space and recreational areas. No sources of HTRW have been identified in the Project area.

Dredging equipment, staging areas, construction equipment, and other motorized vehicles used during local construction events have the potential to spill for example, gasoline and lubricating oils. Accident and spill prevention plans provided in contract specifications should help avoid most spills.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

No sources of HTRW have been identified in the Project area. The predicted status of HTRW under the FWOP is similar to the existing conditions described above.

2.2.12 AIR QUALITY

EXISTING CONDITIONS

Offshore Sand Source and Beach Placement Area

Palm Beach County lies within the Southeast Florida Intrastate Air Quality Region, as established by 40 CFR Part 81.49. The U.S. Environmental Protection Agency (EPA) (40 CFR Part 81.310) designates Palm Beach County as being in attainment with National Ambient Air Quality Standards for ozone, nitrogen dioxide, carbon monoxide, particulate matter, and sulfur dioxide. Air quality in Palm Beach County exceeds national standards. The EPA has not made a designation for lead in southeastern Florida.

Ambient air quality along coastal Palm Beach County is generally good due to prevalent ocean breezes from the northeast through the southeast. Coastal development and the popularity of the beaches area

all contribute to the presence of motorized vehicles and vessels in the project area at any given time. The usually present sea breezes along the Jupiter shore readily disperse airborne pollutants. This Project, regardless of the alternative implemented, would not require air quality permits.

Upland Sand Sources

Air quality at the Stewart Mine located in northwestern Collier County, Vulcan Witherspoon Mine located in southern Glades County, E.R. Jahna Ortona Mine located in southern Glades County, and the ACI Mine located in southern Miami-Dade County is also in attainment with the National Ambient Air Quality Standards for ozone, nitrogen dioxide, carbon monoxide, particulate matter, and sulfur dioxide.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of air quality under the FWOP is similar to the existing conditions described above.

2.2.13 NOISE

EXISTING CONDITIONS

Offshore Sand Source and Beach Placement Area

Low to moderate noise levels in the beach project area result from breaking waves, nearby urban activities, and recreational activities on the beach. Elevated noise levels (above the noise levels of breaking waves), primarily from recreating beachgoers, may occur during the summer and on most weekends.

Upland Sand Sources

All of the upland sand mines have similar noise profiles. They are surrounded by predominately rural agricultural land with no sensitive receptors abutting or directly adjacent to them. The noise of the mines is characterized by mechanical noise associated with operation of the electric dredge and the sorting equipment. Additionally, there is noise from trucks entering and leaving the plants and during truck loading operations.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The predicted status of noise under the FWOP is similar to the existing conditions described above.

2.2.14 AESTHETIC RESOURCES

EXISTING CONDITIONS

An aesthetic or visual resource is a broad term used to identify the particular scenic qualities that define a place or landscape. The sandy beaches and blue waters of the Atlantic Ocean define the aesthetic resources within the Project area. Upland development, vacant lands, and recreational beach access areas backs the coastline. Vacant lands and beach access areas are generally vegetated with low lying shrubby dune plants such as sea oats (*Uniola paniculata*), with occasional interspersed railroad vine (*Ipomoea pescapre*), sea grapes (*Coccoloba uvifera*), and sea purslane (*Sesuvium sp*.). Residents and guests within the Project area enjoy the aesthetically pleasing panoramas of the Atlantic Ocean. However, the general Project area does not include sites designated under 40 CFR 81.407 as a Class I Federal Area, where visibility is an important value. Erosional processes currently occurring within the Project area detract from the aesthetics and will continue to reduce the width of the beach area and related aesthetic value.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Under the FWOP, the risk of wave and storm erosion is likely to increase resulting in the future degradation of the beach and dune system. Loss of beach width and natural habitat would contribute to a reduction in aesthetic value within the project area. Risk of loss of aesthetic values would be reduced as the non-Federal sponsor and other non-Federal entities continue to nourish the beach on an annual to biennial basis, as they have been since 1947.

2.2.15 RECREATION RESOURCES

EXISTING CONDITIONS

Offshore Sand Source and Beach Placement Area

The beach and nearshore environments provide extensive opportunities for recreational activities such as sunbathing, nature observation, surfing, skin and scuba diving, fishing, and boating. A majority of surfing occurs in the area south of the Jupiter Inlet south jetty to about the northern two-thirds of Jupiter Beach Park and at the north end of Carlin Park.

Upland Sand Sources

These sites are not known to have recreational activities ongoing within the mine operational areas.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Under the FWOP, the risk of wave and storm erosion is likely to increase resulting in the future degradation of the beach and dune system. Loss of beach width and natural habitat would contribute to a reduction in recreational opportunities within the project area. Risk of loss of recreation is minimized such that the local nourishments from Jupiter Inlet and the AIWW continue on an approximate annual basis as they have since 1947.

2.2.16 CULTURAL RESOURCES & HISTORIC PROPERTIES

EXISTING CONDITIONS

Archival research, archeological field investigations, and consultation with the Florida State Historic Preservation Officer (SHPO) demonstrate that two recorded archaeological sites are located in the nearshore close to the Project placement area. The Jupiter Wreck (8PB0234) is reported to lie approximately 300 feet south of the inlet and just northeast of the placement area and has been managed under a salvage agreement between the State of Florida and Jupiter Wreck Inc. since 1987. The artifact scatter of the wreck extends seaward from the nearshore for approximately 3000 feet, and is purported to be the remains of the seventeenth century *San Miguel de Archangel*, a Spanish dispatch vessel sunk in 1659. A second wreck, the nineteenth century steamer *Victor* (8PB0102) is located near the south end of the project area approximately 900 feet offshore. Neither site has been affected by previous shore protection efforts and the SHPO concurred with a finding of no effect for placement along this shoreline in 2013 (SHPO, 2013). Additionally, no documented historic structures or resource groups exist adjacent to the west of the shoreline placement area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The no-action alternative would not affect cultural resources and historic properties, however continuing erosion could uncover non-contextual, cultural artifacts that may wash towards shore from offshore shipwrecks.

2.2.17 NATIVE AMERICANS

EXISTING CONDITIONS

No portion of the proposed Project area exists within or adjacent to known Native American-owned lands, reservation lands, or Traditional Cultural Properties. However, Native American groups have lived throughout this region in the past and their descendants continue to live within the State of Florida and throughout the United States. Pursuant to Section 106 of the National Historic Preservation Act (16 USC 470), obligations regarding the USACE Trust Responsibilities to federally-recognized Native American Tribes, and in consideration of the Burial Resources Agreement between the USACE and the Seminole Tribe of Florida, prior consultation on the project has not indicated any historic use of the project area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO-ACTION ALTERNATIVE)

The FWOP conditions of Native American groups are similar to the existing conditions described above.

2.2.18 PUBLIC SAFETY

EXISTING CONDITIONS

Issues of public safety along the beach placement area principally include those typically associated with beach- and water-related recreation, including sun exposure and injuries or drowning from high surf or run-outs. The submerged rock outcrops in shallow water along the shoreline can also result in injuries to bathers. Crime and related activities are of a low to moderate nature and are not considered to be of a significant nature.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Under the FWOP conditions, public safety of the study area is not anticipated to significantly change in the FWOP Condition; however, due to increased erosion and the continued narrowing of the beach, the number of people recreating on the beach is expected to decline and this may affect public safety statistics for this area.

2.3 PHYSICAL ENVIRONMENT (CONDITIONS)

Evaluating continued Federal interest in supporting beach nourishment of the Jupiter Carlin Segment of the Palm Beach County, Florida Shore Protection Project requires a thorough understanding of the area's existing conditions. The study area consists of an open sandy coast subject to frequent storm events. Adjacent properties to the shoreline include residential, commercial, and recreational properties. Many factors influence the coastal processes characteristic to the Palm Beach County, Florida shoreline. This chapter summarizes the following key natural forces and storm conditions, such as Jupiter Inlet and its effects on the down drift beach in the study area, as well as influences by winds, waves, water levels, currents, tropical storms, hurricanes, and extra-tropical storms.

2.3.1 STUDY REACH

The 1.1 mile length of the project spans FDEP R-monuments R-13 to R-19. The down drift reach spans from R-19 to R-26.

EXISTING CONDITIONS

Study reaches are areas that have similar geomorphic and/or socioeconomic characteristics and cannot be practicably designed in a smaller increment. For planning purposes, study reaches can be considered separable elements. Study reaches can be fairly large and may include several Beach-*fx* model reaches. In this case, because the purpose of this report, as specified by WRDA 1986, is to determine economic justification in the previously authorized project, multiple study reaches have not been developed. The Project is already authorized and is being analyzed as a single study reach. WRDA 1986 permits the optimization of the size and timing of the recommended periodic nourishment interval for the authorized project. This evaluation has optimized the Project within the authorized study reach.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The reach will remain the same in the FWOP condition.

2.3.2 EFFECTS OF OTHER PROJECTS

The morphology and reorientation of the shoreline south of Jupiter Inlet is influenced by the following factors:

1) The presence of Jupiter Inlet. As with all inlet systems, shorelines adjacent to an inlet are an inseparable part of the system. More often than not, an inlet behaves as a "sediment sink" which is the case at Jupiter Inlet, as evidenced by the growth of the ebb shoal and shoaling in AIWW. Jupiter Inlet intercepts sediment migrating from north to south and influences local wave-driven currents through interaction with tidal currents. The interception of sediment and the localized currents generally has had an erosional effect on the down drift side of Jupiter Inlet. Sediment that is not either entrapped in the inlet complex must be bypassed to beaches to the south. A sediment budget created with historical shoreline positions, beach profile, ebb shoal and flood shoal volumes, and an accounting of mechanical transfer of sand determine the bypassing rates (if any) of sediments to the south. The Jupiter Inlet Management Plan has an annual 75,000 cy/yr sand bypassing requirement.

Because the Inlet effects are a constant, they likely did not play a direct role in the realignment of the shoreline since 1995. It should be noted, however, that since Jupiter Inlet and adjacent shorelines are

part of a system, the Inlet will have interacted with the shoreline as it reoriented. This may have contributed to the morphological changes already taking place (either hindering or exacerbating them).

2) Local fill events. Since 1947, maintenance material from the Inlet has been placed on the shoreline just south of the Inlet. Beginning in 1970, this material was supplemented with maintenance material from the AIWW. On average, Inlet material (placed at intervals of 1 to 2 years) accounts for an average annual volume of approximately 41,000 cubic yards (cy). AIWW material (placed at intervals typically ranging from 2 to 4 years) accounts for an average annual volume of approximately 29,000 cy. Individually, local placement events vary in volume, cross-shore dimension, long shore extent, and timing.

Because the local fill events have occurred since 1947 through present day, their effect may be considered to be relatively constant, and as such, are not a major contributing factor to reorientation of the shoreline since 1995. These events contribute to the overall sediment transport system through mechanical placement of sediment to the adjacent shoreline. There is also the possibility that placement of the Federal project from R-13 to R-19 has influenced the historic placement location(s) of the locals fills, which would have a localized impact on the morphology.

3) Federal Project. Beginning in 1995, as part of the federally cost-shared project, approximately 1,362,000 cubic yards (cy) of material has been placed in the Project area between R-13 and R-19 (1995 Initial Construction: 604,000 cy, 2002 Nourishment Event: 625,000 cy, 2015 FCCE Nourishment Event: 133,000 cy). Considering the overall sediment budget for the system, the Federal project's placement of more than 1,300,000 cy of material over 1.1 miles of shoreline since 1995 has been one of the most significant changes to the system. The maintenance of the Federal project has contributed to the long term change to the pre-project morphology.

4) Extension of the south jetty. In 1998, the south jetty was lengthened by approximately 175 feet. While not as dramatic of a change as the construction of the Federal Project, the lengthening of the structure likely had an influence on the shoreline to the south by changing the wave climate and nearshore current patterns. The longer jetty also aides in decreasing the amount of material entering the channel from the south. While north to south transport is dominant, south to north transport in the vicinity of the Inlet does occur.

As extension of the south jetty occurred shortly after initial construction of the Federal Project and given that the extension was made to the jetty at the down drift side of the inlet, it is not likely to be a significant contributor to the reorientation of the shoreline. The Inlet itself intercepts the north to south longshore transport. Therefore, there is no active path of sediment migration for the jetty extension to interrupt. The extension has a localized effect on incident waves and nearshore current patterns, offering some shielding from wave and current energy immediately adjacent to the jetty (in the vicinity of R-13). While this is a definite contributor to morphological changes to the shoreline, it is not sufficient to account for the reorientation of the shoreline extending as far south as R-15 and R-16.

In conclusion, through the course of this analysis it became apparent that the shoreline south of Jupiter Inlet, which includes the Project shoreline, has realigned to a more north-south orientation since initial construction of the Federal project in 1995. While each of the components listed above had an impact on the morphology of the shoreline immediately south of the Inlet, the degree to which each contributes to changes in overall orientation that have occurred since initial project construction in 1995 varies. Because of the complexity of the inlet system, where the channel, shoals, and adjacent shorelines interact inextricably, it is not a trivial task to separate each of the contributing elements and quantify their contributions to the morphological changes that have occurred to the south shoreline since 1995.

PRE-PROJECT

Jupiter Inlet began as a natural waterway connecting the Loxahatchee River with the Atlantic Ocean. Subject to natural closing, Jupiter Inlet required periodic maintenance to keep it open before 1922. A special act of the Florida Legislature established the Jupiter Inlet District (JID) in 1921 to provide maintenance by means of a local taxing district. In 1922, forty years before this Project was authorized, the JID constructed two, parallel jetties to help keep the Inlet open. In 1998, the south jetty was lengthened by approximately 175 feet. While not as dramatic of a change as the original construction, the lengthening of the jetty structure likely had an influence on the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project shoreline south of the Inlet by changing the wave climate and nearshore current patterns.

EXISTING

The following paragraphs present the Inlet's history and a record of the Inlet's dredging and sand bypassing history to assist in understanding the effects of the Inlet on the beach.

Currently stabilized with jetties to support navigation and to maintain the outflow of the Loxahatchee River and the C-18 drainage canal, Jupiter Inlet lies in northern Palm Beach County, approximately 16 miles south of the St. Lucie Inlet and 11.7 miles north of the Lake Worth Inlet. The AIWW crosses the Loxahatchee River immediately west of the Inlet.

Jupiter Inlet contributes to beach erosion by acting as a sediment sink. The stabilized inlet interrupts the net southerly longshore sediment transport that would otherwise nourish the project area. Tidal flood[2] currents divert sediment from the coast to inside the inlet. Once inside the inlet, sediments tend to settle out into flood shoals. Tidal ebb[3] currents also divert sediments along the coast farther seaward. These sediments also tend to settle out into ebb shoals as the tidal velocity decreases. Jupiter Inlet's south jetty and the location of the ebb shoal return bar have historically dictated the limits of severe erosion. The ebb shoal, attaching to the shore between R-16 and R-19, has migrated over the years. Aerials from 2008 depict the ebb shoal return bar attached to the shore between R-18 and R-19 at Carlin Park. While severe erosion will occur immediately down drift of inlets, slow long-term erosion may also occur further down drift of the inlet due to the littoral drift deficit.

MAINTENANCE

Three governmental entities routinely dredge near Jupiter Inlet. Palm Beach County acts as the local sponsor of the Jupiter Carlin Segment of the Palm Beach County, Florida Shore Protection Project. The Florida Inland Navigation District (FIND), as the local sponsor for the AIWW, disposes of material from routine AIWW maintenance dredging near Jupiter Inlet along the project shoreline. Finally, the JID acts as local sponsor of Jupiter Inlet, and as such periodically dredges a sand trap located in the Inlet throat. Table 3 presents a history of dredging in the sand trap, ebb shoal, and AIWW since 1947. Most of these dredging events disposed of material on the beach south of the Inlet. From 1947 to 1996, the average total dredged material placed on the beach south of the inlet exceeded 71,000 cubic yards/year (cy/yr), including ebb shoal dredging. From 1997 to 2010 (since the state of Florida's adoption of the Jupiter Inlet

[2] Flood: the occurrence of incoming water (between a low tide and the following high tide)

[3] Ebb: the outward flow of the tide (Webster's Dictionary)

Management Plan), the average total material placed on the south beach exceeded 148,000 cy/yr (including ebb shoal and offshore sand source dredging for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project). Furthermore since 1997, the JID and FIND have dredged and placed on the south beach about 96,500 cy/yr, which exceeds the inlet management plan's 75,000 cy/yr sand bypassing requirement.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The current natural processes will continue to occur within the inlet and will continue to affect the Project area.

Table 3: Dredging History (Average Annual) in the Vicinity of Jupiter Inlet.

Year	Inlet (cy)	ICWW* (cy)	Total Placed (cy)
1947	106,150		106,150
1948	37,000		37,000
1951			
1952	62,000		62,000
1954			
1955	70,000		70,000
1956			
1957	70,000		70,000
1958			
1960	42,000		42,000
1962	45,000		45,000
1963	56,100		56,100
1964			
1965	126,000		126,000
1966			
1968	209,000		209,000
Average Annual	37,420		37,420
1970	45,000	93,278	138,278
1972	78,000	64,400	142,400
1974	50,000		50,000
1975	85,000	136,413	221,413
1977	120,000		120,000
1979	78,000	121,117	199,117
1981	70,000		70,000
1983		172,500	172,500
1985	76,000		76,000
1987	65,000		65,000
1988	60,000	115,000	175,000
1990	85,000		85,000
1991	57,000		57,000
1993	61,500		61,500
1994	71,500		71,500
1995	72,000		72,000
1996		110,500	110,500
1997	31,540		31,540
1999	85,000		85,000
2000	56,200	100,000	156,200
2001	82,900		82,900
2002	44,000	120,000	164,000
2004	60,000	150,000	210,000
2005	78,000		78,000
2006	70,500		70,500
2008	88,000	107,000	195,000
2009	65,000		65,000
2010-2011	88,000		88,000
2012	30,800		30,800
2013	69,000		69,000
2014	41,000		41,000
Average Annual**	43,643	28,671	72,314

*Prior to 1970, material from the ICWW was placed upland

** Average annual volume from 1970 to 2014

2.3.3 PROJECT PERFORMANCE

INITIAL CONSTRUCTION (1995)

Initial construction began in 1995 of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project, and restored approximately 1.1 miles of shoreline from Jupiter Beach Park to Carlin Park (R-13 – R-19) with nearly 604,000 cy of beach-quality sand from Jupiter Inlet's ebb shoal. In compliance with FDEP permit requirements and on behalf of Palm Beach County, Coastal Planning and Engineering (CPE) monitored the Project in 1995, 1996, and 1997. Applied Technology and Management (ATM) monitored the Project in 1998 and 1999.

Between March 1995 and June 1999 (available surveys), three small sand trap and one AIWW dredge events occurred and beach placement events also occurred. These events placed approximately 299,000 cy of dredged sand on the beach for an average of about 75,000 cy per event. Figure 6 shows the historical offshore sand sources used for nourishments within the Project area.

Four storm events affected the fill shortly after construction. Hurricane Erin, a Category 1 storm, and a tropical storm passed near the area in August 1995. In addition to these storms, a strong nor'easter in March 1996 affected the Florida coast. One tropical storm in November 1998 passed within 100 miles of the project area. Table 4 summarizes shoreline changes following initial nourishment of the project area. The presented shoreline change rates and volume changes include the effects of these bypassing events and storms.

The monitoring reports also provided a complete history of the beach volume changes over the four years following initial beach construction. All reports followed the convention of presenting volume changes above the -12 and -18-ft- National Geodetic Vertical Datum of 1929 (NGVD29) contours. Table 5 summarizes the volume changes between pre- and 48-month-post-project conditions.

The initial nourishment of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project exhibited behavior typical of a beach nourishment down drift of an inlet with few exceptions. The shoreline within the Project area behaved typical of a feeder beach undergoing periodic nourishment, erosive in the north near the Inlet with transitory accretion down drift. Overall, the Project area lost approximately 287,000 cy over the 48-month monitoring period.

Gosselin (2002) investigated the relationship between the ebb shoal and nearshore processes to provide guidance on future management activities in the area. Gosselin (2002) provides the following conclusions regarding the impacts to the Project.

- Nourishment activities involved movement of sediment within the active profile rather than reintroduction of previously lost material
- The March 1996 storm significantly affected the area and induced widespread cross-shore movement of sediment beyond the limits of the profile surveys
- The March 1996 storm was the primary cause of the Project's poorer than expected performance during the first year following construction

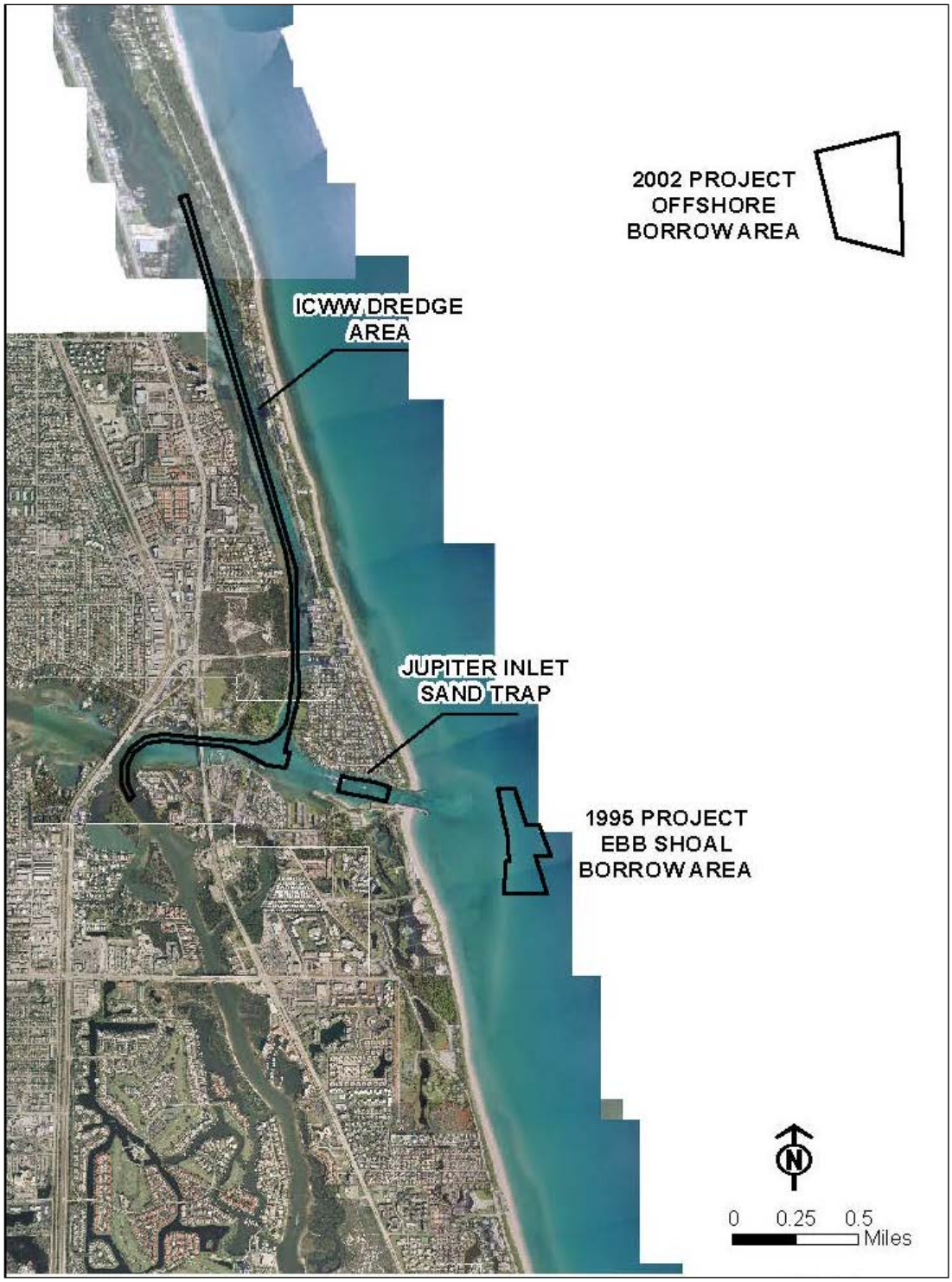


Figure 6: Historic Offshore Sand Sources.

Table 4: Post-Project MHW Shoreline Changes (1995 – 1999).

	MHW Shoreline Changes (ft./yr)			
	1995-1996	1996-1997	1997-1998	1998-1999
R-13	13	77	-84	-43
R-14	-11	-9	-68	-114
R-15	8	-48	-72	-41
R-16	-30	-45	-38	-64
R-17	-122	Unavailable	Unavailable	28
R-18	-122	13	-9	37
R-19	-60	-72	89	-5
Average	-46	-14	-30	-29

Table 5: Pre-Project to 48-Month Post-Fill Volume Changes (ATM, 1999).

FDEP Reference Monument	Intervening Distance (feet)	Volume Change to -12 feet NGVD29 (-13.5 feet NAVD88)		Volume Change to -18 feet NGVD29 (-19.5 feet NAVD88)	
		cy/feet	cy	cy/feet	cy
R-13	406.7	185.43	75,414	70.65	28,733
R-14	921.1	-237.73	-24,087	-394.50	-149,150
R-15	731.3	-4.89	-88,715	-104.57	-182,488
R-16	857.3	-24.20	-12,469	-60.69	-70,838
R-17	797.9	27.42	1,285	4.05	-22,598
R-18	935.2	83.75	51,981	59.88	29,892
R-19	1,335.4	69.75	102,491	58.73	79,195
Subtotal	5,984.90	--	105,899	--	-287,253

Table 6: Post-Project MHW Shoreline Changes (2002 – 2006).

FDEP Reference Monument	MHW Shoreline Change (feet)				
	2002-2003	2003-2004	2004-2005	2005-2006	2002-2006
R-13	61.3	-34.4	-63.3	-127.4	-159.4
R-14	-41.1	2.0	-73.8	-127.5	-243.6
R-15	-83.9	29.8	-92.7	-61.9	-212.0
R-16	-50.2	-6.0	-33.9	-91.2	-184.8
R-17	-30.2	-63.7	76.1	-118.3	-140.6
R-18	-11.1	-73.3	1.8	-13.9	-101.5
R-19	24.9	-25.8	-85.6	34.0	-58.2
Average (R-13 – R-19)	-14.3	-27.5	-39.2	-68.6	-156.1
R-20	27.3	50.6	-71.5	67.4	71.5
R-21	17.8	7.2	33.0	-1.5	52.2
R-22	8.1	28.9	-9.1	8.6	32.2
R-23	-29.4	8.0	25.6	-26.0	-7.4
Average (R-20 – R-23)	6.9	25.6	-8.5	26.0	48.7

PROJECT PERFORMANCE - FIRST PERIODIC NOURISHMENT EVENT (2002)

Approximately seven years after initial construction, the first Federal periodic nourishment occurred between December 2001 and March 2002. The fill consisted of approximately 625,000 cy of sand with a median grain size of 0.38 mm from an offshore sand source approximately two miles northeast of Jupiter Inlet. ATM (2004), Albada and Craig (2006), Woodward et al. (2006), and Bridges et al. (2008), on behalf of Palm Beach County, presented the results of 6-, 12-, 24-, 36-, and 48-month post-construction monitoring of the first periodic nourishment.

In addition to the Federal nourishment, between February 2002 and May 2006, six small scale, local beach nourishment events occurred. These events included four sand trap and two AIWW dredge placement events. These dredging events placed approximately 520,500 cy on the project beach. During the four-

year post construction period, several storms affected the project area to varying degrees. In September 2004, two major hurricanes affected the project area. Hurricane Frances, a Category 2 storm, occurred in early September followed by Hurricane Jeanne, a Category 3 storm, in late September. Both hurricanes made landfall about 15 miles north of the project area. In 2005, three more tropical events affected the area. These storms included Hurricane Katrina, a Category 1 storm in August 2005, Hurricane Wilma, a Category 3 storm in October 2005, and a tropical storm in October 2005. Table 6 summarizes shoreline changes following the first Federal periodic nourishment of the Project. The presented shorelines include the effects of these bypassing events and storms.

Table 7 summarizes the volume changes between 2001 and 2006. It indicates a substantial loss of material throughout the entire beach monitoring area (-1,579,400 cy) with the greatest erosion immediately south of the inlet to R-17. The severity and close timing of the 2004 hurricanes, changes to the Inlet's ebb shoal, and its attachment bar, shown in beach profile surveys, likely contributed to the extent of storm-induced losses in the vicinity of the inlet.

Another significant storm event for this region that affected the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project was Hurricane Sandy in 2012. Hurricane Sandy affected this area eight years after Federal participation ended and eleven years after the last federally cost-shared periodic nourishment event. The following information is from the Project Information Report (PIR) prepared by the USACE, at the request of the non-Federal sponsor, under Pubic Law (PL) 84-99, Flood Control and Coastal Storm Emergencies (FCCE)(33 U.S.C 701n, 69 Stat 186), which authorizes the Chief of Engineers, acting for the Secretary of the Army, to provide emergency and disaster assistance. This assistance includes rehabilitation of federally authorized and constructed shore protection projects. PL 84-99 assistance applies to SPPs the USACE has designed and constructed to provide storm damage reduction.

Hurricane Sandy produced large waves that impacted Florida's Southern and Central Atlantic coast for an extensive period of time. Storm surge was not excessive in terms of its maximum value, but the duration of elevated water levels was substantial. Water levels were 1 foot over predicted for more than 48 hours and peak water levels were approximately 2 feet more than predicted for a 24 hour period. During Hurricane Sandy Florida's southern and central Atlantic coast experienced severe erosion that was observed from Brevard County (north of Palm Beach County) southward through Broward County (South of Palm Beach County). At the time of Hurricane Sandy's impacts the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project was in a depleted condition. An analysis of the post-storm survey showed that the shoreline had receded from 50 to 150 feet relative to the pre-storm survey, with the greatest losses occurring at the ends of the fill segment. The width of beach fill placement required to reestablish the construction berm ranged from 100 to 375 feet, with the greatest density of fill placement required at the north end of the fill (Figure 7).

The total measured pre- to post- storm erosion due to Hurricane Sandy was 86,700 cy. From the PIR, the total volume required to rebuild the authorized construction template based on the December 2012 survey was 822,000 cy. Of this total, 735,300 cy would have been constructed with Construction General funding and cost-shared with the non-Federal sponsor, and 86,700 cy would be 100% federally-funded through the FCCE program.

Ultimately, a contract was awarded in FY14 for 87,000 cy of FCCE material to be 100% federally funded. However, this contract was terminated for convenience. A contract was then awarded to a different contractor in FY15 for 110,000 cy of material which was also 100% federally funded. The FY15 event successfully placed 132,638 cy of material within the Project template.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The FWOP for project performance would be null if there is no extension of Federal participation in the Project. The local nourishments would continue on an approximate annual to biennial basis as they have been since 1947, however without extension of the Federal project there would be continued erosion and increased storm damages to infrastructure.

Table 7: Pre-Project (2001) to 48 Months Post-Fill Volume Changes (Bridges et al., 2008).

FDEP Reference Monument	Intervening Distance (feet)	Volume Change*	
		cy/feet	cy
South jetty	--	--	--
R-13	449	-542.8	-243,500
R-14	815	-333.7	-271,900
R-15	795	-347.7	-276,300
R-16	828	-248.8	-205,900
R-17	867	-123.7	-107,200
R-18	1,135	15.4	17,500
R-19	668	24.0	16,100
Subtotal (R-13 – R-19)	5,555	-192.9	-1,071,200
R-20	1,865	-19.7	-36,800
R-21	1,162	-23.3	-27,100
R-22	1,026	-251.0	-257,600
R-23	526	-355.1	-186,700
Subtotal (R-20 – R-23)	4,580	-111.0	-508,200

*Computed volume changes extended from the dune to the maximum depth available between any given two profiles. Elevations varied from -30 to -24.5 feet-NGVD29 (-31.5 to -26 feet NAVD88).

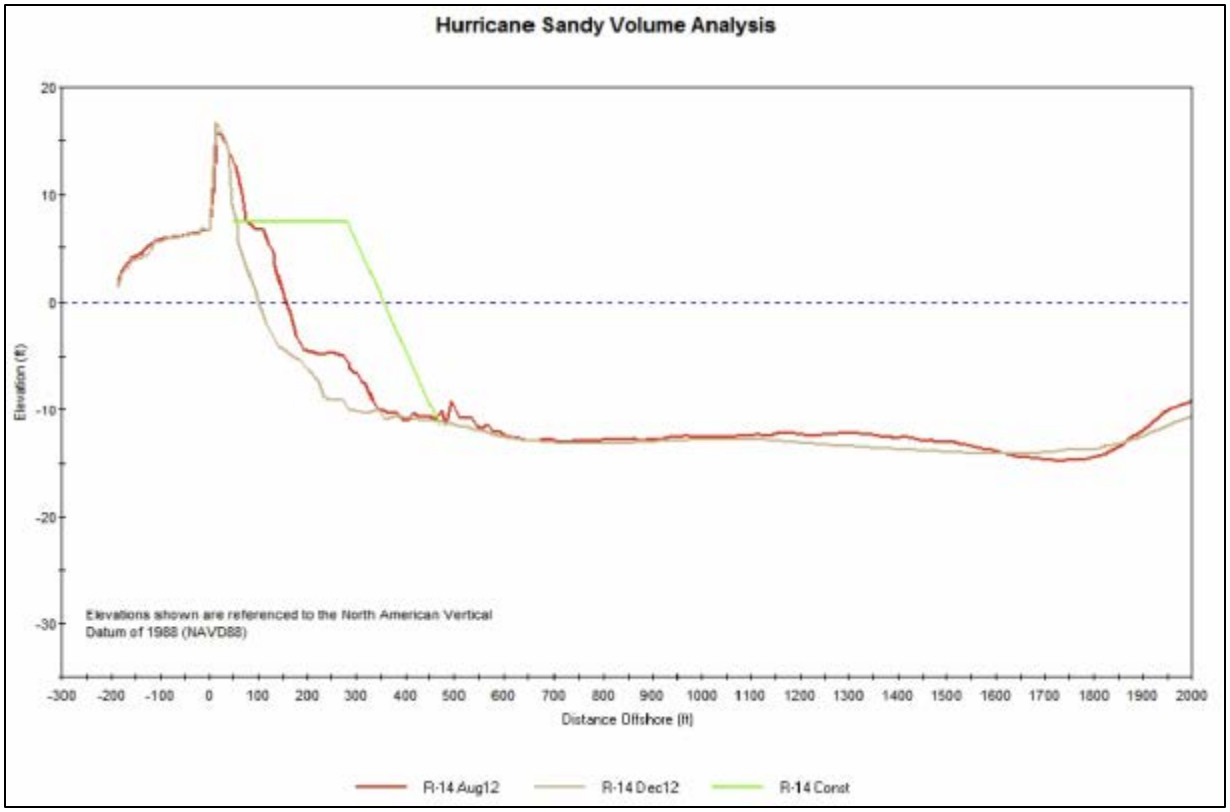


Figure 7: Volume Profile Analysis at R-14 for the Authorized Construction Template, Pre-Storm, and Post-Storm Survey.

2.3.4 OPERATIONS & MAINTENANCE

EXISTING CONDITIONS

Federal participation in periodic nourishment of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project concluded in 2005. There is currently no Federal participation, with the exception of PL 84-99 assistance. Local nourishments events of the Project have occurred on practically an annual basis since 1947 by Palm Beach County, Jupiter Inlet District (JID), and the Florida Inland Navigation District (FIND).

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

In the future it is assumed that Palm Beach County, JID and/or FIND would conduct periodic nourishments to provide minimal protection to the design berm per the Jupiter Inlet Study Management Implementation Plan (adopted by FDEP in 1997), which estimates the need to bypass approximately 75,000 cy of suitable material annually to offset the impacts of the Inlet. The approximate volume bypassed annually as per the Inlet Study Management Plan is incorporated into the background erosion rates for the FWOP analysis. This volume, however, does not provide the level of storm damage reduction that the continued Federal participation in the Project would provide.

2.3.5 GEOLOGY

EXISTING CONDITIONS

The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is located in northern Palm Beach County, on the barrier island beach, immediately south of Jupiter Inlet in the Atlantic Coastal Ridge physiographic region. The Savannah, Altamaha, and other rivers of Georgia and the Carolinas have transported sand to the Florida East Coast; shore currents and wave action gradually shifted this sand southward. The combined effect of wind and wave action has formed much of this sand into successive parallel ridges or dunes. Unconsolidated sand and shell underlain by a limestone/sandstone base compose the Florida beaches.

The foundation for most of the barrier islands in Palm Beach County is the Anastasia Formation. This rock formation appears at several places in the county as a submerged reef that generally parallels the shoreline. The exposed formation appears at various locations from the high water line to approximately 1,000 feet offshore. Nearshore rock outcroppings exist in the project area. The most prominent outcropping occurs near R-18. A portion of this outcropping extends above mean high water, and the remainder extends into the nearshore area. Additional details on the geology of the project area may be found in Appendix D.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The geology in the FWOP condition would be expected to function and/or change according to the conditions described above.

2.3.6 SHORELINE CHANGE & EROSION RATES

EXISTING CONDITIONS

Changes in MHW position provide a historical view of the behavior of the shoreline. Beach profiles are traditionally gathered by the FDEP, local sponsors, and the USACE. Available beach surveys for Palm Beach County date back to 1883.

Initial construction of the Jupiter Carlin Segment of the Palm Beach County, Florida Shore Protection Project occurred in 1995, followed by periodic nourishments starting in 2002. MHW shoreline positions were measured at each DNR survey monument location, for each survey, along the proper azimuth (75 to 85 degrees – dependent on monument – measured clockwise from north). MHW change rates between 1883 and 1990 are tabulated in Table 8. In order to determine the historical (pre-project) erosion rate, surveys from 1995 to present were removed from the MHW analysis.

In order to better interpret the shoreline change, the MHW position data was put into a graphical format (Figure 8). As seen in the figure, shoreline changes fluctuate over time along the study areas. Historically, the shoreline appears to be relatively stable. However, highly fluctuating periods of accretion and high erosion immediately south of the south jetty (R-13 to R-15) reflect that typical erosion down drift of the Inlet is being compensated with nearly annual placement of maintenance material dredged from the Inlet entrance channel and the AIWW.

South of the project area, the pre-project shoreline change rates show an accretive trend. This shoreline likely benefitted from the migration of Jupiter Inlet and the AIWW dredged material placed in the project area since 1947.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

The shoreline should experience similar rates of erosion and accretion in the FWOP conditions as described in the existing conditions chapter above. However, sea level rise may accelerate coastal erosion rates and increase impacts resulting from erosion. Chapter 2.3.13 provides additional information on sea level change with respect to the Project. In the FWOP, there is an increased risk of storm damages.

Table 8: Mean High Water Shoreline Position Change.

DNR Monument	MHW Shoreline Position Change in Feet Per Year						
	Before Federal Project						
	1883-1929	1929-(1945)	(1945)-(1966)	(1966)-(1972)	(1972)-1974	1974-1987	1987-1990
R-13	-7.6	8.9	3.2	-18.5	-27.0	-1.2	1.3
R-14	17.1	5.9	0.4	42.2	-104.5	0.9	-14.0
R-15	-5.0	6.4	-2.0	11.2	-1.0	-3.4	14.7
R-16	-3.1	4.6	-1.6	4.5	11.0	-5.3	24.0
R-17	-3.6	6.3	-2.1	-2.8	4.5	-1.6	23.7
R-18	-2.2	6.9	-1.1	-4.7	20.5	-0.5	12.0
R-19	-1.7	5.9	-5.1	-1.5	43.5	-0.2	1.3
Note: () denotes an average year value representing a survey taken over a range of years							

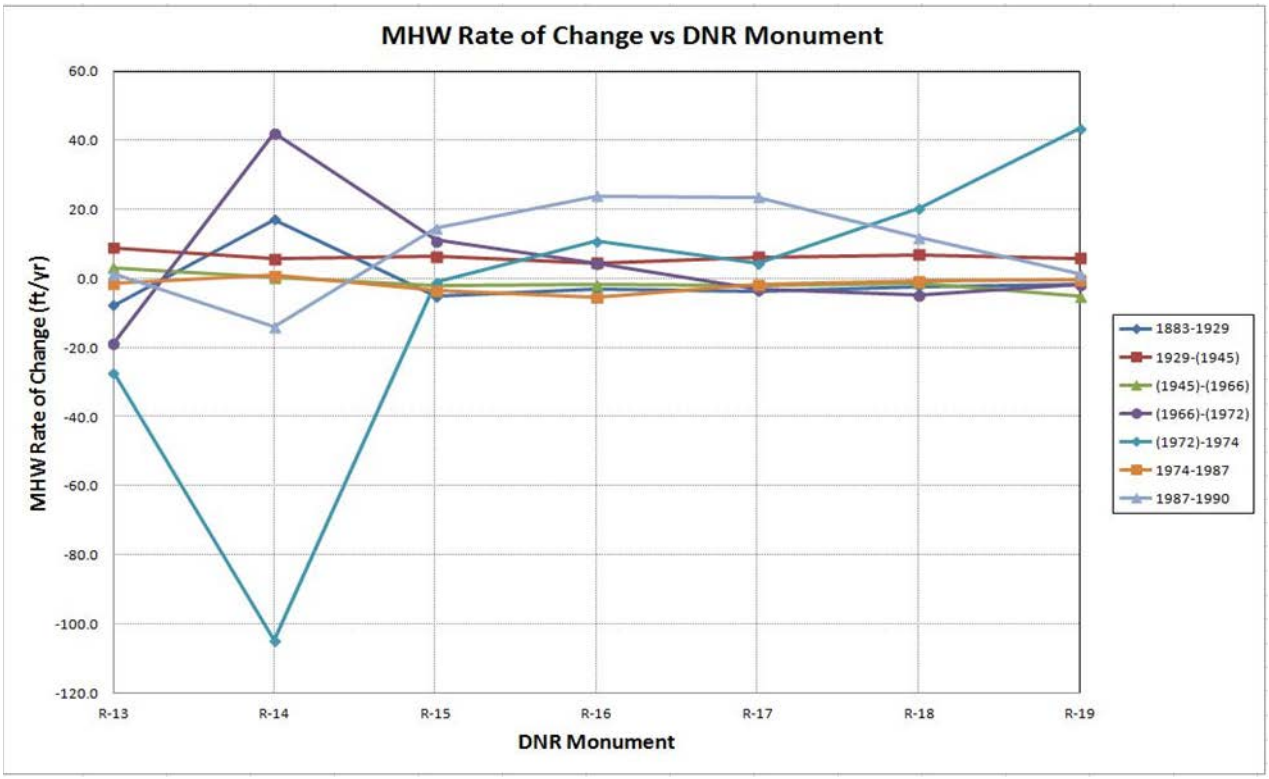


Figure 8: Mean High Water Rates of Change across DNR R-monuments

2.3.7 WINDS

EXISTING CONDITIONS

Local winds in the study area are the primary means of generating the small-amplitude, short period waves that are an important mechanism of daily (non-storm related) sand transport along the south-central Florida shoreline. Predominant winds from the east-southeast quadrant are generally mild in nature and occur in the spring and summer months. The greatest wind velocities originate from the north-northeast quadrant in fall and winter months typically during passage of nor'easters which can cause extensive beach erosion and shorefront damage. During the passage of tropical storms and hurricanes that generate devastating winds, waves, and storm surge which can cause direct damage to coastal structures and infrastructure. Appendix A provides additional detail on winds.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Winds predicted for the FWOP condition are similar to the existing conditions described above. Impacts from winds, without a federally maintained project may increase the risk of storm damage in the FWOP condition.

2.3.8 WAVES

EXISTING CONDITIONS

The wave energy dissipation that occurs as waves enter the nearshore zone and break is an important component of sediment transport. Wave height, period, and direction, in combination with tides and storm surge, are the most important factors influencing the behavior of the beach and dune system.

The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is exposed to both short period wind-waves and longer period open-ocean swells originating predominantly from the northeast during spring, fall and winter months and from the northeast to southeast during summer months. Open-ocean swells originating from south of due east are blocked by two large shoals north and west of the Bahamas known as the Little Bahama Bank and the Great Bahama Bank, respectively. Water depths across the Bahama Banks average about 30 feet, so longer-period swells are reduced or eliminated by bottom friction or the presence of land masses as they traverse the Bank. During severe storm events such as hurricanes and tropical storms, high wind velocities can generate large, damaging waves over the relatively short distance between the Bahamas and Florida.

Appendix A provides additional detail on waves.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Waves in the FWOP condition are likely to be similar to existing conditions, taking into account expected sea level rise; an increase in water depth may increase the potential for coastal flooding, allow larger storm waves to attack the shore, and increase risks of storm damages to infrastructure.

2.3.9 ASTRONOMICAL TIDES

EXISTING CONDITIONS

Astronomical tides are created by the gravitational pull of the moon and sun and are entirely predictable in magnitude and timing. The National Oceanic and Atmospheric Administration (NOAA) regularly

publishes tide tables for selected locations along the coastlines of the Unites States and selected locations around the world. These tables provide times of high and low tides, as well as predicted tidal amplitudes.

Tides in Palm Beach County are semidiurnal: two high tides and two low tides per tidal day. Tidal datum for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project were determined using the NOAA VDatum model (http://vdatum.noaa.gov). Tidal datum are summarized in Table 9. The tidal range (difference between MHW and MLW) is 2.81 feet for the project area.

Table 9: Tidal Datum for Jupiter Carlin Study Area

Tidal Datum	Elevation Relative to NAVD88 (feet)
Mean Higher High Water (MHHW)	0.45
Mean High Water (MHW)	0.24
North American Vertical Datum (NAVD88)	0.00
Mean Sea Level (MSL)	-1.13
Mean Low Water (MLW)	-2.57
Mean Lower Low Water (MLLW)	-2.76

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Tidal amplitudes will not likely change significantly from existing conditions, but due to sea level change (SLC), tidal elevations will change relative to the vertical datum, NAVD88. It is estimated that sea level will rise between 0.2 feet relative to NAVD88 (base SLC scenario) and 1.0 feet relative to NAVD88 (high SLC scenario) over the remainder of the 50-year project life. Increases between 0.6 feet relative to NAVD88 (base SLC scenario) and 4.3 feet relative to NAVD88 (high SLC scenario) and expected over the 100-year planning horizon. For details on SLC refer to Chapter 2.3.13.

2.3.10 CURRENTS

EXISTING CONDITIONS

Jupiter Inlet, ocean tidal currents, and wave-induced longshore currents have the potential to significantly affect sediment transport processes in the study area. With the exception of intermittent local reversals and eddies, the Florida Gulf Stream, the most significant ocean current off the East Coast of Florida, flows northward with an average annual current velocity approximately 28 miles per day (mpd), varying from an average monthly low of 17 miles per day in November to an average monthly high of approximately 37 miles per day in July. The Gulf Streams lies approximately 10 to 15 miles offshore of the project area.

The near-shore currents in the project vicinity are not generally influenced by the Gulf Stream, but may be influenced indirectly via interaction with incident waves. Littoral currents in addition to the presence of Jupiter Inlet affect the supply and distribution of sediment on the project shoreline. Longshore currents, induced by oblique wave energy, generally determine the long-term direction and magnitude of littoral transport. Cross-shore currents may have a more short-term impact, but can result in both temporary and permanent erosion. The magnitude of these currents is determined by the wave characteristics, angle of waves from offshore, configuration of the beach, and the nearshore profile. For

Palm Beach County beaches, the net sediment transport is from north to south. This is due to the dominant wave activity from the northeast during the fall and winter months, particularly nor'easters.

Locally, wave-induced longshore and cross-shore currents cause sediment transport in the active beach zone within the Project. The magnitude of the longshore current relates directly to the wave angle approach and the magnitude of the waves. The local wave climate investigation presented in this study indicates that the strongest waves generally approach from the northeast quadrant. Cross-shore currents, typically generated during storms, often result in the offshore transport of beach material.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Currents in the future are likely to be similar to existing conditions, with the exception of storm events. In the FWOP condition, the effects of these currents may increase the risk of storm damages.

2.3.11 STORM EFFECTS

EXISTING CONDITIONS

The study area is located in a region of considerable hurricane activity, resulting in relatively frequent hurricane impacts. The shoreline of Palm Beach County is influenced by tropical systems during the summer and fall and by nor'easters during the late fall, winter, and spring. Although hurricanes typically generate larger waves and storm surge, Nor'easters often have a greater impact on the shoreline because of their longer duration and higher frequency of occurrence.

During intense storm activity, the shoreline is expected to naturally modify its beach profile. Storms erode and transport sediment from the beach into the active zone of storm waves. Once caught in the waves, this sediment is carried along the shore and re-deposited farther down the beach or is carried offshore and stored temporarily in submerged sand bars. Periodic and unpredictable hurricanes and coastal storms, with high energy breaking waves and elevated water levels, can change the width and elevation of beaches and accelerate erosion. After storms pass, lower energy waves usually return sediment from the sand bars to the beach, which is restored gradually to its natural shape. While the beach profile typically recovers from storm energy as described, extreme storm events may cause sediment to leave the beach system entirely, sweeping it into inlets or far offshore into deep water where waves cannot return it to the beach. Therefore, a portion of shoreline recession due to intense storms may never fully recover.

In recent years, a number of named storms, passing within the 50-mile radius have significantly impacted the project area, including Dorian (2013), Sandy (2012), Ernesto (2006), Wilma (2005), Tammy (2005), Frances (2004), and Jeanne (2004). Damages from these storms, as well as from more distant storms causing indirect impacts, included substantial erosion and damage from winds, waves, and elevated water levels.

Figure 9 shows historic tracks of hurricanes and tropical storms from 1858 to 2013, as recorded by the National Hurricane Center (NHC) and is available from the NOAA. The shaded circle in the center of this figure indicates a 50-nautical mile radius drawn from the center of the study area and encompassing the entire Palm Beach County shoreline. Based on NHC records, 58 hurricanes and tropical storms have passed within this 50-mile radius over the 156-year period of record. Statistically, this represents an average of one storm every 2.7 years. The 50-mile radius was chosen for display purposes in Figure 9 because any tropical disturbance passing within this distance, even a weak tropical storm, would be likely

to produce some damage along the shoreline. Stronger storms are capable of producing significant damage to the coastline from far greater distances.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Storm effects in the FWOP are anticipated to be similar to the existing conditions described above. However, the risk of storm damage threatening infrastructure, in the absence of a Federal project, is greater under the FWOP condition.

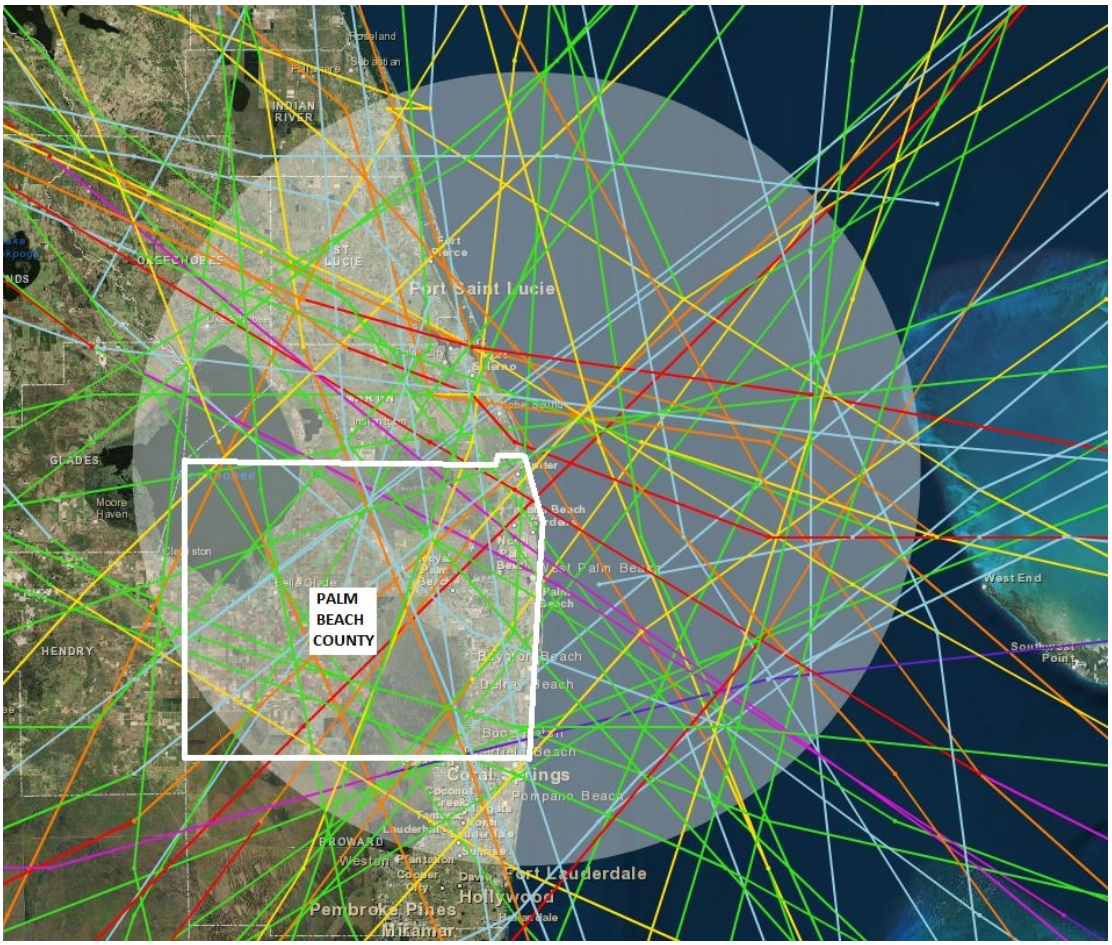


Figure 9: Historic Storm Tracks - Hurricanes and Tropical Storms (1858-2013, 50-miles radius)

2.3.12 STORM SURGE

EXISTING CONDITIONS

Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to storm forces. Surges occur primarily as a result of atmospheric pressure gradients and surface stresses created by wind blowing over a water surface. Strong onshore winds pile up water near the shoreline, resulting in super-elevated water levels along the coastal region and inland waterways. In addition, the lower atmospheric pressure that accompanies storms also contributes to a rise in water surface elevation. Extremely high wind velocities coupled with low barometric pressures (such as those experienced in

tropical storms, hurricanes, and very strong nor'easters) can produce very high, damaging water levels. In addition to wind speed, direction and duration, storm surge is also influenced by water depth, length of fetch (distance over water), and frictional characteristics of the nearshore sea bottom. An estimate of storm surge is required for the design of beach fill crest elevations. An increase in water depth may increase the potential for coastal flooding and allow larger storm waves to attack the shore.

The dune system at the northern end of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project, just south of the Jupiter Inlet south jetty, is relatively low and flat. This region has an elevation of around +11 feet-NAVD and is susceptible to overtopping from extreme storm surges. Further south, topographic surveys show that much of the dune reaches an elevation of +17 to +20 feet-NAVD which reduces the risk of overtopping due to extreme storm surges. A series of existing hurricane storm-surge maps have been produced by the Florida Division of Emergency Management (FDEM) for all of Florida's coastal counties. The FDEM Storm Tide Zone Map for North Palm Beach County is included as Figure 10. This map indicates that much of the north end of the project is susceptible to storm tides from hurricanes of category 1 through 3. South of Jupiter Beach Road, development and natural dune features have raised the elevation of the project area such that it is only susceptible to storm tides east of the dune line or along the inland portions of the barrier island.

Storm surge levels versus frequency of occurrence were obtained from data compiled by the University of Florida for the Florida Department of Transportation (FDOT, 2003). Table 10 provides peak storm surge heights by return period for Jupiter Carlin. The storm surge elevations presented include the effects of astronomical high tide and wave setup, but do not take into consideration changes to sea level over time. Future high water events (combinations of storm and tide) may occur more frequently and storms may result in higher waves with increased potential for dune overtopping and damages (beyond what is accounted for in the intermediate and high SLC scenarios of the Beach-fx modeling analysis – see Appendix A for additional modeling details).

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Storm surge in the future is likely to be similar to existing conditions, taking into account expected SLC.

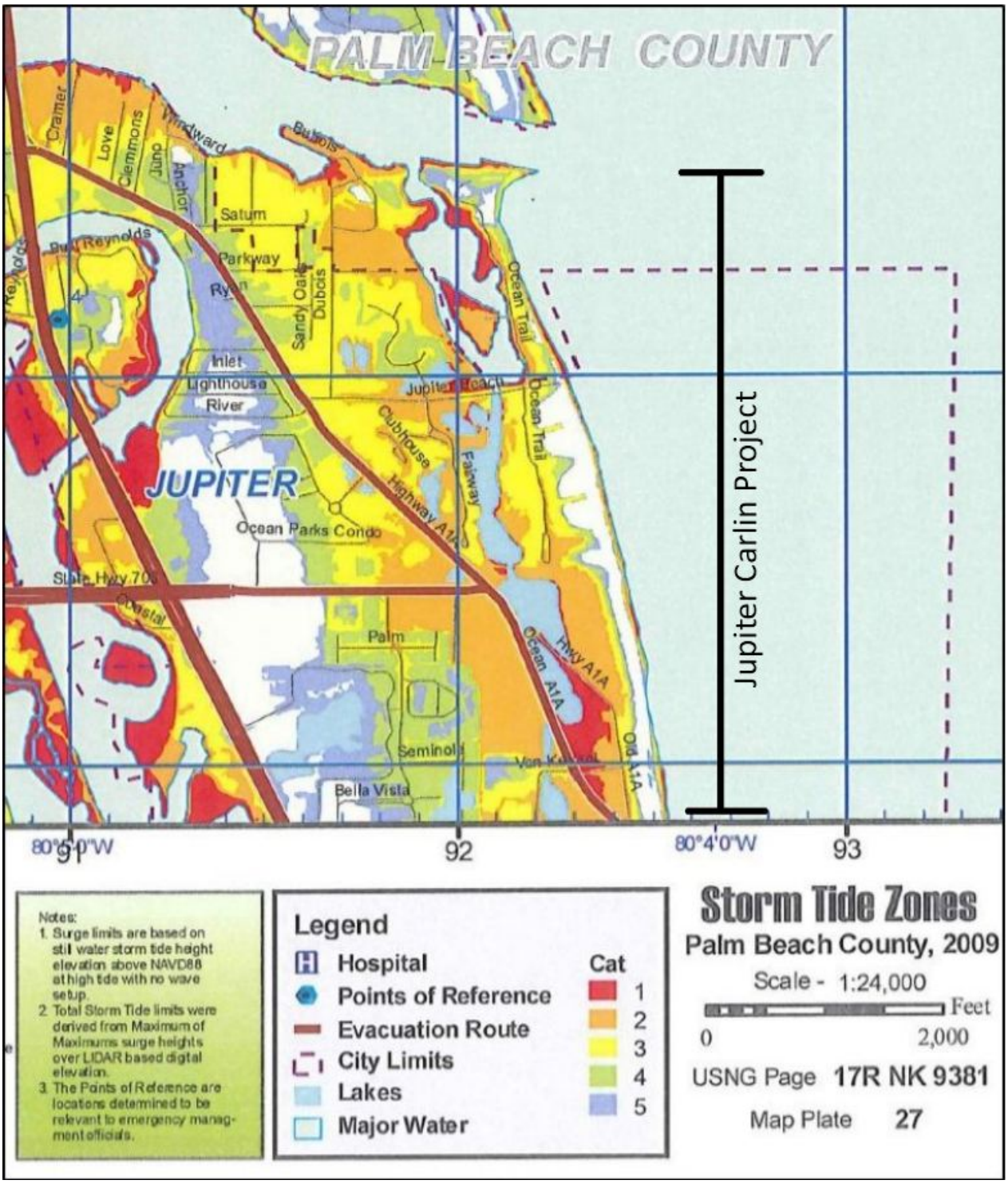


Figure 10: Storm Surge Zones, North Palm Beach County, Florida (FDEM, 2010).

Table 10: Storm Tide Elevations (FDOT Station 2504)

Return Period (Years)	Total Storm Tide Level (Feet, NAVD88)
500	13.9
100	9.7
50	8.3

2.3.13 SEA LEVEL CHANGE

EXISTING CONDITIONS

It is anticipated that the global MSL will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea level change on design, construction, operation, and maintenance of coastal projects, the USACE has provided guidance in the form of an Engineering Regulation (ER) ER 1100-2-8162 and Engineering Technical Letter (ETL) 1100-2-1. Three estimates are required by the guidance, a Baseline (or "Low") estimate, which is based on historic sea level rise and represents the minimum expected sea level change; an Intermediate estimate; and a High estimate representing the maximum expected sea level change. Table 11 provides an overall summary of FWOP average annual damages in each SLC scenario. The SLC results are intuitive in the sense that one would expect damages to be positively correlated with water levels (i.e. as water levels increase throughout the project life so do damages). What is important to note, however, is the magnitude of the effect. The average annual FWOP damages increase from $1.6 million with the baseline SLC scenario to $2.2 million in the high SLC scenario. The FWOP condition was modeled for three SLC scenarios. ER 1110-2-8162 provides both a methodology and a procedure for determining a range of sea level change estimates based on the local historic sea level change rate, the construction (base) year of the project, and the design life of the project.

Table 11: Simulated FWOP AAEQ Damaged in the Baseline, Intermediate and High SLC scenarios.

	SLC1 (Baseline)	**SLC2 (Intermediate)**	**SLC3 (High)**
Damage	$569,670	$912,770	$975,441
Armor Cost	$865,315	$1,057,111	$1,089,011
Land Loss	$192,011	$157,174	$147,849
Total	**$1,626,996**	**$2,127,055**	**$2,212,301**

The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is located approximately 80 miles from NOAA gauge #8723170 at Miami, Florida. The historical sea level change rate taken from this gauge, determined from a 51 year period of record, is give as 2.39 mm/year (0.0078 ft./year) with a 95% confidence interval of +/-0.43 mm/yr (equivalent to a change of 0.78 feet in 100 years) (http://www.corpsclimate.us/ccaceslcurves.cfm). Given a project start year of 2019 and 26 years

remaining in the project life (project end date of 2045), a table of sea level change rates was produced for each of the three required scenarios.

Figure 11 shows the sea level change rates, starting from the base year (the year in which benefits are realized, i.e., the project is completed) of 2020 and ending in 2045, the project end year. A graphic representation of the three levels of projected future SLC for the life of the project is also provided. Average intermediate and high sea level change rates were found to be 0.0156 ft/yr and 0.0419 ft/yr, respectively. Note that the relative sea level change (RSLC) is referenced to both 1992 (the middle of the current tidal epoch) and the vertical datum feet-NAVD88. Had the vertical reference been feet MSL, all curves would have initiated in 1992 with a RSLC of 0.0 feet-MSL.

Jupiter Carlin
8723170, Miami Beach, FL
NOAA's Published Rate: 0.00784 feet/yr
All values are expressed in feet relative to NAVD88

Year	USACE Low	USACE Int	USACE High
1992	-1.0	-1.0	-1.0
1995	-0.9	-0.9	-0.9
1998	-0.9	-0.9	-0.9
2001	-0.9	-0.9	-0.9
2004	-0.9	-0.9	-0.8
2007	-0.8	-0.8	-0.8
2010	-0.8	-0.8	-0.7
2013	-0.8	-0.8	-0.6
2016	-0.8	-0.7	-0.6
2019	-0.7	-0.7	-0.5
2022	-0.7	-0.6	-0.4
2025	-0.7	-0.6	-0.3
2028	-0.7	-0.6	-0.2
2031	-0.7	-0.5	-0.1
2034	-0.6	-0.5	0.0
2037	-0.6	-0.4	0.1
2040	-0.6	-0.4	0.3
2043	-0.6	-0.3	0.4
2045	-0.5	-0.3	0.5

Print Table

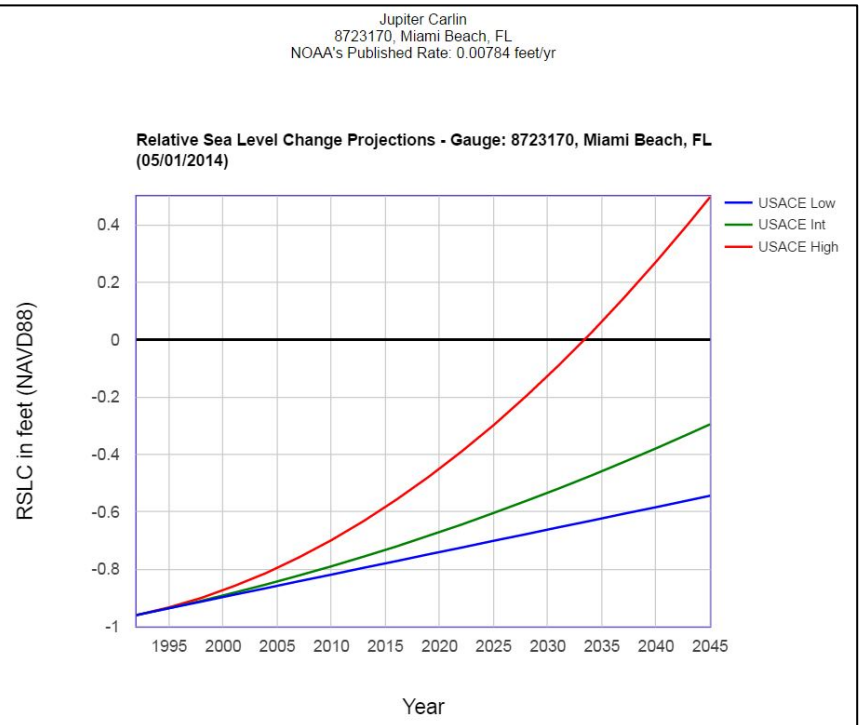


Figure 11: Relative Sea Level Change, Jupiter-Carlin (http://www.corpsclimate.us/ccaceslcurves.cfm).

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

A graphic representation of the three levels of projected future sea level change for the life of the project is depicted in Figure 12. Note that in this representation Relative SLC (RSLC) is not referenced to NAVD88 (as shown previously in Figure 11), but instead shows the RSLC as relative differences in the water level between the project start and end dates. This provides a simple change in height over the Project's remaining life (and through the 100-year planning horizon) which can then be used to assess potential impacts due to rising water levels. The project area can expect to see sea level rise 0.6 to 4.3 feet above its current position within the 100-year planning horizon as predicted by the baseline and high sea level change rates, respectively. At the end of the 50-year project life (2045), the High SLC scenario predicts that sea level will reach 1 foot, well below the critical 3.2 foot threshold (Figure 12). Projected out 100 years, the High SLC scenario is the only scenario that reaches the 3.2-foot threshold (between 2080 and 2085).

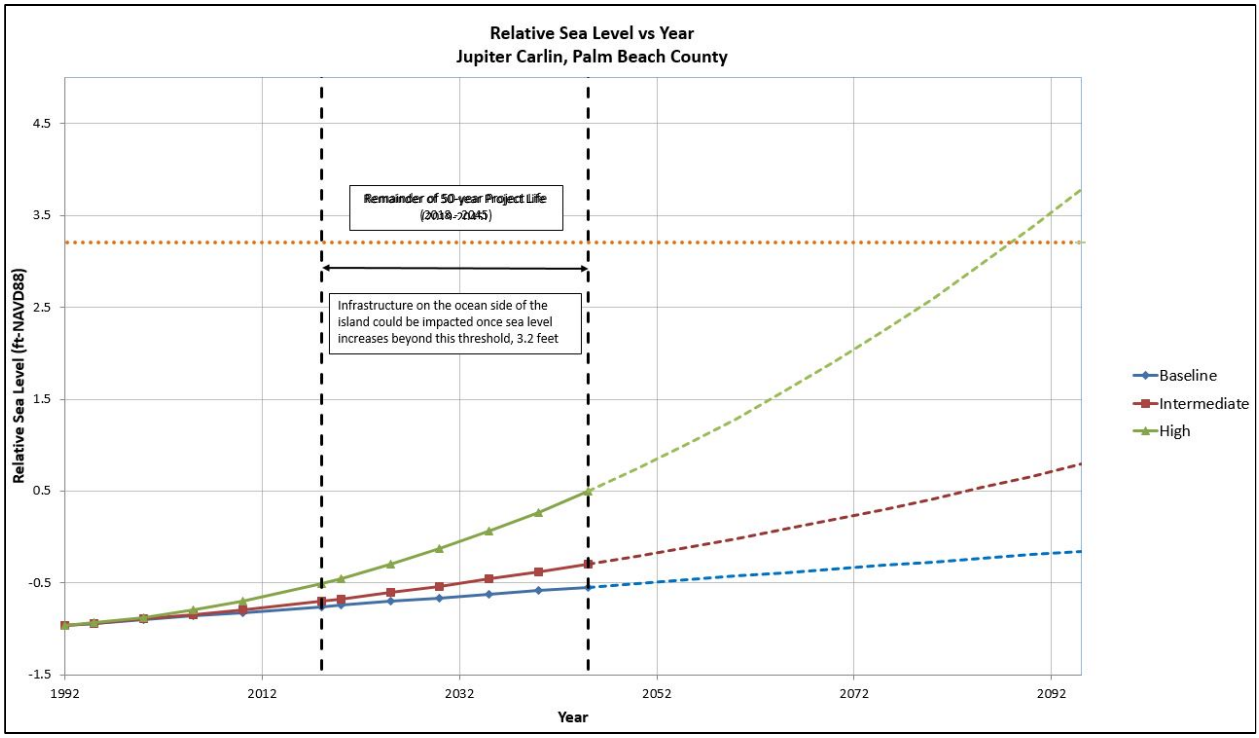


Figure 12: Relative Sea Level Change by Year for Jupiter Carlin Segment of the Palm Beach County Shore Protection Project Area.

2.3.14 STORM TIDE & BACK BAY FLOODING

EXISTING CONDITIONS

Upland elevations within the Project area on the Atlantic Ocean side of the island average approximately 4.2 feet-NAVD88. These uplands are fronted by a dune system with variable elevations ranging from of 11.5 feet-NAVD88 to 19.5 feet-NAVD88. Elevations on the marsh side average 9.0 feet-NAVD88. Although the marsh side of the island is not within the current Project area, stakeholders should be aware of increased risk to infrastructure as sea level rises. Based on lidar topographic survey data, contoured over the barrier island between R-13 and R-19, key cross-island ground elevations were identified. Table 12 provides the key ground elevations according to R-monument and grouped by similar shoreline dimensions (see Appendix A for details on profile groupings).

Table 12: Key Elevations along Cross-island Profiles.

R-Monument	Ground Elevations (feet-NAVD88)			
	Average Dune Elevation	Roads	Atlantic Side Structures	Marsh Side Structures
R-13	11.5	6.0	6.0	10.0
R-14	11.5	3.5	5.0	10.0
R-15	17.5	6.0	5.0	10.0
R-16	17.5	6.0	5.0	11.0
R-17	19.5	3.0 – 5.0	5.0	11.0
R-18	13.5	3.0 – 5.0	5.0	11.0
R-19	16.5	5	5	11.0
Average for Study Area (R-13 to R-19)	15.4	4.9	5.1	10.6

Representative profiles, taken in the vicinity of R-12, R-15/R-16, and R-19 are show in Figure 13 to Figure 15. Note that the topographic survey from which the profile was drawn are "bare earth" and do not illustrate vegetation or structures. Each profile shows the variability over the length of the project as well as across the width of the island. The width of the barrier island varies from approximately one mile at the north end of the project (R-13) to 0.75 miles in the vicinity of R-19. Typically the marsh side of the island is fronted by both expanses of heavy vegetation and areas of development.

A key question when assessing the vulnerability of the study area to SLC is when critical thresholds will be crossed. Throughout the study area, the dune crest height represents a critical threshold. The average dune height from Table 12 is 15.4 feet-NAVD88. Roads and other infrastructure on the ocean side of the barrier island are located at a lower elevation than the dune, approximately 3.5- to 6.0 feet-NAVD88. Since the dune lies between the ocean and infrastructure, the dune height will be the ocean side critical elevation.

The 50-year storm tide elevation for the Project is +8.3 feet-NAVD88 (FDOT, 2003). Water elevations during such storm events could reach the top of the dunes once sea level increases by 3.2 feet (8.3 feet of storm tide + 3.2 feet of SLC = 11.5 feet) (between R-13 to R-14). Because overtopping of the dune in the vicinity of R-13 and R-14 would cause flooding over the full extent of the project, the higher dune crests (south of R-14) are not considered to have any preventative significance against SLC. Note that this is a general measure of still water (hydraulic) overtopping and does not include overtopping due to waves which can occur at lower still water elevations. A complete surge and wave analysis was beyond the scope of this study.

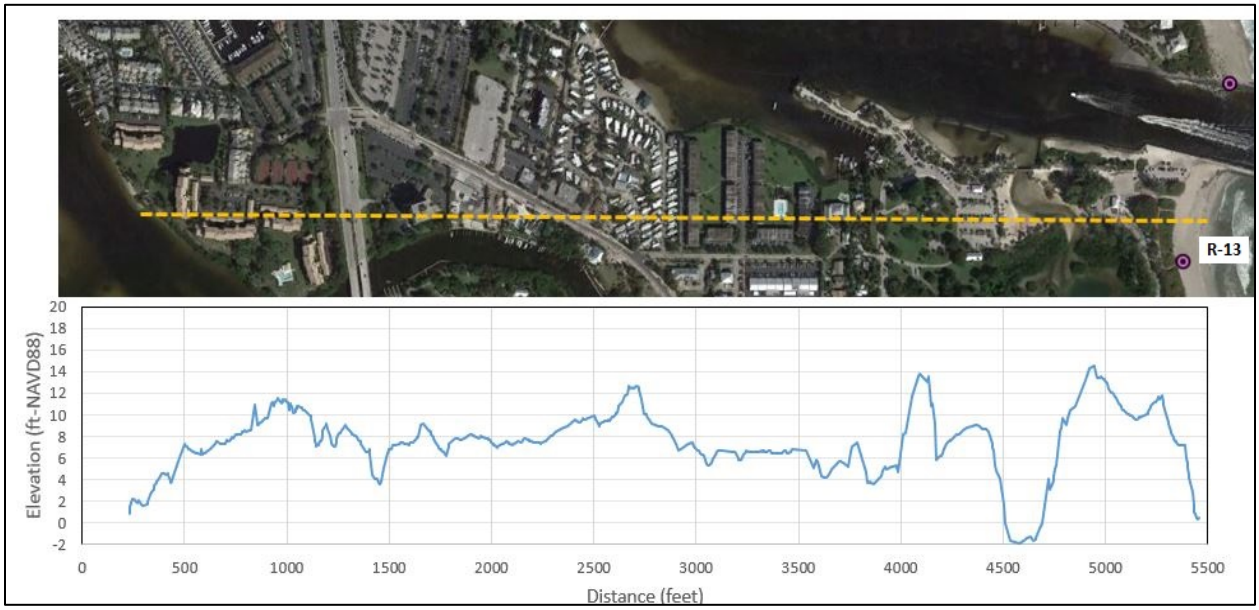


Figure 13: Cross-island Profile in the Vicinity of R-13.

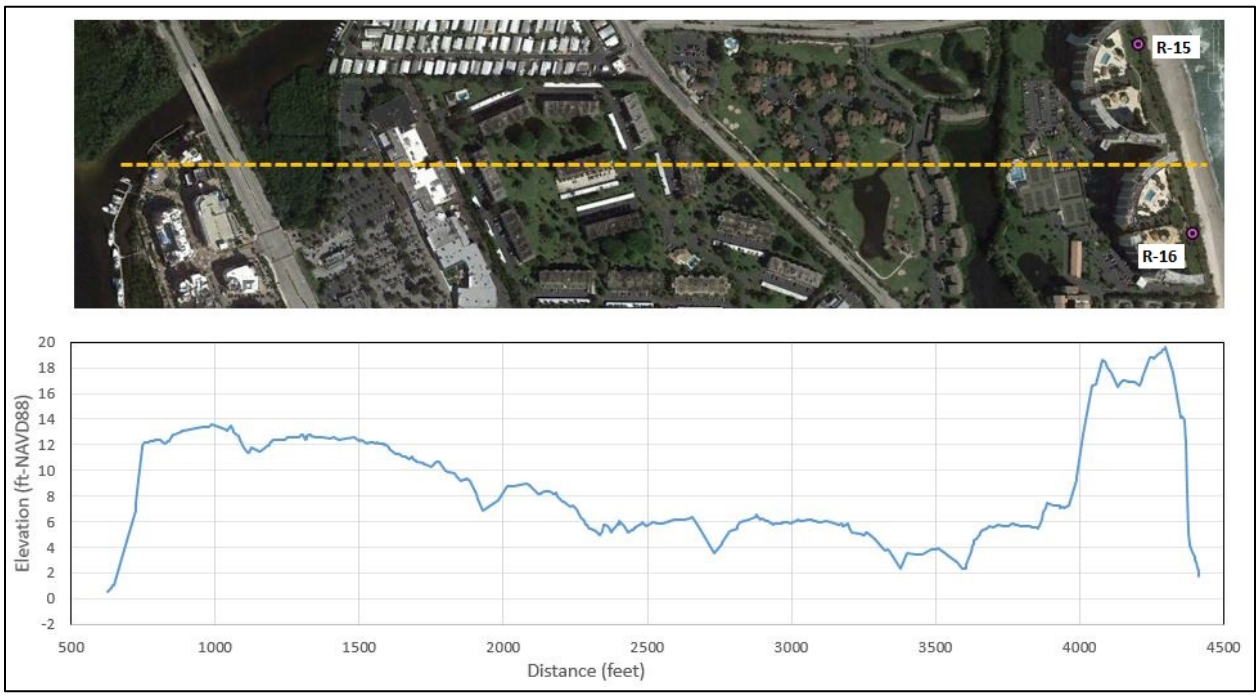


Figure 14: Cross-island Profile in the Vicinity of R-15.5.

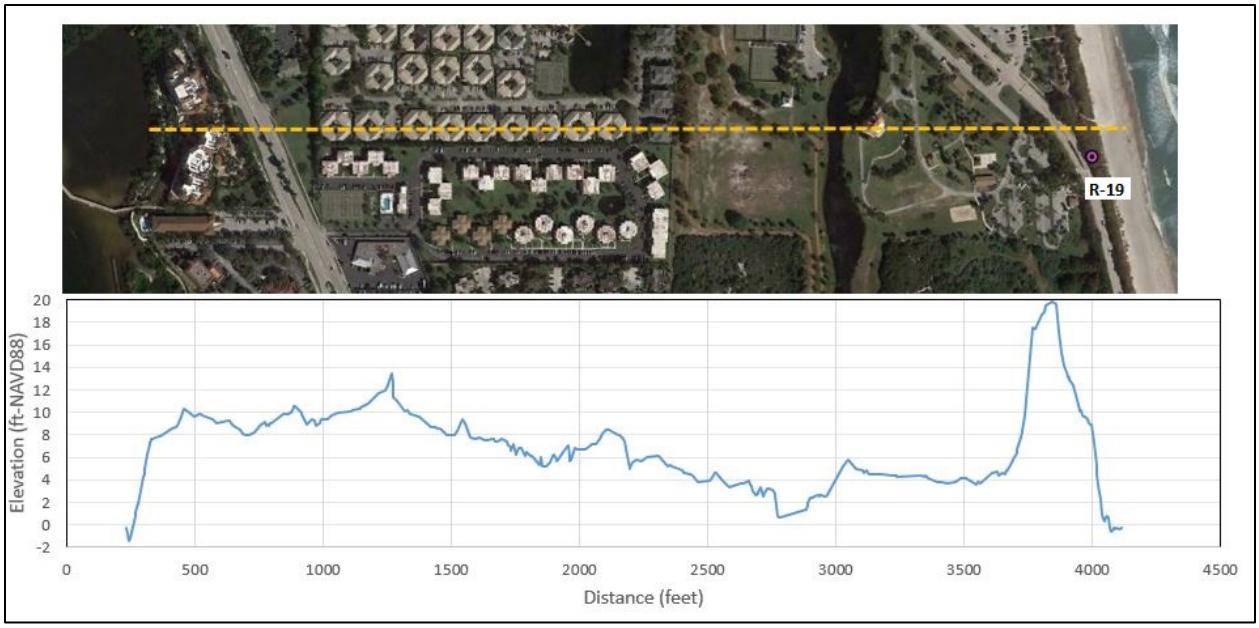


Figure 15: Cross-island Profile in the Vicinity of R-19.

Flood Proofing

Dune raising and/or the introduction of revetments or seawalls are adaptations that deal directly with the shoreline feature (dune system) that provides the maximum level of protection from inundation, erosion, and wave damage. Much like an inland levee, the dune system provides a single continuous barrier between the water and the land.

Flood proofing also consists of a type of barrier. However, flood proofing solutions apply localized barriers (new construction, sealing/waterproofing existing structural elements, and/or raising lower elevation structures) to individual structures. Depending on the density of infrastructure in the upland, flood proofing can be logistically challenging and expensive. Different structure types would require different flood proofing solutions. Because it is assumed that sea levels would be allowed to overtop the dune and flood the general project site, each solution would also require a design that resists failure due to erosive undermining and from direct wave attack. Projects where the density of upland structures is low would have less logistical and cost concerns, but would still require individual specialized design.

In addition to logistics and cost, peripheral damages must also be considered. If the general project site is allowed to be inundated by seas overtopping the dune some "structures" would likely remain highly vulnerable despite flood proofing. These include roads, walkways, boardwalks, utility posts/boxes/outlets, and other structural features that would be difficult or not cost effective to flood proof individually. Peripheral damages would also include landscaping, park lands, open habitat, and other non-structural, but important community upland features.

It should also be noted that flood proofing predominantly safeguards against direct physical damage to structures. This alternative does not consider potential risks to human life due to flooding in the vicinity of the protected structures. It is recommended that this alternative be combined with a storm warning and evacuation system specifically designed for expected SLC.

Storm Warning and Evacuation Plans

Development or improvement of storm warning and evacuation plans is not a standalone alternative. While the development and implementation of site specific storm warning systems and evacuation plans can be costly, there are no traditional benefits by which to offset those costs. Note that traditional benefits depend predominantly on physical damages to property. However, the development and implementation of such storm warning and evacuation plans could have a significant impact on safeguarding human life. Combined with an alternative that produces traditional benefits, this alternative could be justified for a Federal project.

Assessment of Potential Adaptation Paths

As discussed in previous chapters, not all methods of adaptation are equal when applied to combating the impacts SLC. Some are more effective than others and are more complete or acceptable. Table 13 provides a qualitative assessment to the potential adaptation paths that could be applied to the Project.

Table 13: Qualitative Assessment of Adaptation Paths.

Measure	Effectiveness	Performance	Completeness	Acceptability
Dune Raising	High	High	High	High
Hard Structures	High	High (Medium, if the structure is non-continuous with gaps)	High (Medium, if the structure is non-continuous with gaps)	Medium (may change if damages outweigh environmental concerns)
Flood Proofing	Medium (limited to certain structure types and only effective for inundation)	Medium (limited to specific structures)	Low (Vulnerable to wave attack and erosion, peripheral damages)	Low (limited benefit, peripheral damages, prohibited in high hazard flood zones)
Storm Warning and Evacuation Plans	Low (When applied only to traditional damages; rating does not include risk to human life)	Low (does not address inundation, wave attack, or erosion)	Low (does not affect traditional damages)	Low (limited benefit unless combined with another alternative)

EXTERNAL VULNERABILITY

ETL 1100-2-1 recommends that systems related to, but existing outside, the Project area should also be evaluated for vulnerability to SLC. The marsh side of the island in the Project vicinity does not contain any critical infrastructure, such as hospitals or emergency services. This analysis only brings attention to the vulnerability of the marsh side of the island for stakeholder knowledge. The analysis addresses only still water (hydraulic) overtopping and does not consider wave overtopping, which can occur at lower water elevations. The analysis also does not address flooding due to small bay connected channels or canals that may run through the upland region of the island.

Infrastructure on the marsh side is generally built at approximately 10.0 feet NAVD88. This side of the island is mainly affected by tides, not storm surge. Tidal range on the marsh side of the island is smaller than the ocean side. Mean Higher High Water (extreme high tide) is 0.19 feet-NAVD88 on the marsh side (+0.45 feet-NAVD88 on the ocean side). Factoring in extreme high tide, infrastructure could be periodically impacted once sea level increases by about 9.8 feet (0.19 feet of tide + 9.8 feet of sea level increases = 10.0 feet, the elevation where structures are impacted). At the end of 50 years, sea level is not expected to rise more than 1.0 foot under the High SLC scenario (Figure 16). Projected out 100 years, the maximum increase in water level is approximately 4.3 feet, well below the 9.8 foot threshold. Therefore, it is unlikely that infrastructure on the backside of the island would be impacted during even higher high tide events over the remaining economic period of analysis concluding in 2045.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Storm tide and back bay flooding is likely to continue to occur at the rates described above and, in the future, pose threats to the structures within the project area.

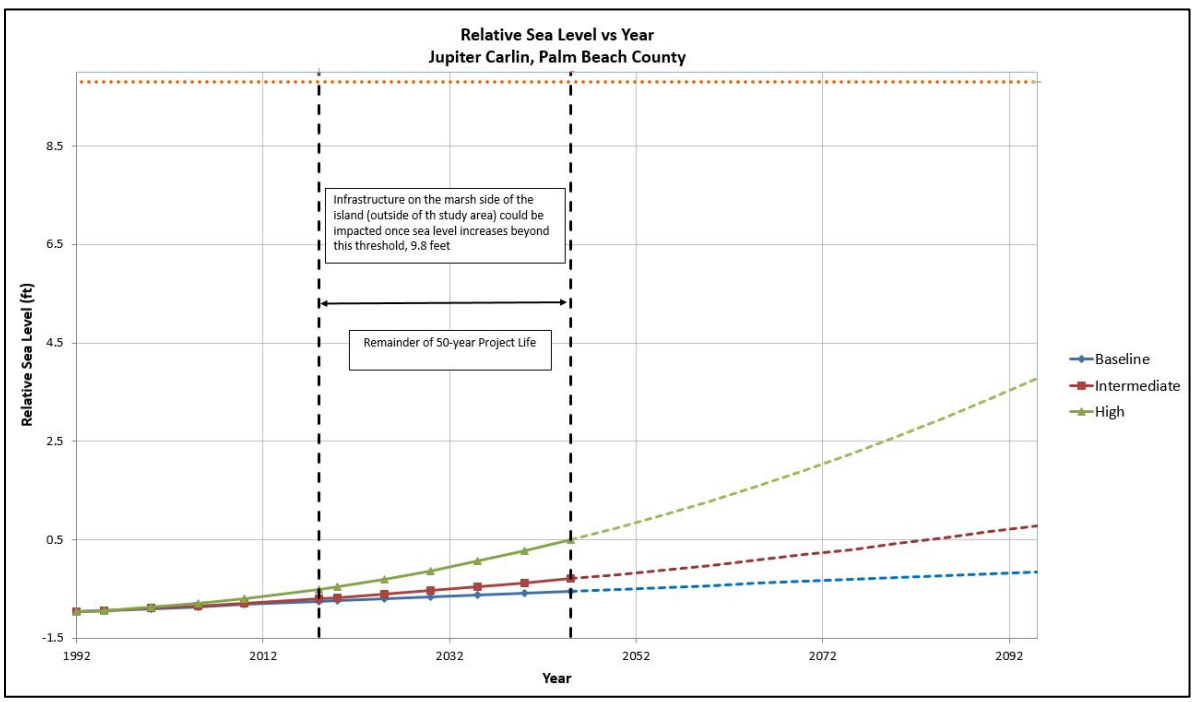


Figure 16: Threshold Vulnerability on the Marsh Side of the Island.

2.4 BUILT ENVIRONMENT

2.4.1 UPLAND DEVELOPMENT

EXISTING CONDITIONS

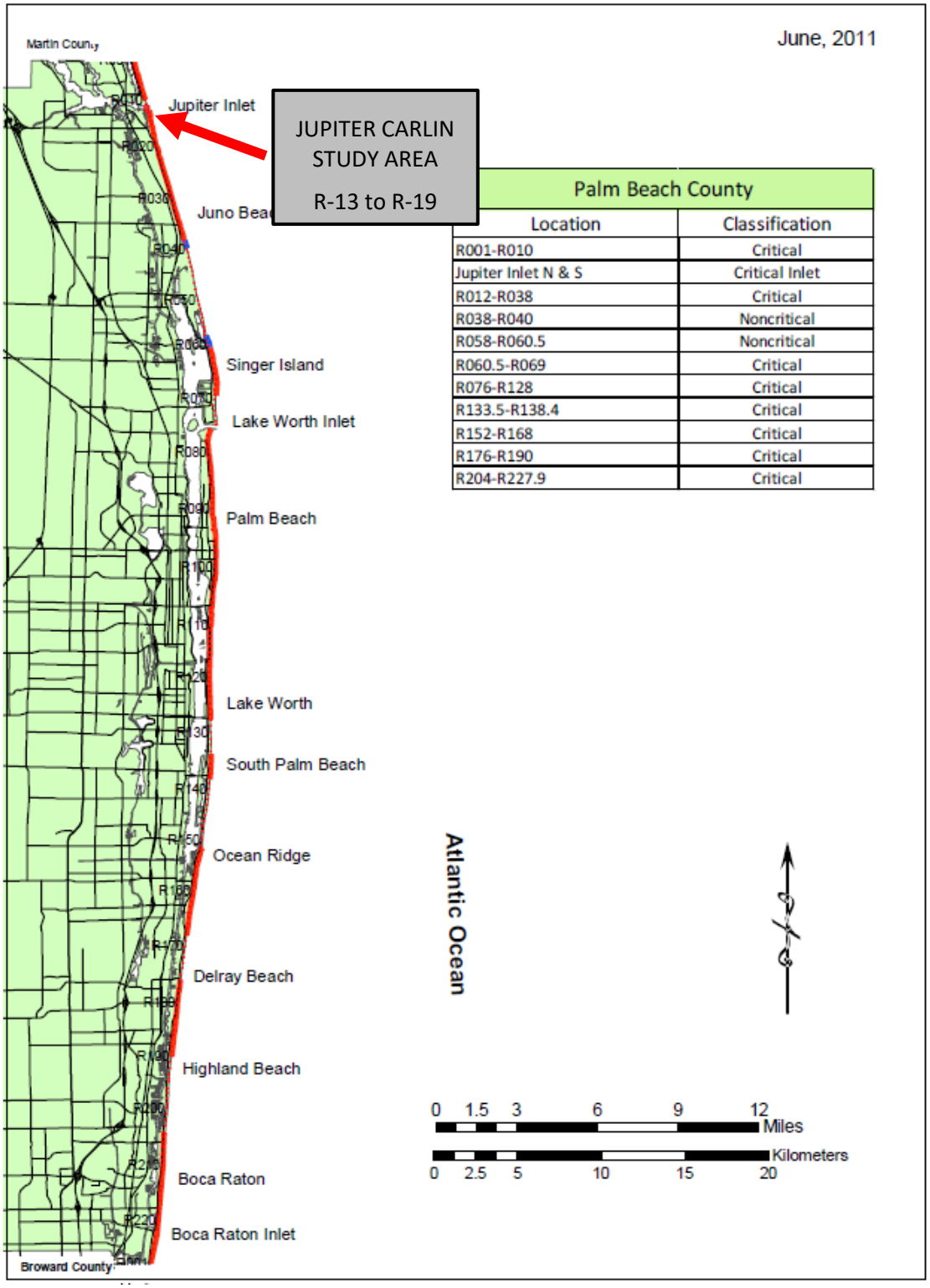
The Project area (Figure 17) is a state-designated critical erosion area. Two parks are in the project area, Jupiter Beach Park (located near Jupiter Inlet) and Carlin Park (located at the southern end of the project area). The parks contain open spaces with parking, beach accesses, bathhouses, and other amenities. The project area also includes several buildings: Ocean Trail Condominiums I – IV (4, 15-story condominiums); Ocean Trail Condominium V (a 6-story condominium); and Jupiter Beach Resort and Spa (a 10-story resort).

The proximity of these buildings to the beach makes them potentially vulnerable to erosion, wave, and flood damage. Inundation damage — either from backside flooding or from dune overwash and flooding — may prove the most likely damage mechanism to these multi-story structures. Small amenities, such as cabanas and bathhouses, may prove more susceptible to undermining (erosion).

The area south of the Project consists mainly of State Road (S.R.) A1A running parallel to the shoreline and the Jupiter Reef Club — a 31-unit condominium located near R-21. Five one- and two-story buildings comprise the complex. The elevation of S.R. A1A (near 22 feet NAVD88) likely precludes most storms' effects except for the most extreme events. The Jupiter Reef Club lies seaward of the dune. A seawall offers the complex some storm protection. Sand placed within the Project eventually migrates south and offers some storm damage reduction benefits to the down drift beaches south of the Project.

FUTURE WITHOUT-PROJECT CONDITIONS (NO ACTION ALTERNATIVE)

Upland Development in the FWOP condition may increase in the Project area. Erosion will continue to occur and inundation damage will continue to pose threats to the infrastructure within the Project area (See Figure 18).



Palm Beach County	
Location	Classification
R001-R010	Critical
Jupiter Inlet N & S	Critical Inlet
R012-R038	Critical
R038-R040	Noncritical
R058-R060.5	Noncritical
R060.5-R069	Critical
R076-R128	Critical
R133.5-R138.4	Critical
R152-R168	Critical
R176-R190	Critical
R204-R227.9	Critical

Figure 17: Palm Beach County Critically Eroded Beaches, FDEP, Bureau of Beaches and Coastal Systems, 2011.

Figure 18: Aerial Image of the Ocean Trail Condominiums and Jupiter Beach Resort and Spa, South Looking North. Photo Courtesy of Palm Beach County, 2007.

2.4.2 PUBLIC ACCESS & PARKING

EXISTING CONDITIONS

Federal participation in shore protection projects involving placement of sand is limited to shorelines open to public use. Guidance is provided in Engineering Regulation (ER) 1105-2-100 and ER 1165-2-130. Cost sharing for any recommended plan is based on shoreline ownership, use, and the availability of public access.

There are currently five suitable parking and access points within the study area of R-13.5 to R-19 (Figure 19). From north to south: Dubois and Jupiter Inlet Parks located at R-13; Jupiter Beach Park is located at R-14; and West Carlin and Carlin parks located between R-18 and R-19.

USACE policy in ER-1105-2-100 states: "Lack of sufficient parking facilities for the general public (including nonresident users) located reasonably near and accessible to the project beaches may constitute a restriction on public access and use, thereby precluding eligibility for USACE participation…Generally, parking on free or reasonable terms should be available within a reasonable walking distance of the beach…Reasonable access is access approximately every one-half mile or less." Based on existing information, there is one gap larger than one-half mile between the existing access points. Additional information may be found in Plan Formulation and Recommended Plan chapters.

Figure 19: Public Parking Facilities for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project Area.

FUTURE WITHOUT-PROJECT CONDITIONS (NO-ACTION ALTERNATIVE)

Similar to existing conditions, there is sufficient parking available for recreational use in the Project area under FWOP, such that Palm Beach County does not need to create additional public access and parking. However, erosion caused by past storm events has reduced the available public parking in the northern portion of the Project area.

2.4.3 HURRICANE EVACUATION ROUTE

EXISTING CONDITIONS

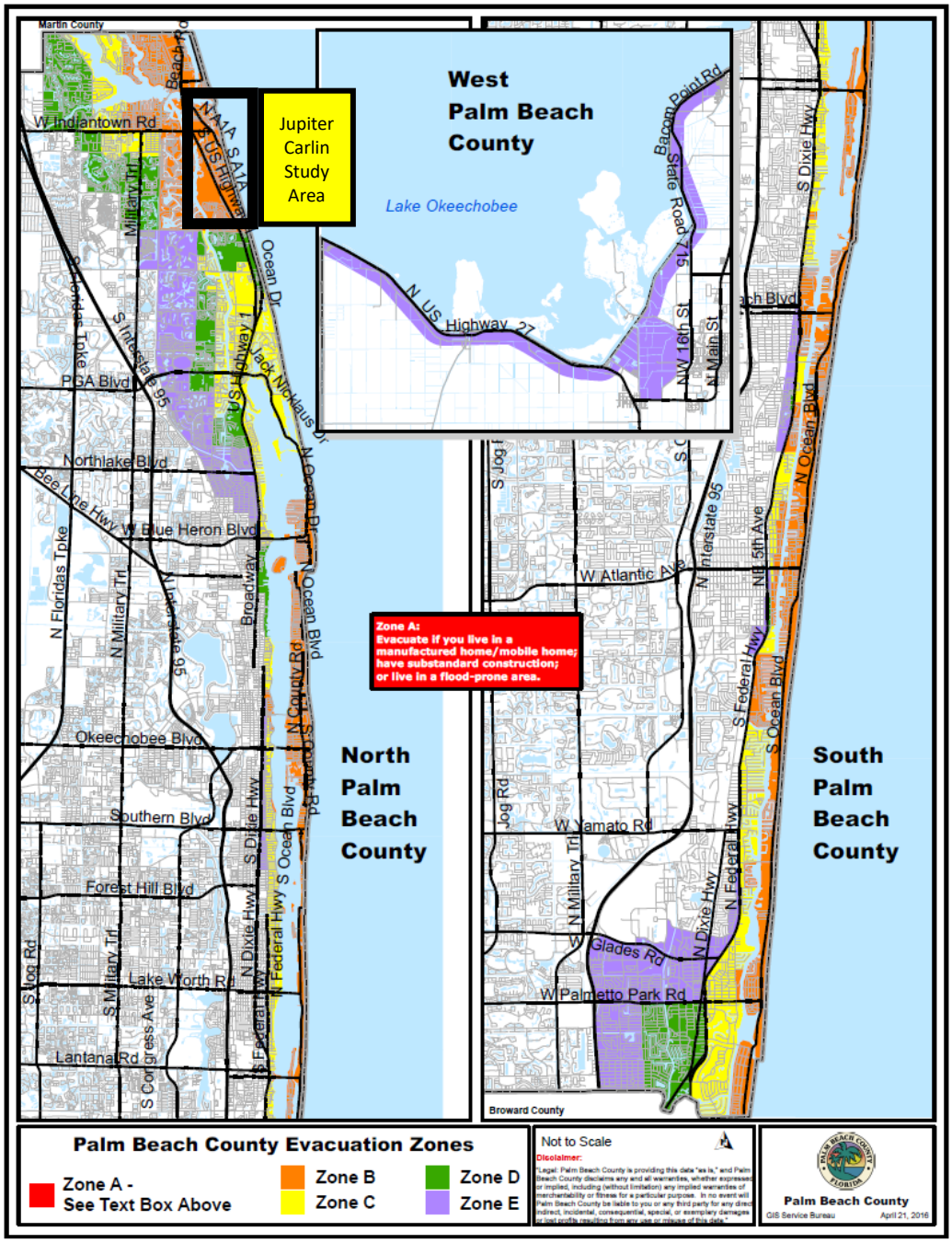
Florida State Road A1A (SR A1A), is a designated evacuation route for the area (Figure 20). This evacuation route is not as vulnerable in the Project area as it is located several hundred feet from the ocean. However, from R-19 south to R-26, the down drift reaches included in the modeling and economic analyses, SR A1A is located only 100 feet from the mean high water line of the ocean.

For the Project area described within this chapter and for residents located near the Project area, this highway is a major evacuation route, but is set back from the shoreline to avoid damages in most instances.

FUTURE WITHOUT-PROJECT CONDITIONS (NO-ACTION ALTERNATIVE)

In the FWOP condition the FDOT would continue to operate and maintain SR A1A and continued erosion may eventually threaten the integrity and continued use of the evacuation route.

Figure 20: Hurricane and Evacuation Zones in Palm Beach County



(:http://www.floridadisaster.org/publicmapping/Evac/EVAC_PALM_BEACH.pdf).

2.5 ECONOMIC ENVIRONMENT

The beaches of Palm Beach County play a pivotal role in the local and regional economy. Palm Beach County is one of the premier tourist destinations in Florida, largely because of its beaches. The Jupiter Carlin Segment of the Palm Beach County Shore Protection Project area provides extensive opportunities for local recreational activity, vacation and eco-tourism, and seasonal residency in addition to full-time residency. County records indicate that in 2016 alone, more than 700,000 visitors came to the two public parks in the Project area. These visitors included foreign tourists, out-of-state tourists, Florida visitors from other counties, and local visitors.

The revenue generated by these visitors is critical to economy of Palm Beach County. Recreational visitors contribute to Regional Economic Development (RED) by supporting both local businesses and local tax revenue. Recreation in the Project area also contribute to important Other Social Effects (OSE) in Palm Beach County, including Economic Vitality and Social Connectedness.

In addition to quantifying recreation benefits, the 934 Report economic analysis must estimate storm and erosion damage in both the FWOP condition and future with-project (FWP) condition. This chapter of the report includes key information about methods and assumptions used in this analysis. The information on the coastal assets detailed in this chapter was collected from Palm Beach County mapping resources, site visits, and contractors.

2.5.1 DAMAGE ELEMENTS – STRUCTURE & CONTENTS VALUE

Beach-*fx* is an event-driven life-cycle model that estimates damages and associated costs over a period of analysis based on storm probabilities, tidal cycle, tidal phase, beach morphology and many other factors. Damages to developed shorelines include damages to buildings, pools, patios, parking lots, roads, utilities, seawalls, revetments, bulkheads, replacement of lost backfill, etc., all classified as “damage elements “

Detailed structure information for the 1.1 mile stretch of shoreline authorized for the Jupiter Carlin Segment of the Palm Beach County, Florida SPP (R-13 through R-19) is used to compute damages, and includes:

- Six condominium buildings including a condominium resort
- Parking lots, parking garages, access roads, pools, decks, tennis courts, guard/pool houses, and dune walkovers associated with the condominiums
- Three large public parking lots
- Public roadways
- Carlin Park Civic Center
- Several public pavilions, gazebos, bath houses, and dune walkovers

In addition to structures located in the 1.1 miles of shoreline that comprise the authorized Project, structure information was compiled for the approximately 1.5 miles of shoreline down drift of the Project area (R-19 to R-26). SR A1A, the Jupiter Reef Club Resort, a parking lot, and several dune walkovers are included in the down drift analysis. Inclusion of this down drift shoreline is consistent with the economic analysis presented in the GDM Addendum for the Jupiter Carlin Segment of the Palm Beach County, Florida SPP.

In total, attribute information for 204 separate damage elements (149 damage elements within the authorized Project area and 55 damage elements down drift of the placement area) was populated for economic modeling using Beach-*fx*. The proximity of these buildings, roads, and other structures to the beach makes them potentially vulnerable to erosion, wave, and flood damage.

Under the FWOP conditions, there is expected to be continued erosion of the shoreline by wave- and storm-generated forces and interception of longshore sand transport by the inlet and inlet structures. The Project area's down drift proximity to the Jupiter Inlet and storm events has resulted in chronic erosion, which extends from the Inlet south. From Bridges et al. (2008), the Project area loses about 210,000 cy/yr. The loss of the protective beach would expose beachfront development and infrastructure (buildings, roads, utilities, parking lots) to destructive storm waves. Loss or reduction of the shoreline would likely decrease turtle nesting habitat in this area. The erosion would negatively affect the public directly and indirectly through damage to or loss of residences and infrastructure, loss of recreational opportunity, high costs associated with storm damage repairs, and loss of tourism and associated income to the local economy.

2.5.2 STRUCTURE INVENTORY

The economic value of the existing structure inventory represents the depreciated replacement costs of damageable structures and their associated contents within the study area along the coastline. The damage element inventory includes 204 damageable structures with an overall estimated value of $134,683,210, with structure and content valuations of $102,639,930 and $32,043,280, respectively. Table 14 provides the distribution of structure and content values broken down by Beach-*fx* Reach.

Table 14: Distribution of Structures and Contents Value (in FY 2017 Dollars) by Model Reach for the Study Area (JC13-2 to JC19-1) Including Down drift Model Reaches (JC20-1 to JC 26-1).

Beach-fx Reach	Location	DE Count	Structure Value	Content Value	Total Value	% of total value
JC14-1	Project Reach	7	$445,189	$0	$445,189	0.33%
JC15-1	Project Reach	36	$26,214,068	$7,901,250	$34,115,318	25.33%
JC16-1	Project Reach	68	$71,457,187	$23,168,250	$94,625,437	70.26%
JC17-1	Project Reach	1	$68,400	$0	$68,400	0.05%
JC18-1	Project Reach	9	$452,571	$90,000	$542,571	0.40%
JC19-1	Project Reach	28	$1,200,888	$183,750	$1,384,638	1.03%
JC20-1	Downdrift Reach	10	$335,385	$0	$335,385	0.25%
JC21-1	Downdrift Reach	21	$1,618,119	$700,030	$2,318,149	1.72%
JC22-1	Downdrift Reach	9	$218,038	$0	$218,038	0.16%
JC23-1	Downdrift Reach	8	$243,944	$0	$243,944	0.18%
JC24-1	Downdrift Reach	3	$163,313	$0	$163,313	0.12%
JC25-1	Downdrift Reach	1	$141,588	$0	$141,588	0.11%
JC26-1	Downdrift Reach	3	$81,241	$0	$81,241	0.06%
Total			$102,639,930	$32,043,280	$134,683,210	100%

*Note: JC 20-1 through JC26-1 consist of approximately 1.5 miles of shoreline down drift of the Project area

2.5.3 BEACH-*FX* MODEL SETUP

The Economics Appendix (Appendix C) provides a complete description of the Beach-*fx* model set-up and use. Data on historic storms, beach survey profiles, and private, commercial & public structures within the Project area are used as input to the Beach-*fx* model. The model is then used to estimate future damages resulting from hurricanes and coastal storms. In addition to direct damage to structures and contents, two other categories of damage include armor and land loss. The category of "Armor Cost" includes damage to existing armor as well as costs associated with building new armor in the future, in the absence of a Federal project.

Data on coastal armor within the Project area was collected from a variety of sources including site visits, aerial photography, and the USACE SAJ Coastal Engineering personnel. Coastal armor value was determined by the USACE SAJ Cost Engineering personnel. The Project contains only one instance of existing coastal armor. This is a 40-foot long steel sheet pile seawall with a concrete cap that fronts the Jupiter Beach bath house. The down drift area modeled in Beach-*fx* includes an additional instance of existing armor located near R-21. This sheet pile seawall fronts the Jupiter Reef Club Resort complex.

The stretch of shoreline that is not currently armored has been categorized as being either armorable in the future or not armorable. This categorization is based on the assumed likelihood that armor would or would not be constructed by local interests in the future, should Federal participation in the Project not be implemented.

Land Loss benefits arise from preventing permanent loss of the upland (areas landward of the existing dune). The upland has economic value, as it is the location of current and future development (residential, commercial, etc.). Beach-*fx* estimates net shoreline changes over time, including changes to the upland width. More information about armor costs and land loss benefits is provided in the Economics Appendix.

The FWOP damages are used as the base condition against which potential alternatives will be compared. The difference between FWP and FWOP damages are used to determine project benefits.

2.5.4 BEACH-*FX* MODEL ASSUMPTIONS

- **Economic Period of Analysis:** 26 years (FY2019 through FY2045)
- **Base Year:** The year in which the constructed Federal Project would be expected to begin accruing benefits is 2020, January 1, 2020 through December 31, 2020.
- **Discount Rate:** 2.875% FY17 Federal Water Resources Discount Rate
- **Damage Functions:**
    - Damage functions developed by the Institute for Water Resources (IWR), Coastal Storm Damage Workshop (CSDW), Coastal Storm Damage Relationships Based on Expert Opinion Elicitation in 2002, were used to the maximum extent possible.
    - Damage functions used for the high rise condominium structures were developed based on their unique construction and foundation type, and are documented in a 2010 White Paper titled "Large Building Flood Damage Functions", by Christopher P. Jones, P.E.
- **Coastal Armor:**
    - Existing armor set at the lot level will protect the damage elements in that lot until failure is triggered. If the armor fails, structures will be subject to damages until the armor is rebuilt. Armor failure thresholds for erosion, wave attack, and inundation have been set based on the armor design and engineering judgment.

  - When erosion reaches the seaward edge of armorable in the future lots, armor will be constructed at this location. Before the armor is built the damage elements are subject to damages. Once construction of the armor is completed, armor will function normally.
  - Shorefront properties that are not armorable will not be armored in the future because of either permitting restrictions, or the cost of armor would not likely be warranted to protect the relatively low value structures on these properties.
- **Number of Times Rebuilding Allowed:** The maximum number of structure rebuilds can be specified for damage elements. Based on the assumed likeliness that certain types of damage elements will eventually stop being rebuilt by property owners, the following are the number of times that rebuilding is allowed for certain types of damage elements:
  - Dune Walks: 6X
  - Gazebos: 3X
  - Isolated Structures: 3X
  - Remaining: 52X

2.5.5 STARTING SHORELINE POSITION FOR MODELING IN BEACH-*FX*

According to PGL 22, the FWOP beach profile should approximate pre-project conditions (in this case, the 1995 pre-Project shoreline). A FWP condition can then be developed based on existing conditions (current surveys). The logic behind this approach is that it should be possible to evaluate the entire life of the project, including the proposed extension of Federal participation, by comparing it to an FWOP condition in which *the Project had never been built*. Typically in Beach-fx studies, the starting profile of the FWOP and FWP conditions in the model are the same, but the guidance for Section 934 studies, the requirements are clear for the FWOP and FWP assumptions, and for Jupiter Carlin, the starting profiles for FWOP and FWP are slightly different. Figure 21 depicts the comparison of starting profiles for FWOP and FWP, as well as a representation of sacrificial berm widths evaluated. The hatched lines represent sacrificial berms widths evaluated from 20-ft to 100-ft. A range of sacrificial berm widths in 10-foot increments from 10-ft to 100-ft, however for display purposes, only 20-ft increments are presented on this graphic. In compliance with conditions of the 1995 PCA, the FWP starting position in Beach-*fx* will reflect the authorized design berm as that was required to be maintained per the PCA.

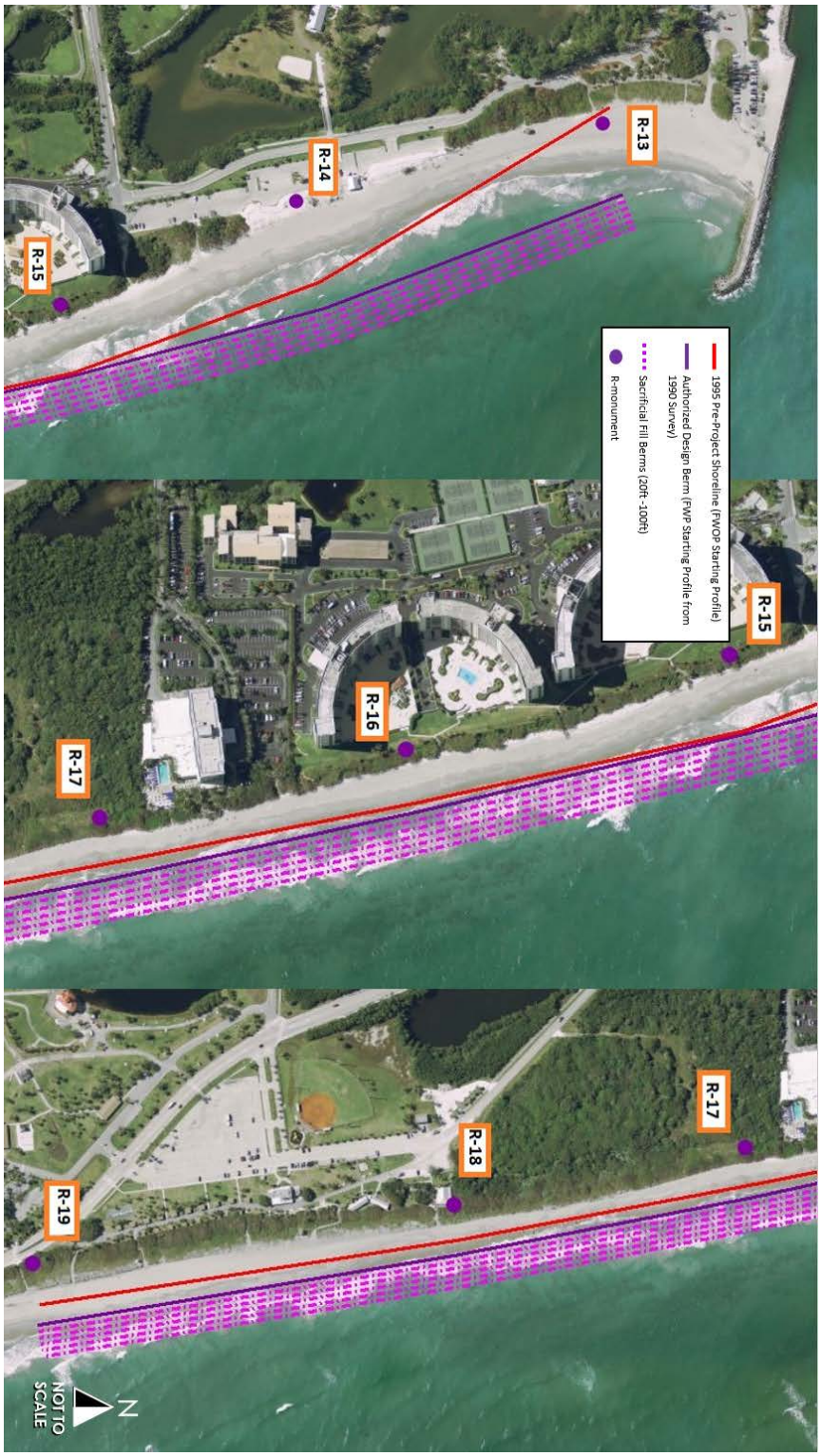


Figure 21: Comparison of Starting Profiles, FWOP 1995 Pre-Project Survey (Red) and FWP (Solid Purple).

2.5.6 BEACH-*FX* FWOP DAMAGE RESULTS

Over 100 iterations the FWOP damages range between $801,756 and $5,059,001 in average annual terms. A breakdown of the type of damage is provided in Table 15: . The largest category of damage by far is armor construction or repair costs in the Project reach. In this reach, new armor is constructed relatively early in most simulations. The new armor reduces or prevents future damage, but it also incurs its own cost.

SPATIAL DISTRIBUTION OF WITHOUT-PROJECT DAMAGES

There is a great deal of variability in the amount of damages amongst the Beach-*fx* reaches. This is explained by the large number of variables, all of which the Beach-*fx* model takes into account. Examples of variation between the reaches result from the following:

- Density and amount of development
- Typical size and value of structures
- Typical distance between structures and mean-high water
- Size, shape and location of the dunes and coastal morphology
- Rate of erosion for each reach
- Amount and type of coastal armoring present
- Timing that property owners construct coastal armoring in the future.

The spatial summary of the Jupiter Carlin FWOP damages presented in Table 15 indicate that the majority of damage (about 78%) occurs within the Project reach.

Table 15: FWOP Average Annual Damages by Reach (AAEQ Terms in FY17 Price Levels).

	Damages	Armor Costs	Land Loss	Damages + Armor Cost + Land Loss
Project Reach	$330,568	$865,315	$79,218	$1,275,101
Down drift Reach	$239,102	$0	$112,803	$351,905
Total	**$569,670**	**$865,315**	**$192,021**	**$1,627,006**

DAMAGE DISTRIBUTION BY DAMAGE DRIVING PARAMETER

Within the Beach-*fx* model environment, damage to structures and contents can be caused by three different damage driving parameters: flooding (inundation), wave attack, and erosion. The results of damage to structures and contents are broken out by parameter in the following table (Table 16). Typically, in Florida coastal studies, the vast majority of damage (as estimated by Beach-*fx*) is caused by erosion. This appears to also be the case in Jupiter Carlin, where an overwhelming majority of storm damages is caused by erosion.

Table 16: Present Value Damages by Damage-Driving Parameter.

Reach Group	Flood Loss	Erosion Loss	Wave Loss
Project Reach	0.1%	53.9%	0.7%
Down drift Reach	0.0%	45.2%	0.1%
Total	0.1%	99.0%	0.8%
Reach Group	Flood Loss	Erosion Loss	Wave Loss
Project Reach	$8,653	$3,758,590	$49,246
Down drift Reach	$0	$3,153,094	$9,893
Total	$8,653	$6,911,684	$59,139

TEMPORAL DISTRIBUTION OF DAMAGES

The temporal distribution of storm damages is fairly front-loaded. In most iterations, new armor construction is triggered quickly (in the early years of the simulation). This new armor helps protect the inventory from storm damage, but it incurs its own cost. Damages and costs that occur early in the simulation are not discounted as heavily as those that occur later, thus they can have a disproportionately large impact on average annual damage.

Later in the simulation, some of the unarmored lots begin to accrue increasing erosion and land loss damage. These damages, while significant, are smaller in magnitude than the armor costs that tend to accrue early on. The temporal distribution of damages is summarized further in the Economics Appendix.

FWOP CONDITION CONCLUSION

The simulated FWOP suggests that the Project area may be subject to considerable storm and erosion damage throughout the period of analysis. In particular, there are three important conclusions:

- Most of the FWOP damages consist of new armor construction for maintaining and protecting condominiums
- The overwhelming majority of the damage and new armor is caused by erosion
- Damages in the FWOP condition increase in the accelerated SLC scenarios

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CHAPTER 3

PLAN FORMULATION

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3 PLAN FORMULATION

3.1 PLAN FORMULATION RATIONALE

> *"Four accounts are established in the Principles and Guidelines (P&G 1983) to facilitate the evaluation of management measures and display the effects of alternative plans. The National Economic Development (NED) account displays the plan with the greatest net economic benefit consistent with protecting the nation's environment; the Environmental Quality (EQ) account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of alternative plans; the Regional Economic Development (RED) account displays changes in the distribution of regional economic activity (e.g., income and employment); and the Other Social Effects (OSE) account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, and others. The Federal Principles and Guidelines require that for Coastal Storm Risk Management (CSRM) projects, the NED plan is to be the selected plan unless an exception is granted. The NED plan must also be evaluated in consideration of the Principles and Guidelines criteria of completeness, effectiveness, efficiency, and acceptability."*

As this is a Section 934 study, the Project has been previously authorized and constructed. The recommended plan became the authorized Project and was formulated by combining management measures, meeting planning objectives and avoiding constraints from the 1987 GDM, subsequently revised by the 1994 GDM Addendum. Furthermore, per the Planning Objectives and Constraints section of the 1994 GDM, guidance provided by the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (USWRC, 1983) was met. Plan formulation was performed based on the USACE Guidance for a Section 934 report, ER 1105-2-100, and Policy Guidance Letter (PGL) No. 22.

3.2 PROBLEMS

Existing problems in the study area include:

1. Storm damages due to erosion, inundation, and waves threatening infrastructure
2. Loss of natural habitat due to storm surge, waves, inundation, and erosion
3. Shoreline erosion threatening recreational opportunities

Erosion, mainly storm induced, is the greatest problem in the study area as a negative impact to infrastructure. Additional problems associated with the eroding shoreline include loss of recreational resources (impacting tourism) and loss of natural habitat. Predicted sea level rise and coastal storms in the study area will continue to exacerbate erosion.

The Project is located immediately south of Jupiter Inlet in northern Palm Beach County. Jupiter Inlet acts as a sediment sink, and as a result there is a severe erosional stress on the beach south of the Inlet, with additional processes and forces that contribute to the problem (described in Chapter 2, Existing Conditions). Palm Beach County, as the non-Federal sponsor, has shown a commitment to an erosion control program which restores the County's coastline through the beneficial use of dredged material from the inlet tidal shoals, placement of material from offshore sand sources, and upland sand mines.

3.3 OPPORTUNITIES

Opportunities are positive conditions in the study area that may result from implementation of a Federal project such as:

1. Reduction of storm damages to residential and commercial properties along the Palm Beach County shoreline
2. Reduction of impacts to the natural dune function, where possible
3. Protection of habitat for nesting sea turtles, benthic invertebrates, and shore birds
4. Protection of the current hurricane evacuation route
5. Maintenance of existing recreation and tourism levels

These opportunities may be realized by implementing a single management measure or a combination of management measures which may be structural and/or non-structural. Management measures such as beach nourishment and dune creation/remediation include additional opportunities to protect natural habitat for sea turtles, shore birds, etc. While some natural functions, such as sea turtle nesting, may be disrupted during construction activities, there is an opportunity for long-term benefits in preserving the beach habitat.

3.4 OBJECTIVES

3.4.1 PLANNING OBJECTIVES

This 934 report is an integrated feasibility study and environmental document. As with a separate NEPA document, it discusses and documents the environmental effects of the Recommended Plan and summarizes compliance with Federal statutes and regulations.

Specific planning objectives as stated in the 1987 GDM for the overarching Palm Beach County Project are:

1. Protection of flooding and wave damage
2. Beach erosion control
3. Provision of a recreation beach
4. Protection of tourist base economy

Specific planning objectives for the Jupiter Carlin segment of the Palm Beach County SPP, as stated in the 1994 GDM Environmental Impact Statement are:

1. A reduction of damages to public and private upland structures resulting from storm tides and waves
2. A reduction of the effects of Jupiter Inlet on littoral drift
3. An improved ability of coastal plant and animal species to withstand storm impacts
4. Enhancement of a recreational beach
5. Protection of an income base derived from tourism

The objectives from the 1994 GDM are inclusive of the 1987 GDM, with the addition of number three, which is “an improved ability of coastal plant and animal species to withstand storm impacts.” These are carried forward into the extension of Federal participation for the Project.

The overarching goal of this study is to formulate an alternative for coastal storm risk management to determine if Federal participation in reduction of the damages caused by erosion and coastal storms to shorefront structures and infrastructure within the study area is warranted and economically justified. Specific study objectives have been developed to provide a means of determining whether individual management measures are capable of solving the problems while utilizing the opportunities identified and avoiding the constraints. The following objectives have been developed based on the Project's problems, opportunities, goals, and Federal and state objectives and regulations over the remaining 26-year planning horizon (2019-2045).

1. Objective 1: Reduce storm damages to property and infrastructure within the Project area.
2. Objective 2: Maintain environmental quality in the Project area and adjacent areas, for natural and human uses - sea turtle nesting habitat, shore bird foraging habitat, aesthetics, etc.
3. Objective 3: Maintain recreational use of beach and nearshore areas in the Project area including beach-going, surfing, fishing, and wildlife viewing.

3.4.2 FEDERAL OBJECTIVES

The Federal objective, as stated in The Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, established by the U.S. Water Resources Council on March 10, 1983 (P&G), is to contribute to NED consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net economic benefits that accrue in the study area and the rest of the Nation.

The Federal objective does not seek to identify specific targets within objectives. For example, targeting a pre-defined storm frequency (100 year storm) relative to the storm damage reduction objective would be ineffective. Rather, the planning process includes formulation of alternative plans to maximize benefits relative to costs.

3.4.2.1 FEDERAL ENVIRONMENTAL OBJECTIVES

The USACE strives to balance the environmental and developmental needs of the Nation in full compliance with the NEPA, and other authorities provided by Congress and the Executive Branch. Public participation is encouraged early in the planning process to define environmental problems and elicit public expression of needs and expectations. Significant environmental resources and values that would likely be impacted, favorably as well as adversely, by an alternative under consideration are identified early in the planning process. Significant adverse impacts that cannot be avoided are mitigated as required by Section 906(d) of WRDA 1986.

3.4.2.2 ENVIRONMENTAL OPERATING PRINCIPLES

Consistent with the NEPA, the USACE has formalized its commitment to the environment by creating a set of "Environmental Operating Principles" applicable to all its decision-making and programs. These principles foster unity of purpose regarding environmental issues and ensure that environmental conservation and preservation, and restoration are considered in all the USACE activities. Section 6.33 includes a discussion of the USACE Environmental Operating Principles and how the study addresses them.

3.4.2.3 CAMPAIGN PLAN OF THE U.S. ARMY CORPS OF ENGINEERS (USACE)

The USACE Campaign Plan goals and objectives are derived, in part, from the Commander's intent, the Army Campaign Plan, and the Office of Management and Budget. The four campaign plan goals and their associated objectives also build on prior strategic planning efforts. Each campaign plan goal and objective is led by a USACE senior leader who manages and oversees actions to reach the goal and objective.

The successful achievement of the Campaign Plan goals and objectives are dependent on actions implemented by the entire USACE team. The implementing actions supporting each goal and objective are contained in the headquarters staff and Major Subordinate Command (MSC) implementation guidance for the Campaign Plan. The four goals of the FY15-19 Campaign Plan are:

Goal 1, Support National Security: Deliver innovative, resilient, and sustainable solutions to the Department of Defense (DoD) and the Nation.

Goal 2, Transform Civil Works: Deliver enduring and essential water resource solutions using effective transformation strategies.

Goal 3, Reduce Disaster Risks: Deliver support that responds to, recovers from, and mitigates disaster impacts to the nation while ensuring sustainable operations.

Goal 4, Prepare for Tomorrow: Build resilient People, Teams, Systems, and Processes to sustain a diverse culture of collaboration, innovation, and participation to shape and deliver strategic solutions.

These Campaign Plan goals and associated objectives have been addressed through the course of this study.

3.4.3 STATE & LOCAL OBJECTIVES

The State of Florida is empowered by the Federal Coastal Zone Management Act (CZMA) and its implementing regulations at 15 Code of Federal Regulations (CFR) 930 to review Federal activities within or adjacent to its coastal zone to determine whether the activity is consistent with the requirements of the state's approved management program for its coastal zone. The Federal CZMA requires Federal activities to be consistent with a state's coastal zone program to the maximum extent practicable; it does not require compliance with a state's program. Florida's Coastal Zone Management Program was established under the Coastal Management Act of 1978 (Chapter 380.20, Florida Statutes) and approved by the Federal Coastal Zone Management Office in 1981. Florida does not regulate its coastal zone through one comprehensive law but rather through several state statutes and administrative codes. Through Florida's comprehensive planning act, local governments are also given the opportunity to determine whether these activities are consistent with their coastal goals and policies. The FDEP is the lead state agency for the implementation of the Federal CZMA.

The Beach and Shore Preservation Act (Chapter 161, Florida Statutes) is Florida's primary statute for developing and implementing the state's strategic coastal management plan, regulating coastal construction seaward of the mean high water line, and regulating activities seaward of the coastal construction control lines. The Act, administered by the FDEP, was first passed in 1965 and has since been significantly amended. The objective of the Beach and Shore Preservation Act is to preserve and protect Florida's sandy beaches and adjacent beach and dune systems. The FDEP strives to accomplish this objective with the following programs: Coastal Construction Control Lines, Joint Coastal Permit Program,

Erosion Setbacks, Coastal Building Zone, Erosion Control Program, Erosion Control Line, and Inlet Management.

3.4.3.1 LOCAL COMPREHENSIVE PLANNING

The state's Local Government Comprehensive Planning Act of 1985 (Chapter 163) requires that all local governments prepare, adopt, and implement comprehensive plans that address community growth and development needs. It requires that local, regional, and state comprehensive plans be consistent with each other and requires coastal counties and cities to include a "coastal management element" in their local plans. This section of the plan must be based on an inventory of the beach/dune system and existing coastal land uses and an analysis of the effects of future land uses on coastal resources. Local governments must also address disaster mitigation and redevelopment, designation of coastal high-hazard areas, beach protection, and shoreline use.

The Palm Beach County's Department of Environmental Resources Management (DERM) Shoreline Protection Plan identifies the County's mission to: establish, implement, and maintain programs for the protection, preservation, and enhancement of the land and water resources of Palm Beach County (DERM 2014).

3.5 CONSTRAINTS

3.5.1 PLANNING CONSTRAINTS

As per Engineer Regulation (ER) 1105-2-100, constraints are defined as restrictions that limit the planning process. Constraints, like objectives, are unique to each planning study. Some general types of constraints that need to be considered are resource constraints and legal and policy constraints. Resource constraints are those associated with limits on knowledge, expertise, experience, ability, data, information, money and time. Legal and policy constraints are those defined by law, Corps policy and guidance. Plans should be formulated to meet the study objectives and to avoid violating the constraints. Constraints are designed to avoid undesirable changes between the FWOP and FWP conditions.

One of the original Project-specific constraints was the minimization of impacts to nearshore hardbottom resources. Extension of Federal participation in future nourishments, under the Section 934 Authority, will not require additional mitigation as the Recommended Plan includes no expansion or increase in volume outside of the currently authorized Project's equilibrium toe of fill that would adversely impact hardbottom resources.

Planning constraints identified as part of this study are:

1. Avoid conflict with Federal regulations, as stated in Federal law, USACE regulations and Executive Orders, specifically the CBRA, Clean Water Act and CZMA.
2. Avoid and/or minimize impacts to nearshore hardbottom resources over the 26-year planning horizon (2019-2045).
3. Avoid impacts to sea turtle nesting habitat including the placement of fill during construction and / or nourishment during nesting season over the 26-year planning horizon (2019-2045).
4. Avoid and/or minimize impacts to the hurricane evacuation route (SR A1A) over the 26-year planning horizon (2019-2045).

3.5.2 LOCAL CONSTRAINTS

No specific local constraints were identified. Local and state laws, such as Florida State statutes, do not constrain plan formulation for CSRM projects, except to extent supremacy has been waived.

3.6 PLAN FORMULATION ANALYSIS

3.6.1 SUMMARY OF PLAN FORMULATION EVALUATION

As per ER 1105-2-100 Appendix E, Section IV E-24 g.(2)(b)(2) states: "Only an extension of periodic nourishment can be implemented under Section 934. Nevertheless, other alternatives should be evaluated as part of a 934 study. This alternatives analysis should be similar in scope to Section 216 of the 1970 Flood Control Act (FCA)". The Section 216 of the 1970 FCA allows the USACE to review completed navigation, flood control, and water supply projects in which there have been significant changes in the physical or economic conditions from the time they were constructed. The Jupiter Carlin Segment of the Palm Beach County, Florida SPP has had no significant changes in the economic or physical conditions from the time it was constructed.

With the exception of the Federal Project, the only physical change since the Project was constructed occurred in 1998, with the construction of the Jupiter Inlet south jetty extension. The 175-ft extension of the south jetty situated down drift of the Inlet has a localized effect on incident waves and nearshore current patterns, ultimately offering limited protection from wave and current energies immediately south of the jetty. Given that the south jetty extension was determined through detailed engineering analysis not to be a significant driver for changes to the Project's shoreline, additional alternatives, other than periodic beach nourishment, were not considered for further evaluation, considering the history of success for coastal storm risk management through periodic beach nourishment.

The originally authorized and constructed Project has design berm, based upon the 1990 MHW line, and an approximate 100-ft sacrificial berm. The team evaluated a range of optimizations of sizes (and timing of nourishments) of sacrificial berm widths in 10-ft increments within the 100-ft Project, in comparison to the FWOP condition (Figure 22).

The Section 934 analysis concluded with an economically justified recommendation for an optimization of the authorized Project, comprised of a 30-ft sacrificial berm with a six-year nourishment interval, as the most cost effective nourishment scheme for continued Federal participation through 2045.

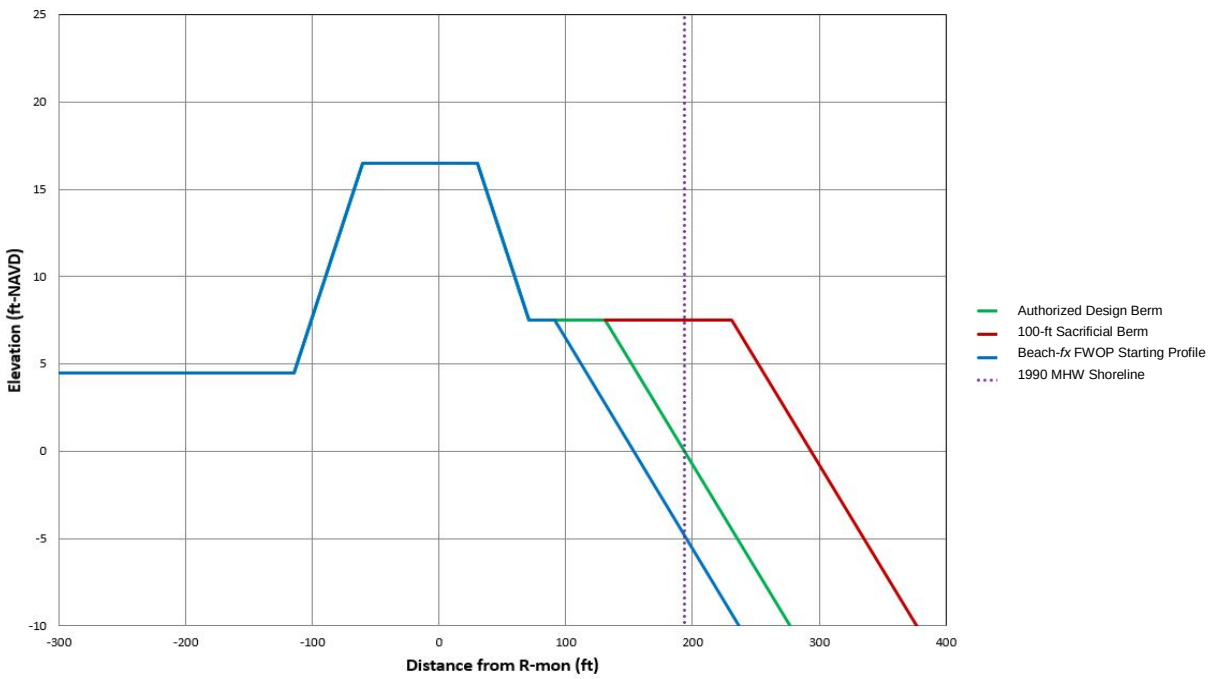

Figure 22: Jupiter Carlin Segment of the Palm Beach County Shore Protection Project Profile Comparison.

3.6.2 OPTIMIZATION OF THE AUTHORIZED PROJECT

As the purpose of the Section 934 Report is to evaluate the feasibility of extending the period of Federal participation of the authorized Project up to 50 years from the date of initial construction, the evaluation for Jupiter Carlin concludes in 2045, 50 years from the initial construction in 1995. Planning guidance also has a provision, Policy Guidance Letter (PGL) Number 22, for the optimization of the Federal Project, including modifications to the periodic nourishment interval and sacrificial fill volume to improve efficiency. PGL 22 c., states that:

> *As the basic decision is to determine if continued Federal participation in the authorized project is justified given current conditions of development and current budgetary priorities, the without project beach profile should approximate pre-project conditions (i.e. conditions that existed just prior to initial project construction). The following two step process is required:*
>
> *(1) identify (update, no indexing) current benefits of the existing project to determine if continued maintenance of the existing project is economically justified and consistent with current policies; and (2) develop alternatives (size & timing) for nourishment and recommend the most cost-effective nourishment scheme for the authorized project.*

Given this guidance, the Section 934 analysis assessed benefits and costs of the authorized Project and optimizations of nourishment intervals and volumes for the authorized Project over a 26-year planning horizon, beginning in 2019 and concluding in 2045.

A key assumption that went into the optimization modeling in Beach-*fx* is that the authorized design berm is entirely present in the FWP condition of the initial nourishment event. The assumption is based upon a requirement from the March 1995 PCA that states:

> *the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project or the functional portion of the Project, at no cost to the Government, in a manner compatible with the Project's authorized purposes…Such operation, maintenance, repair, replacement and rehabilitation shall include, but is not limited to, beach berm reshaping; maintenance of storm drainage outfalls; and periodic nourishment for the economic life of the Project.*

The economic life of the Project concludes in 2045. Therefore, it is the non-Federal sponsor's responsibility to ensure compliance with Article VIII of the PCA and restore the design berm, "at no cost to the Government," prior to any Federal expenditures for the initial nourishment event of the Section 934 period of Federal participation extension.

To satisfy Step 1, in determining whether the federally authorized Project remains economically justified, a range of sacrificial berm widths and nourishment intervals, optimizations of the authorized Project, were evaluated in Beach-*fx*. Specifically, a range of sacrificial berm widths from 10 to 100 feet were simulated and evaluated (Table 17). Based upon the GDM Addendum, the federally authorized Project consists of a 0-foot berm extension of the 1990 MHW shoreline (design berm), an approximate 100-ft wide sacrificial berm, and a seven year nourishment interval.

Table 17: Optimization Comparison Using Screening Level Costs in FY17 Price Levels.

Sacrificial Berm Widths****	Primary Storm Damage Reduction Benefits**	Costs	BCR	Net Benefits
10ft	$1,044,194	$1,840,252	0.567	-$796,058
20ft	$1,026,052	$1,461,549	0.702	-$435,497
30ft	$1,005,186	$1,366,755	0.735	-$361,569
40ft	$957,456	$1,347,004	0.711	-$389,548
50ft	$881,274	$1,309,066	0.673	-$427,792
60ft	$837,371	$1,361,508	0.615	-$524,137
70ft	$804,239	$1,326,262	0.606	-$522,023
80ft	$765,339	$1,325,189	0.578	-$559,850
90ft	$715,945	$1,308,003	0.547	-$592,058
100ft*	$701,599	$1,320,544	0.531	-$618,946

Note:
***The 100 foot berm extension most accurately represents the authorized Project.**
****Land Loss & Recreation Benefits not included.**
*****All nourishments assumes dredge mobilization/demobilization & placement costs. OMRR&R costs not included, ROM screening costs.**
******All berms assume design berm in place prior to initial construction.**

The costs presented in Table 17 represent rough order of magnitude (ROM) cost estimates which were developed using information from similar historic projects. The costs presented are averages based on 100 Beach-*fx* iterations, over the 26-year economic period of analysis. The costs include placement costs

($/cy) and dredge mobilization and demobilization costs. When comparing costs of different sacrificial berm widths, the significant cost driver is the number of mobilization/demobilization events over the life of a project versus the placement costs. Mobilizations and demobilizations for a periodic nourishment are a significant proportion of costs for each nourishment. Therefore, the greater number of mobilizations/demobilizations over the life of a project, the more costly. An example of this situation can be seen in the costs from the 10ft to incrementally larger berm widths, the smaller the sacrificial berm, the smaller the nourishment interval will be, increasing the number of mobilization events, ultimately increases the costs on a disproportionately to storm damage reduction benefits.

The results of this initial screening suggested that none of the optimizations would be economically justified based solely on primary benefits. The authorized Project, equivalent to the 100-ft berm, has a BCR of less than 1.0, and therefore is not economically justified, given current conditions, on primary storm damage reduction benefits alone. This analysis satisfies Step 1 from the PGL 22 4c guidance.

Table 18: Screening Comparison of the 30-ft versus the 40-ft Berm Optimizations (AAEQ Terms in FY17 Price Levels)

Preliminary Summary of 30 foot Plan* **	
AAEQ Storm Damage Reduction Benefits	$1,005,186
AAEQ Land Loss Benefits	$196,225
TOTAL AAEQ PRIMARY BENEFITS*	$1,201,411
AAEQ Costs	$1,366,755
BCR	0.88
Net Annual Benefits	-$165,344
Average # of nourishments	~ 4
# of Iterations with 4 nourishments	59
# of Iterations with <4 nourishments	37
# of Iterations with >4 nourishments	**4**
Average Nourishment Interval	6 years
Average Nourishment Volume (cy)	193,300

Preliminary Summary of 40 foot Plan* **	
AAEQ Primary Benefits	$957,456
AAEQ Land Loss Benefits	$198,345
TOTAL AAEQ PRIMARY BENEFITS*	$1,155,801
AAEQ Costs	$1,347,004
BCR	0.86
Net Annual Benefits	-$191,203
Average # of nourishments	~ 3
# of Iterations with 3 nourishments	53
# of Iterations with <3 nourishments	9
# of Iterations with >3 nourishments	**38**
Average Nourishment Interval	9 years
Average Nourishment Volume (cy)	253,600

Notes:
***Recreation benefits not included.**
****Both nourishments assume dredge mobilization/demobilization & placement costs. OMRR&R costs not included, ROM screening costs.**
*****All berms assume design berm in place prior to initial construction.**

To satisfy Step 2 from PGL 22 4c guidance, to recommend the most cost-effective nourishment scheme for the authorized Project from a range of optimized sacrificial berm widths (which subsequently drive the nourishment intervals). The 30-ft and the 40-ft sacrificial berm optimizations were close in comparison for maximizing the net benefits. This similarity in net benefits resulted in a subsequent comparison of the two optimizations in order to recommend the most cost-effective nourishment scheme of the authorized Project (Table 18). While the net benefits of the 30-ft and 40-ft berms are similar and the 40-ft plan is projected to cost even less, when evaluating the number of iterations from the Beach-*fx* outputs, the 40-ft plan proves to carry more risk in that there are more iterations where additional nourishments are

triggered over the life-cycle than the 30-ft optimization. Furthermore, both the 30-ft and 40-ft optimizations have a BCR of greater than 0.5, which under current policy and guidance, may proceed with calculating incidental recreational benefits (discussed further in the next Chapter) which could contribute to providing additional benefits necessary for economic justification (a BCR greater than 1.0). Ultimately, the 30-ft plan was determined to be the most cost-effective optimization of the authorized Project, carrying less risk than the 40-ft plan, and given the limited change to shoreline ownership, shoreline use, and public access, it was carried forward for continued evaluation as the Recommended Plan.

With every optimization of the authorized Project presented in Table 17, the design berm remains unchanged; only the size and timing of the sacrificial volume was optimized. Though the 30-ft berm optimization is smaller than the previously constructed authorized Project, the estimated periodic nourishment interval is smaller as well, every six years as opposed to every seven years. Traditionally, in shore protection studies, a fixed periodic nourishment interval is defined and optimized over a specified period of Federal participation, in this case, 26 years. In Beach-*fx*, rather than having a fixed nourishment interval, periodic nourishment events are triggered when specific criteria are met. The triggers are set up to simulate a point at which the berm extension erodes to at least half its equilibrated width in at least one reach, and a minimum set volume has eroded from the entire Project template. Based on these parameters, the average time interval between nourishment events over all 100 iterations is six years. In reality, this interval could vary significantly depending on erosion and storm events. More information about the nourishment triggers is provided in Appendix A. The analysis uses life-cycle modeling results to develop plans that are more resilient and adaptable. Life-cycle modeling allows planners to design projects while recognizing the inherent uncertainty that exists when future events are simulated.

3.6.3 RECOMMENDED PLAN

The NED plan is the plan that reasonably maximizes net benefits (benefits minus costs) consistent with protecting the nation's environment. There is no locally preferred plan in this study and, therefore, the NED plan is the Recommended Plan. The 30-ft sacrificial berm of the Recommended Plan, with a six-year nourishment interval, maintains the 1990 MHW line (the design berm) and is consistent with the authorized Project's north-to-south limits, spanning 1.1 miles of shoreline. The northern limit of the fill is located at R-13, approximately 500 feet south of Jupiter Inlet's south jetty. A 700 foot taper starting at R-13 and extending to approximately R-13.7 connects the fill to the northern shoreline. The southern limit is located at R-19. A 1,200-foot taper between R-18 and R-19 connects to the existing southern shoreline. For planning and cost-estimating purposes, a hydraulic dredge operation is proposed to fill the Project template with suitable material from the offshore sand source, Jupiter Carlin A. However, should Jupiter Carlin A not be feasible, there are four upland sand mines that have been evaluated for geotechnical suitability, proximity, and availability for future nourishment events. Environmental analysis of impacts from use of these upland sand mines is also covered in this document.

- **Average # Nourishment Events:** 4 periodic nourishment events
- **Average Periodic Nourishment Volume**: 193,300 cy
- **Average Periodic Nourishment Interval**: 6 years
- **Initial Nourishment Duration**: approximately 3 months

The average initial construction volume over 100 iterations is 191,900 cy. The average total Project volume of all nourishments over 100 iterations is 804,000 cy. The average time interval between nourishment events over 100 iterations is six years. Assuming that periodic nourishment events occur at this average interval, the nourishment years for the four planned events are 2020, 2026, 2032, and 2038.

Table 19 lists the final optimization measures and summarizes the major environmental features and consequences of the future with-out project (No Action Plan) ; the 10 to 20-foot berm (less than the Recommended Plan; the Recommended Plan which is the 30-foot berm; and 40 to 100-foot berm (greater than the Recommended Plan). As noted in the table, the effects are similar for all optimization measures, except for minor differences in magnitude of effect, and therefore only the Recommended Plan is carried forward for detailed analysis in Chapter 5.

Table 19: Summary of Direct and Indirect Impacts of the Recommended Plan.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
GENERAL ENVIRONMENTAL SETTING	Increased protection of upland infrastructure as well as creation of additional habitat. Temporary adverse effects including, but not necessarily limited to sea turtles, benthic resources, aesthetics, and noise. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly less than the Recommended Plan.	Increased protection of upland infrastructure as well as creation of additional beach habitat. Temporary adverse effects including, but not necessarily limited to sea turtles, benthic resources, aesthetics, and noise.	Increased protection of upland infrastructure as well as creation of additional beach habitat. Temporary adverse effects including, but not necessarily limited to sea turtles, benthic resources, aesthetics, and noise. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Risk of erosion would increase threatening the existence of the beach, dunes, adjacent uplands, and any development in those areas. This risk is minimized such that the local nourishments from Jupiter Inlet and the Atlantic Intracoastal Waterway continue on an approximate annual basis as they have since 1947.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
DUNE AND BEACH	Reduced erosion and reduced loss of dune vegetation. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly less than the Recommended Plan.	Reduced erosion and reduced loss of dune vegetation.	Reduced erosion and reduced loss of dune vegetation. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Risk of dune and beach habitat erosion would increase. Species that utilize the beach and dune environment may decrease in number. This risk is minimized such that the local nourishments from Jupiter Inlet and the Atlantic Intracoastal Waterway continue on an approximate annual basis as they have since 1947.
NEARSHORE HABITAT	Dredging and beach placement would directly affect nearshore habitat. Mitigation for previous impacts to hardbottom has been successfully completed.	Dredging and beach placement would directly affect nearshore habitat. Mitigation for previous impacts to hardbottom has been successfully completed. No additional mitigation required.	Dredging and beach placement would directly affect nearshore habitat. Mitigation for previous impacts to hardbottom has been successfully completed.	Nearshore habitat should not change.
FISH AND WILDLIFE RESOURCES	Beach placement would temporarily impact fish and wildlife species that utilize the beach placement area. Effects would be slightly less than the Recommended Plan.	Beach placement would temporarily impact fish and wildlife species that utilize the beach placement area.	Beach placement would temporarily impact fish and wildlife species that utilize the beach placement area. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Species that utilize the beach may decrease in number due to erosion. No changes in fish and wildlife resources that occur within or below the swash zone are anticipated.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
SEA TURTLES	Dredging and beach placement activities may affect sea turtles. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly less than the Recommended Plan.	Dredging and beach placement activities may affect sea turtles. Protective measures would be implemented.	Dredging and beach placement activities may affect sea turtles. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly greater than the Recommended Plan.	Risk of dune and beach habitat erosion would increase. Nesting habitat may decrease.
MANATEE	Dredging operations may affect, but are not likely to adversely affect the manatee. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly less than the Recommended Plan.	Dredging operations may affect, but are not likely to adversely affect the manatee. Protective measures would be implemented.	Dredging operations may affect, but are not likely to adversely affect the manatee. Minor magnitude and duration would change with each berm width alternative. Protective measures would be implemented. Effects would be slightly greater than the Recommended Plan.	Status of manatee would not change.
SMALLTOOTH SAWFISH	Dredging operations may affect, but are not likely to adversely affect the sawfish. Protective measures would be implemented. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly less than the Recommended Plan.	Dredging operations may affect, but are not likely to adversely affect the sawfish. Protective measures would be implemented.	Dredging operations may affect, but are not likely to adversely affect the sawfish. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly greater than the Recommended Plan.	Status of smalltooth sawfish would not change.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
PIPING PLOVER AND RUFA RED KNOT	Beach placement operations may affect, but are not likely to adversely affect the plover and knot. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly less than the Recommended Plan.	Beach placement operations may affect, but are not likely to adversely affect the plover and knot. Protective measures would be implemented.	Beach placement operations may affect, but are not likely to adversely affect the plover and knot. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly greater than the Recommended Plan.	Beach erosion may result in less habitat for piping plovers and rufa red knots.
WHALES	Dredging operations within offshore borrow sites may affect, but are not likely to adversely affect whales. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly less than the Recommended Plan.	Dredging operations may affect, but are not likely to adversely affect whales. Protective measures would be implemented.	Dredging operations may affect, but are not likely to adversely affect whales. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly greater than the Recommended Plan.	Status of whales would not change.
BEACH JAQUEMONTIA	Beach placement operations may affect, but are not likely to adversely affect the beach jaquemontia. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly less than the Recommended Plan.	Beach placement operations may affect, but are not likely to adversely affect the beach jacquemontia. Protective measures would be implemented.	Beach placement operations may affect, but are not likely to adversely affect the beach jacquemontia. Minor magnitude and duration changes with each berm width alternative. Protective measures would be implemented. Effects would be slightly greater than the Recommended Plan.	Dune erosion may result in less habitat for beach jacquemontia.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
ESSENTIAL FISH HABITAT (EFH)	Dredging and beach placement would directly affect EFH. Magnitude and duration would change with each berm width alternative. Mitigation for previous impacts to hardbottom has been successfully completed.	Dredging and beach placement would directly affect EFH. Mitigation for previous impacts to hardbottom has been successfully completed.	Dredging and beach placement would directly affect EFH. Minor magnitude and duration changes with each berm width alternative. Mitigation for previous impacts to hardbottom has been successfully completed.	EFH would not change.
COASTAL BARRIER RESOURCES ACT UNITS (OTHERWISE PROTECTED AREA)	Beach placement would increase beach habitat. The Project would not encourage additional development.	Beach placement would increase beach habitat. The Project would not encourage additional development.	Beach placement would increase beach habitat. The Project would not encourage additional development.	Risk of beach erosion would increase affecting coastal barrier resources.
WATER QUALITY	Dredging and beach placement would temporarily impact water quality. Magnitude and duration would change with each berm width alternative. Water quality would be monitored and protection measures implemented. Effects would be slightly less than the Recommended Plan.	Dredging and beach placement would temporarily impact water quality. Water quality would be monitored and protection measures implemented.	Dredging and beach placement would temporarily impact water quality. Minor magnitude and duration changes with each berm width alternative. Water quality would be monitored and protection measures implemented. Effects would be slightly greater than the Recommended Plan.	Water quality would not change.
HAZARDOUS, TOXIC, RADIOACTIVE WASTE (HTRW)	Encountering HTRW is not anticipated.	Encountering HTRW is not anticipated.	Encountering HTRW is not anticipated.	No known HTRW.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
AIR QUALITY	Temporary increase in air pollution is predicted. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly less than the Recommended Plan.	Temporary increase in air pollution is predicted.	Temporary increase in air pollution is predicted. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Air quality would not change.
NOISE	Construction noise levels would comply with local regulations. Construction noise is not anticipated to exceed 55 dBA at noise sensitive areas. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly less than the Recommended Plan.	Construction noise levels would comply with local regulations. Construction noise would not be anticipated to exceed 55 dBA at noise sensitive areas.	Construction noise levels would comply with local regulations. Construction noise would not be anticipated to exceed 55 dBA at noise sensitive areas. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Noise levels would not change.
AESTHETICS	Beach placement would temporarily impact aesthetics. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly less than the Recommended Plan.	Beach placement would temporarily impact aesthetics.	Beach placement would temporarily impact aesthetics. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Continued beach erosion may adversely affect aesthetics.
RECREATION	Beach placement would temporarily impact recreation. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly less than the Recommended Plan.	Beach placement would temporarily impact recreation.	Beach placement would temporarily impact recreation. Minor magnitude and duration changes with each berm width alternative. Effects would be slightly greater than the Recommended Plan.	Beach erosion would result in less recreational area.

ALTERNATIVE ENVIRONMENTAL FACTOR	10 to 20-foot Berm (smaller footprint than Recommended Plan)	30-foot Berm (Recommended Plan)	30 to 100-foot Berm (greater footprint than Recommended Plan)	FWOP (No Action Plan)
CULTURAL RESOURCES	Dredging would not adversely affect cultural resources with protective buffers in place. Beach placement would have no effect.	Dredging would not adversely affect cultural resources with protective buffers in place. Beach placement would have no effect.	Dredging would not adversely affect cultural resources with protective buffers in place. Beach placement would have no effect.	No effect.
NATIVE AMERICANS	Consultation with Federally recognized tribes is ongoing. No effect is anticipated.	Consultation with Federally recognized tribes is ongoing. No effect is anticipated.	Consultation with Federally recognized tribes is ongoing. No effect is anticipated.	No effect.

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CHAPTER 4

RECOMMENDED PLAN

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4 RECOMMENDED PLAN

The Recommended Plan for the Jupiter Carlin Segment of the Palm Beach County, Florida SPP was formulated based on analysis and modeling efforts documented in the 1994 GDM Addendum. Updated modeling and economic analysis have confirmed that an optimization of size and timing of the authorized Project remains economically justified. A detailed description of the optimized plan is presented in the following chapters. The economic results presented reflect the costs from the Total Project Cost Summary (TPCS) found in Appendix B. Therefore, the costs presented in this chapter are updated from rough order magnitude (ROM) costs and may differ slightly from the values presented in previous chapters of this report.

4.1 BENEFITS OF THE RECOMMENDED PLAN

4.1.1 STORM DAMAGE REDUCTION BENEFITS

The USACE participates in CSRM projects formulated exclusively for storm damage reduction, with economic benefits equal to or exceeding the costs, based solely on damage reduction benefits or a combination of damage reduction benefits and recreation benefits.

Palm Beach County is highly susceptible to coastal storms which increases the risk of storm damages. This is particularly true for the large and high-value commercial structures more pronounced in the central section of the Project area. Beach-*fx* modeling has demonstrated that, in the absence of a Federal project, significant economic damage from coastal forces can be expected to occur over the 26 years of remaining Federal participation.

The Recommended Plan is effective at reducing damages over time, requiring four periodic nourishment events throughout the 26 remaining years of Federal participation. Based on the Beach-*fx* analysis, it is estimated that the Recommended Plan prevents about 70% of the FWOP damages. Primary storm damage reduction benefits are summarized in Table 20.

Table 20: Primary Storm Damage Reduction Benefits of the Recommended Plan in average annual terms. (Note: Storm damage are the combination of structure and content damages reduced and armor costs prevented.)

AAEQ Damages FWOP	$1,484,133
AAEQ Damages FWP	$443,463
AAEQ Primary Storm Damage Reduction Benefits (damages reduced)	$1,040,670

4.1.2 LAND LOSS BENEFITS

In outlining the process and procedures to be used in the evaluation of CSRM projects, ER-1105-2-100 allows for the inclusion of land loss due to erosion to be included in the damages, stating that such damages should be computed as the market value of the average annual area expected to be lost. Prevention of land loss is a component of storm damage reduction benefits, but is not computed within the Beach-*fx* model. Thus, calculation of land loss benefits must be completed external to the model and

added to the structure and contents damage benefits to obtain the total storm damage reduction benefits of the project.

There are two key pieces of information needed to calculate land loss benefits of a storm damage reduction project: (1) the square footage of the land lost each year and (2) the market value of land in the project footprint. Appendix C provides detail on how the square footage of land loss each year was calculated. As the second component of the land loss benefits calculation, nearshore land values are used to estimate the value of land lost. As discussed in the Real Estate Appendix, a nearshore land value of $14.00 per square foot is assumed for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project.

Using the analysis technique described, the total value of land loss benefits over the 26 years of remaining Federal participation, is estimated at $192,011 in average annual equivalent terms.

Typically, in CSRM studies, prevention of land loss is also part of the primary project benefits. These benefits arise from preventing permanent loss of the upland (areas landward of the existing dune). Upland has economic value, as it is the location of current and future development (residential, commercial, etc.). Beach-*fx* estimates net shoreline changes over time, including changes to the upland width. However, as noted in Chapter 2, many lots are defined as currently armored or armorable in have the potential to be armored in the future. The armor prevents erosion damage to the upland in both the FWOP and FWP conditions. Therefore, land loss benefits do not apply to some of the lots. For the remaining lots, land loss benefits have been computed. The land loss benefits of the Recommended Plan are summarized below in Table 21.

Table 21: Land loss Benefits of the Recommended Plan.

AAEQ Value of Land Lost FWOP	**$290,900**
AAEQ Value of Land Lost FWP	**$98,900**
AAEQ Benefits (damages reduced)	**$192,000**

4.1.3 RECREATION BENEFITS

Under current policy, recreation must be incidental in the formulation process and may not be more than fifty percent of the total benefits required for justification. If the criterion for participation is met, then all recreation benefits may be included in the benefit-to-cost analysis. The participation criterion is met for Jupiter Carlin and all recreation benefits are included.

Benefits arising from recreation opportunities created by a project are measured in terms of willingness to pay. Three acceptable calculation methods are outlined: (a) the travel cost method (TCM), (b) the contingent valuation method (CVM), and (c) the unit day value method (UDV).

The unit day value (UDV) method estimates a user's willingness to pay for a given recreational opportunity by assigning ratings to five criteria designed to measure the quality of the overall recreation experience provided by the project area. According to ER-1105-2-100 Appendix E, UDV may be used to account for visitations of up to 750,000 per year. Historic data provided by Palm Beach County lifeguard counts indicates that visitations to the public parks at the northern and southern extents of the Project area

exceeded 700,000 in 2016 (706,860 visitors reported). The average growth rate between 2010 and 2016 was 2.03% annually, leading to an estimated 750,793 visitations by 2019 (the Project base year). Due to the efficiency of the UDV method, the method was selected and visitations were capped at 750,000 throughout the period of the analysis.

Using the methods described above and applying the visitation cap of 750,000 visitors per year results in estimated average annual recreation benefits of approximately $1,864,000. More information about the recreation benefits analysis is provided in the Economics Appendix.

The total Benefit-to-Cost Ratio (BCR) including primary storm damage reduction benefits, land loss benefits, and incidental recreation benefits for the Recommended Plan is equal to 1.49 (See Table 22).

Table 22: Economic Summary of the Recommended Plan with Refined Costs. (AAEQ Terms in FY18 Price Levels)

Economic Summary	Primary Storm Damage Reduction Benefits	Primary Storm Damage Reduction + Incidental Recreation Benefits
Price Level	FY18	FY18
FY18 Water Resources Discount Rate	2.75%	2.75%
AAEQ Damage Reduction Benefits	$1,041,000	$1,041,000
AAEQ Land Loss Benefits	$192,000	$192,000
AAEQ Recreation Benefits	$0	$1,864,000
AAEQ Total Benefits	$1,233,000	$3,097,000
AAEQ Costs	$2,082,000	$2,082,000
AAEQ Net Benefits	**($846,000)**	**$1,014,000**
Benefit to Cost Ratio (BCR)	**0.59**	**1.49**

Note: Refined costs include current placement cost estimates; Pre-construction, Engineering, and Design (PED); construction management; lands and damages, OMRR&R and updated cost contingency. Baseline SLC scenario.

4.2 COSTS OF RECOMMENDED PLAN

The Project certified first costs, including a 25% overall contingency, in FY18 price levels is $47,551,000. The Project yields $1.49 in benefits for every $1.00 spent (i.e. BCR is 1.49). The plan is efficient, acceptable and complete. It is resilient in the face of SLC. Though the Recommended Plan is relatively small in scope and scale, it represents the most prudent investment of Federal and sponsor dollars. The economic summary is shown in Table 23. The Cost Appendix (Appendix B) provides additional detail.

Table 23: Recommended Plan Total Refined Project Certified First Costs (FY18 price levels).

Construction Cost (mobilization and placements)		**$33,326,000**
Lands and Damages		$122,000
Preconstruction, Engineering, and Design (PED)		$3,768,000
Construction Management		$825,000
	Subtotal	**$38,041,000**
Contingency (25%)		$9,510,000
	Total Project Cost	**$47,551,000**

Note: The above costs reflect remaining Project costs, they do not include costs associated with past nourishment events or study costs to-date.

4.3 PROJECT DESIGN

The Recommended Plan has a design berm consistent with the authorized Project, which equates to a 0-foot extension of the 1990 MHW shoreline, a 30-foot optimized sacrificial berm, a six year average periodic nourishment interval, and an average period nourishment volume of 193,300 cy. The period of Federal participation concludes in 2045, 50 years from the date of initial construction. The total estimated volume of material required until 2045 is 804,000 cy.

For planning and cost-estimating purposes, it is assumed that the periodic nourishment events would occur in 2020, 2026, 2032, and 2038. Any deficits of material from the authorized design berm will be restored by the non-Federal Sponsor prior to the initial event (i.e., it is assumed that the authorized design berm will be in place prior to the initial event, therefore the planned nourishment volume is slightly smaller at 191,900 cy, than the average periodic nourishment volume). Additionally, the volume for the final periodic nourishment in 2038 includes an additional 32,200 cy, for a total of 225,500 cy, to provide storm damage protection benefits for the Project until 2045.

The initial nourishment volume is estimated to be approximately 191,900 cy and carried out with material from an offshore source. For planning and cost-estimating purposes, the three subsequent nourishment events are planned to be carried out using the offshore sand source through the remaining 26 years of Federal participation. However, should the offshore sand source be unavailable for these events, there are four upland sand mines that have been evaluated for geotechnical suitability, proximity, and availability for future nourishments. Environmental analysis of impacts from use of these upland sand mines is also covered in this document.

A description of the Recommended Plan is shown in Table 24**.**

Table 24: Recommended Plan Description.

Recommended Plan Description	The Recommended Plan includes:
Average # Nourishment Events	4 nourishment events
Average Volume of Each Periodic Nourishment	First nourishment: 191,900 cubic yards Second nourishment: 193,300 cubic yards Third nourishment: 193,300 cubic yards Fourth nourishment: 225,500 cubic yards
Average Periodic Nourishment Interval	approximately every 6 years
Nourishment Construction Duration	approximately 3 months
Recommended Plan Total Project Cost (including 25% contingency)	$47,551,000(FY18 Price Level*)
Cost sharing	63% Federal / 37% non-Federal
Benefit-to-Cost Ratio (BCR)	1.49 @ 2.75% discount rate (FY18)

4.3.1 PROJECT BERM

The design berm for the project area is +7.5 ft-NAVD88, which is approximately the natural berm elevation. Restricting the design berm elevation to the natural berm elevation minimizes scarping of the beach, which hinders beach access by nesting sea turtles and can pose safety problems for recreational beach use. Other reasons for following the natural berm elevation are related to storm damage reduction. A berm constructed at a lower elevation would increase the probability of overtopping by storm surge, thereby offering less protection to upland development and/or existing dunes.

According to the modeling and economic analyses as described in the 1987 GDM and 1994 GDM Addendum, the authorized Project consisted of a 0-foot extension of the 1990 MHW line with additional sacrificial material, known as “sacrificial fill,” to offset erosive losses over between a seven-year planned nourishment interval.

Due to the layout of the shoreline and dune system, relative to the 1990 MHW line, the 30-foot sacrificial fill berm extension of the Recommended Plan ranges from 50 feet (R-17) to 210 feet (R-13). The variable berm widths of the Recommended Plan are shown under the green column in Table 25, entitled 30’. The originally authorized and constructed Project variable berm widths are shown under the orange column, entitled 100’.

Table 25: Nourishment Template Variable Berm Widths.

Reach	Berm Width (feet) Relative to 2018 Projected Toe of Dune													
	Initial	Auth.Design	Total Nourishment Template											
	(2018)	(1990 MHW)	10'	20'	30'	40'	50'	60'	70'	80'	90'	100'	110'	120'
JC13	105	200	210	220	230	240	250	260	270	280	290	300	310	320
JC14	0	160	170	180	190	200	210	220	230	240	250	260	270	280
JC15	0	80	90	100	110	120	130	140	150	160	170	180	190	200
JC16	0	60	70	80	90	100	110	120	130	140	150	160	170	180
JC17	0	40	50	60	70	80	90	100	110	120	130	140	150	160
JC18	0	60	70	80	90	100	110	120	130	140	150	160	170	180
JC19	20	60	70	80	90	100	110	120	130	140	150	160	170	180

4.3.2 PROJECT BEACH SLOPES

After waves adjust and sort the placed sand, the sand is expected to settle into an equilibrium beach slope, similar to the native beach. For Jupiter-Carlin, the native beach slope is estimated as 1 (vertical) on 10 (horizontal) above MLW and 1 on 25 below MLW. The construction slope is assumed to be 1 on 10. Since sand from the sand source was determined to be a near match to the gradation of the existing beach, it is expected that the placed sand will equilibrate to a shape similar to the existing profile.

It is unnecessary and impractical to artificially grade beach slopes below the low water elevation since they will be shaped by wave action. For this reason, the front slope of the sand placed at the time of construction may differ from that of the natural profile. The final slope of the placed sand depends on the characteristics of the sand and the wave climate in the Project area. With steep initial slopes, the sand will quickly adjust to the natural slopes.

4.3.3 PROJECT VOLUMES

The average initial nourishment volume over 100 Beach-*fx* iterations is 191,900 cy. The average volume of individual future nourishment events over 100 iterations is approximately 193,300 cy. These are average volumes based on Beach-*fx* modeling. Appendix A includes a detailed description on how these averages are reached and the variability that can be expected.

4.3.4 PROJECT CONSTRUCTION

The Recommended Plan is a 0-foot extension of the 1990 MHW shoreline with 30-feet of advanced fill and a six year average periodic nourishment interval. The initial fill volume is estimated at 191,900 cy to be carried out with material from Jupiter Carlin A, an offshore sand source located approximately two miles northeast. The USACE will cost-share in construction of remaining nourishments, as discussed further in Chapter 4.6.

As previously discussed, the front slope of the beach-fill placed at the time of construction, or future periodic nourishment, may differ from that of the natural profile. This reflects the capabilities of the construction equipment that will be used to build the Jupiter Carlin Segment of the Shore Protection Project. Within the first year or two after placement of the beach-fill, the construction profile will be reshaped by waves into an equilibrium profile, causing the berm to retreat to a position more characteristic of the Project design template.

4.3.5 PERIODIC NOURISHMENT EVENTS

Periodic nourishment events take place based on both an economically optimized periodic nourishment interval and the physical performance of the Project. Typically, Project performance has been determined by assessing the condition of the design template. When the design template is breached, the Project is no longer providing the required level of protection, and may be considered for periodic nourishment. Additionally, if the total volume required to restore the receded profiles exceeds the set threshold volume, then a periodic nourishment event may be considered. The decision to nourish may then be made based on traditional concerns, including the budget cycle and available funding.

The average volume of individual future nourishment events over 100 Beach-*fx* iterations is 193,300 cy. With an average time interval of six years, the projected nourishment years would be 2020, 2026, 2032, and 2038. An additional 32,200 cubic yards of sand will be placed for the 2038 event to carry the Project throughout its period of Federal participation. It would be uneconomical to plan for a periodic nourishment event to occur in 2044 with only one year left in the period of Federal participation. Appendix A provides additional detail on periodic nourishment triggers.

Pre-construction monitoring efforts may include bathymetric mapping of the offshore sand source, which will be done as part of the construction engineering and design prior to each nourishment. Measured wind, wave, and water level information will be obtained from the best available existing data sources. This data will be applied in support of previously discussed monitoring efforts. It may also be used to periodically assess the state of SLC and to determine if reassessment of the Project volumes and/or periodic nourishment intervals, based on an intermediate or high SLC scenario, is required.

4.3.6 SEA LEVEL CHANGE CONSIDERATIONS

General

Sea level change is a growing concern in coastal regions of the United States. It is therefore necessary to ensure that coastal projects are adaptable to changing conditions. Constructing or elevating shoreline structures (e.g., seawalls, revetments, groins, etc.), raising dunes, flood proofing infrastructure, and implementing storm warning and evacuation plans are some types of coastal adaptation methods.

Dune Raising

For the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project, the most efficient and (currently) environmentally acceptable means of adapting the Project is to raise the crest elevation of the existing dune. The active portion of the shoreline profile, the berm and foreshore, will adjust naturally with rising tide levels. The dune, however, will require additional material to raise its elevation.

Based on the high sea level change curve, a 50-year storm surge will begin to exceed the Jupiter Carlin's lowest dune crest elevation near the year 2080 (approximately 35 years beyond the 50-year planning horizon). By the end of the 100-year planning horizon, the high sea level curve predicts that existing dune crest will be overtopped by approximately 3.3 feet. Within the 100-year planning horizon, a 100-year storm surge might be considered. The 100-year surge, +9.7 ft-NAVD88 would exceed the existing dune crest by 2.5 feet by the end of 100-year planning horizon.

While the existing dune elevation is adequate to prevent overtopping from a 50-year storm surge through the 50-year planning horizon, to adapt the Project to resist overtopping from the same surge through the 100-year planning horizon, it would be necessary to raise the crest to a minimum elevation of 12.6 ft-

NAVD88 (Figure 23). To resist overtopping from the 100-year surge, the crest would need to be raised to a minimum of 14.0 ft-NAVD88. Due to construction tolerances these elevations would be rounded up to the nearest half of a foot or 13.0 ft-NAVD88 and 14.0 ft-NAVD88, respectively.

Although dune raising is outside of the current Project authority, with an approved decision document this adaption is physically feasible within the planning period and may be assessed in the future if SLC approaches the critical elevation threshold of 3.2 feet. Dune raising extends the dune's footprint seaward, rather than landward, ensuring that there is sufficient land/real estate to make the adaptation without interfering with upland infrastructure. Based on design profiles, it is estimated that raising the dune to 13.0 feet would require approximately 40,700 additional cubic yards of material. Raising the dune to 14.0 feet would require approximately 73,200 additional cubic yards. While dunes of this elevation occur throughout the coastal regions of eastern Florida, dune elevations directly adjacent to the Project have elevations nearer to the existing dunes. Therefore, while raising the dune over the length of the Project would provide increased protection from wave and erosion damage, infrastructure behind the dunes would still be vulnerable to indirect flooding from adjacent areas.

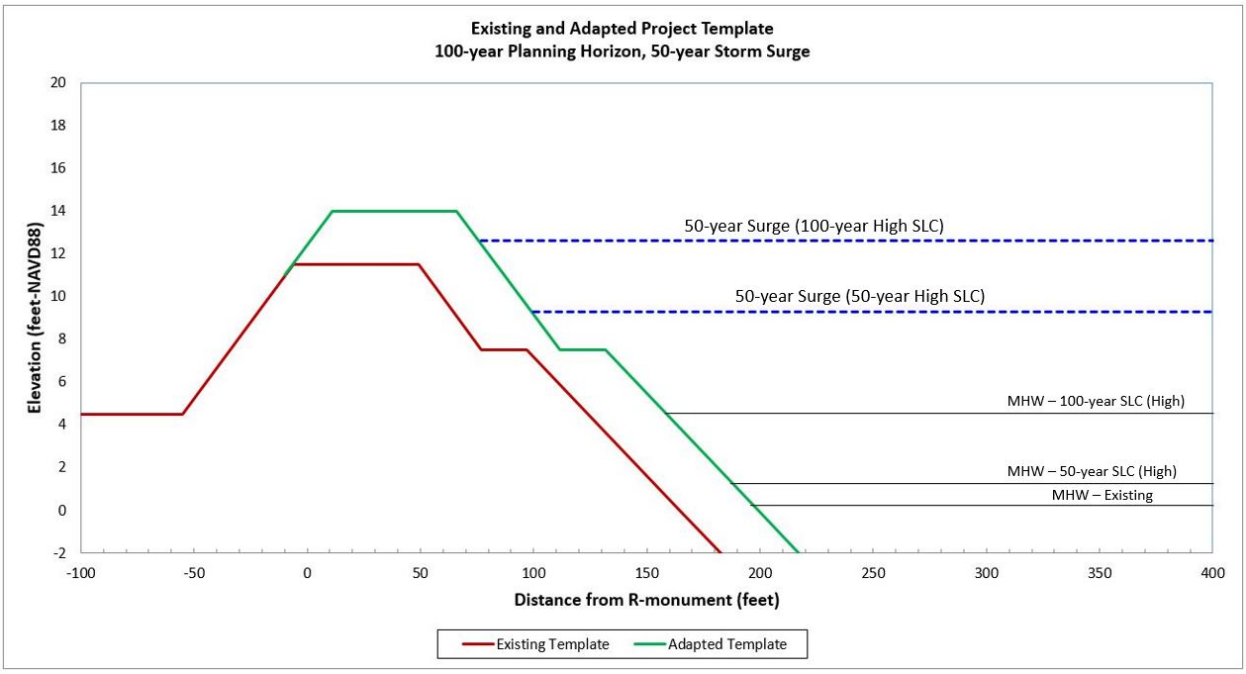

Figure 23: Existing and Adapted Project Profile.

Hard Structures

Presently there are few seawalls and revetments in or near the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project. Structures are not preferred as they can lead to increased erosion of the berm and foreshore due to wave reflection and have an adverse impact to sea turtle and shore bird habitat. However, if sea level change follows the high sea level curve, environmental and aesthetic concerns may become secondary to the protection of upland infrastructure and the increased risk to human life.

If hard structures become favorable in the future, it is feasible that previously screened out alternatives would become viable and possibly cost effective.

An important question about the Recommended Plan is its performance under different Sea Level Change (SLC) scenarios. As discussed earlier in this report, the study area is experiencing SLC. Each of the SLC scenarios described earlier are considered equally likely to occur. Therefore, if the Project does not perform, then it cannot be considered a completely effective plan. Table 26 shows the performance of the Recommended Plan under the three SLC scenarios.

As shown in Table 26, though the average benefits of the Project increase in the SLC scenarios, the average costs also increase. The costs increase because periodic nourishment is triggered more frequently. Thus, the Project performance (in terms of the benefit-to-cost ratio) is relatively constant throughout the SLC scenarios.

Table 26: Project Performance of the Recommended Plan in the Baseline, Intermediate, and High SLC Scenarios. (AAEQ Terms at FY17 Price Levels)

	SLC1 (Baseline)	SLC2 (Intermediate)	SLC3 (High)
AAEQ FWOP Damages*	$1,434,985	$2,127,055	$2,212,301
AAEQ FWP Damages	$429,800	$429,442	$419,024
AAEQ Primary Storm Damage Reduction Benefits	$1,005,186	$1,697,613	$1,793,276
AAEQ Cost**	$1,366,755	$1,644,764	$2,051,797
AAEQ Net Benefits	**($361,569)**	**$52,849**	**($258,521)**
BCR	**0.74**	**1.03**	**0.87**

*Includes structure and content damages from Beach-fx. Land loss damages not included.
**Screening level costs, not fully refined.

4.4 RECOMMENDED PLAN SAND SOURCE

The Recommended Plan will require approximately 804,000 cy of sand over a 26 year period of analysis. The offshore sand source, Jupiter Carlin A, is the source of material for the four nourishment events. Jupiter Carlin A lies in water depths of approximately 60 to 70 feet, centered about two miles offshore, between the northern Palm Beach county line south to R-10. Irregular in shape, the sand source encompasses approximately 700 acres. Based on historic data, the thickness of potential beach-compatible material ranges from 4 to 20 feet, with an average thickness of more than 10 feet. There is an estimated available volume quantity of approximately 5 million cubic yards, which is more than adequate for the anticipated volume needed through the period of Federal participation ending in 2045.

It is more cost-effective to proceed with material from Jupiter Carlin A, however sand mines were evaluated for suitability for this analysis. Truck haul cost estimates for each nourishment event were approximately $5 million more per each nourishment event, as opposed to Jupiter Carlin A.

Alternatively to Jupiter Carlin A, four commercial sand venders were identified based on their proximity to Palm Beach County, their ability to meet the sand quality criteria, and their ability to meet the anticipated quantity and production requirements for the Project. Sand from all four mines is natural, not manufactured, and would require processing to meet the Project's sand specifications. All four mines have an available volume of suitable sand that far exceeds the required volume for the Project's needs.

Additional details on the sand sources may be found in Chapters 2 and 5, and Appendix D.

4.5 OPERATIONS & MAINTENANCE CONSIDERATIONS

The operations, maintenance, repair, rehabilitation, and replacement (OMRR&R) anticipated for this Project may include topographic and bathymetric surveys of the placement area and adjacent areas, aerial photography, and a monitoring report on an annual basis for 3 years following construction and then biannually until the next construction event. This physical monitoring of the Project is necessary to assess Project performance and to ensure that Project functionality is maintained throughout the Project life. Profile surveys should provide accurate assessments of dune and beach fill volumes and a basis for assessing post-construction dune and beach fill adjustments, as well as variation in the profile shape due to seasonal changes and storms. This physical monitoring will play a vital role in determining if periodic nourishment is necessary.

Other OMRR&R items, per Policy Guidance Letter No. 27 (11/17/92), may include scarp repair and beach tilling, as needed, between nourishment activities. The operations and maintenance will also include some of the items of local cooperation. These items entail performing surveillance of the beach and any specific directions prescribed by the government. The terms of the OMRR&R responsibilities will be detailed in the new Project Partnership Agreement.

4.6 RECOMMENDED PLAN COST SHARING

Federal participation in shore protection projects is limited to shorelines open to public use. For the present study, a cost share recalculation was completed using Section 103(d) of WRDA 1986 guidelines: costs assigned to developed lands (publicly or privately owned) are cost shared up to 65% Federal and 35% non-Federal. Undeveloped public lands are cost shared up to 65% Federal and 35% non-Federal. Lands with exclusively private benefits and lands with insufficient parking and/or public access are 100% non-Federal cost. Shorelines owned by the Federal government are 100% Federal cost. Note, for the purposes of this report, "developed" indicates the presence of buildings and/or other infrastructure such as street ends or other transportation facilities. If lands are not within ¼ mile of public access and either public parking or a bus stop, then the associated costs will be 100% non-Federal. Guidance is provided in ER 1105-2-100 wherein user fees, parking, access, beach use by private organizations, and public shores with limitations are addressed (E-24.d). The WRDA of 1999 changed the cost sharing policy previously provided by WRDA 1986 by setting a maximum Federal share of periodic nourishment carried out after 1 January 2003 to 50% for projects authorized for construction after 31 December 1999. However, because construction of the Palm Beach County, Florida, Shore Protection Project was authorized by Section 101 of the Rivers and Harbors Act (Public Law 87-874) on October 23, 1962, that policy does not apply to this project.

Cost sharing in construction for future nourishments of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project is estimated to be 63.0% Federal / 37.0% non-Federal. This cost-sharing breakdown may be adjusted based on conditions of shore ownership and use at the time of construction. The only exception to this cost-sharing percentage occurs during the first nourishment event of the period of Federal participation extension. For this initial event, the non-Federal sponsor must ensure that the entire authorized design berm, based on the 1990 MHW line, is reflected in the shoreline condition prior to any Federal participation in the Project, per the March 1995 PCA requirements. The PCA states that,

> *the Non-Federal Sponsor shall operate, maintain, repair, replace, and rehabilitate the entire Project or the functional portion of the Project, at no cost to the Government, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal and State laws…Such operation, maintenance, repair, replacement and rehabilitation shall include, but is not limited to, beach berm reshaping; maintenance of storm drainage outfalls; and periodic nourishment for the economic life of the Project.*

Therefore, the Non-Federal Sponsor is financially responsible for the initial construction event recommended in this Integrated Section 934 Report and Environmental Assessment for the entire authorized design berm, based on the 1990 MHW line.

The current cost share estimates are based on policy guidance provided by ER 1105-2-100 Appendix E and ER 1165-2-130. Table 27 shows the Federal and non-Federal cost sharing for the Recommended Plan. The total shoreline length of the Project area, based on shorefront length information provided by the Palm Beach County Property Appraiser's office (verified using Google Earth), is estimated to be about 5,600 feet (or approximately 1.1 miles) long. Changes to shoreline ownership and use prior to construction could change the stated cost sharing percentages. Additional details on the cost-sharing for this Project may be found in Appendix F on Public Access and Cost Sharing.

Table 27: Recommended Plan cost sharing.

Corresponds Roughly to FDEP R-monument	Property Description	Shoreline Length (feet)	Lot Description	Ownership	Within 1/4 mile of Public Access	Shoreline Ownership & Purpose*	Level of Federal Participation** (%)	Federal Participation x Shoreline Length (Feet)
R-13 to R-14.5	Jupiter Beach Park (Palm Beach County)	1,470	Developed	Public	Y	IIA	65%	956
R-14.5 to R-16.5	Ocean Trail Unit Owners Assn Inc.	1,370	Developed	Private	Y	IIA	65%	891
R-16.5 to R-17	Jupiter Beach Resort Condo	170	Developed	Private	N	III	0%	0
	Jupiter Beach Resort Condo	220	Developed	Private	Y	IIA	65%	143
R-17 to R-18	Carlin Park (Palm Beach County)	1,025	Undeveloped	Public	Y	IIA	65%	666
R-18 to R-19	Town of Jupiter	1,345	Developed	Public	Y	IIA	65%	874
Total Project Length (feet)		5,600	Total Federal Participation Length (feet)					3,530

Total Project Length (miles)	1.1	Total Federal Participation Length %	63%

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CHAPTER 5

EFFECTS OF THE RECOMMENDED PLAN

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5 EFFECTS OF THE RECOMMENDED PLAN*

This chapter is the scientific and analytic evaluation of effects that would result from implementing the Recommended Plan. Chapter 2 includes the effects resulting from the No Action Alternative, or the FWOP Condition. Table 29 provides a summary of direct and indirect effects of the final array of alternatives. This chapter focuses on anticipated changes to the existing environment including direct, indirect, and cumulative effects as a result of the Recommended Plan, or the FWP Conditions.

5.1 GENERAL ENVIRONMENTAL SETTING

FUTURE WITH-PROJECT CONDITIONS

The FWP design is consistent with the authorized Project template. The proposed design includes no expansion or increase in volume that would affect hardbottom outside of the approved Project's equilibrium toe of fill. Patches of hardbottom lie offshore in the shallow intertidal zone. The placement of fill material within the design template may affect these hardbottom areas. However, the proposed beach fill template for the design and advance nourishment placement is smaller than the authorized Project. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the Project should have no additional effect on hardbottom resources lying within the equilibrium toe of fill. Previous projects have provided mitigation for all such affected resources.

The beneficial effects of continued sand nourishment along the proposed Project area include maintaining a buffer beach to protect upland infrastructure and populations against storms and flooding. Sand nourishment also creates additional habitat for beach flora and fauna as well as more space for recreational activities. Additionally, beach quality sand from permitted upland sand sources may be utilized for this Project which would further reduce potential impacts to marine environments.

The Project would likely produce more favorable environmental conditions than exist at present, although construction operations would produce some temporary adverse effects. These effects would be primarily temporary in nature, and most affected resources would return to pre-construction conditions either immediately after dredging (with respect to resources such as aesthetics and noise) or within one or two years (with respect to sea turtle nesting and benthic resources).

5.2 DUNE & BEACH

FUTURE WITH-PROJECT CONDITIONS

The Project will temporarily stabilize the beach and dune vegetative communities and prevent further erosion-related losses. The beach fill will furnish additional material to existing dune vegetation so the plants can collect and bind wind-blown and storm-driven sand into dune formations.

Previous nourishment projects included a vegetation protection plan with specific measures to ensure that unacceptable impacts to the existing vegetation communities would not occur. Specific measures included no placement of fill landward of the existing line of woody or scrub vegetation (e.g., sea grapes). The precise landward limit of the fill depends upon the dune conditions at the time of construction. If needed, the plant community could be reestablished by planting a mix of native dune species that, depending on nursery availability, may include sea oats (*Uniola paniculata*), beach sunflower (*Helianthus debilis*), and railroad vine (*Ipomoea pes-caprae*).

5.3 NEARSHORE HABITAT

FUTURE WITH-PROJECT CONDITIONS

UNCONSOLIDATED SUBSTRATE

Placement of sand on the beach will result in some change to the existing sand grain size distribution. However, the Project area has been nourished twice (in 1995 and 2002) as part of the Federal Project and several other times. Slight differences in grain size distribution between the native sand and the placed sand were considered acceptable.

HARDBOTTOM HABITAT

The proposed Project does not anticipate any additional impact to hardbottom habitat. The Project template is smaller than the authorized Project's construction template and although impacts to hardbottom from burial during placement of sand and subsequent equilibration of the beach may occur, Palm Beach County has mitigated for the impacts to worm reef and other hardbottom habitats of the initial 1995 Project (Continental Shelf Associates, 2006). The 2002 nourishment did not impact hardbottom beyond the originally projected impact area.

WORM REEF

The proposed Project does not anticipate any additional impact to worm reef or hardbottom habitats and although impacts to worm reef from burial during placement of sand and subsequent equilibration of the beach Project area may occur, the Project template and corresponding equilibrium toe of fill has not changed from the authorized Project. Palm Beach County has mitigated for the impacts to worm reef and other hardbottom habitats of the initial (1995) Project (Continental Shelf Associates, 2006). The 2002 nourishment did not impact hardbottom beyond the originally projected impact area.

5.4 MITIGATION

FUTURE WITH-PROJECT CONDITIONS

The FWP design is smaller than the authorized Project template. The design template remains identical to that in the authorized Project with less advanced fill included in the recommended plan, therefore a smaller overall footprint. The Recommended Plan includes no expansion or increase in volume that would impact hardbottom resources outside of the authorized Project's equilibrium toe of fill. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the present Project should have no additional impact on hardbottom resources lying within the equilibrium toe of fill. Previous projects have provided mitigation for all such affected resources. Additional information on constructed mitigation reefs can be found in Chapter 2.2.3.

Jacksonville District's Regulatory Division (RD) issued a permit for Palm Beach County's 1995 Project (federally cost-shared reimbursable event), and subsequent beach nourishment projects, as well as mitigation reefs. RD determined that the mitigation reefs are compliant with the permit. This information and the results of more recent monitoring are included in Appendix H.

5.5 FISH & WILDLIFE RESOURCES (OTHER THAN THREATENED & ENDANGERED SPECIES)

FUTURE WITH-PROJECT CONDITIONS

The proposed Project would temporarily impact fish and wildlife species that use the Project area. Species with sufficient motility would avoid the Project area during construction and return after completion of construction activities. Dredging and beach placement of sand would disrupt organisms living in the dredged sediments and bury those organisms at the beach placement site before construction. Existing permitted sand mines, which may be used as a source of sand, support minimal fish and wildlife resources as the habitat at these locations has been previously removed. The use of these mines would have minimal or no impact to fish and wildlife resources.

Other potential negative impacts to fish and wildlife from beach restoration may include:

- Disruption of nesting, resting, or foraging birds by excessive vehicle noise or movement.
- Destruction of vegetation suitable for food, protective cover, or nesting sites.
- Degradation or destruction of habitat resulting from placement of unsuitable material or excessive turbidity.
- Death or injury of sea life due to contact, entanglement, or collision with the dredge draghead, equipment, and vessels.
- Destruction or degradation of habitat.

A list of possible methods to minimize environmental impacts to fish and wildlife includes:

- Educating the contractor and employees on possible environmental impacts and ways to minimize these impacts.
- Ensuring construction methods and materials provide the least impact.
- Observing the effects of construction via turbidity monitoring and turbidity control measures.

Dredging and beach placement would result in significant mortality of non-motile benthic organisms. However, these organisms typically adapt well to the dynamic coastal environment. With their high fecundity and recruitment potential, they should repopulate the affected areas in a relatively short period of time.

A review of the readily available literature concerning the potential effects of beach nourishment on benthos and benthic habitats identified a number of reports detailing effects of beach placement and dredging on benthic communities. Key findings included

- The recovery rate of benthic invertebrate community depends on the season in which the fill activities occur and to the grain size of the nourished sediments
- The majority of the articles suggested that nourishing a beach in winter has less of an impact on the benthic habitat than nourishing in other seasons. The articles also suggest that selecting sediments for a nourishment project that match the receiving beach's native sand should lessen the impacts to benthic habitat (e.g., Atlantic States Fisheries Commission, 2002; Ray and Burlas, 2003).

- Research suggested that benthic habitat within nourished areas typically recover in one to two seasons (e.g. Saloman and Naughton, 1984; Ray et al., 2003).

5.6 THREATENED & ENDANGERED SPECIES

FUTURE WITH-PROJECT CONDITIONS

The USACE has determined that the FWP conditions may affect both nesting sea turtles and, if a hopper dredge is used, sea turtles in the water. Also, the plan may affect, but is not likely to adversely affect, loggerhead sea turtle designated critical habitat, manatees, smalltooth sawfish, piping plover, rufa red knot, whales or beach jacquemontia. The terms and conditions of the 1997 NMFS South Atlantic Division Regional Biological Opinion (SARBO) and related coordination, which applies to sea turtles in the water, smalltooth sawfish, and whales; the 2015 USFWS Statewide Programmatic Biological Opinion (SPBO), which applies to nesting sea turtles, manatee, and beach jacquemontia; and the 2013 Programmatic Piping Plover Biological Opinion (P3BO) will be implemented for these species. Existing permitted sand mines, which may be used as a source of sand, do not support threatened and endangered species as the habitat at these locations has been previously removed. The use of these mines would have no effect on threatened and endangered species. The USACE has coordinated with the USFWS on the proposed work pursuant to the SPBO, P3BO, and on the rufa red knot. In accordance with the SARBO, no additional coordination with the NMFS is required. The USFWS concurred with the use of the SPBO and P3BO for the proposed work as well as the effects determination on the rufa red knot in a February 7, 2017 letter to the USACE. The SPBO, P3BO, and SARBO are available at the following link (under District Wide Environmental Documents):

http://www.saj.usace.army.mil/About/Divisions-Offices/Planning/Environmental-Branch/Environmental-Documents/

Additional information on threatened and endangered species coordination may be found in Appendix H.

5.6.1 SEA TURTLES

NESTING SEA TURTLES

The proposed Project will pump material through a pipeline from a dredge to the beach, where it will be graded to the design elevations. Onshore equipment employed for beach restoration generally consists of light vehicles, heavy earth moving equipment such as bulldozers, and dredge pipe.

Beach nourishment may affect the sea turtle incubation environment and nest success. Potential negative impacts to sea turtles include destruction of nests deposited within the Project area during construction, harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches, artificial lighting-induced disorientation of hatchlings as they emerge from the nest and crawl to the water, and behavior modification of nesting females caused by escarpment formation within the Project area. Escarpment formation during the nesting season can cause false crawls or selection of marginal or unsuitable nesting areas to deposit eggs. Additionally, the quality and color of the placed sand could affect nesting success as related to excavation, incubation environment, and hatchling emergence.

Although placement of sand on beaches may provide a greater quantity of nesting habitat, the habitat quality may prove less suitable than preexisting natural beaches. Constructed beaches tend to differ from

natural beaches in several important ways. They are typically wider, flatter, more compact, and contain moister sediments than those found on natural beaches (Nelson and Dickerson, 1988; Ackerman et al., 1992; Ernest and Martin, 1999). On severely eroded sections of beach, where little or no suitable nesting habitat previously existed, sand placement can result in increased nesting (Ernest and Martin, 1999). However, despite the greater quantity of available nesting habitat, nesting density and success often declines for the first year or two following construction (Trindell et al., 1998; Ernest and Martin, 1999; Herren, 1997).

Reduced nesting density and success on constructed beaches have been attributed to increased sand compaction, escarpment formation, and changes in beach profile (Nelson et al., 1987; Crain et al., 1995; Lutcavage et al., 1997; Steinitz et al., 1998; Ernest and Martin, 1999; Rumbold et al., 2001). Changes in beach profile (increased slope) can reduce nesting activity. Compaction can inhibit nest construction or increase the amount of time it takes to construct nests. Escarpments often cause female turtles to return to the ocean without nesting or to dig their nests seaward of the escarpment, where the nests are more susceptible to frequent and prolonged inundation and erosion. In short, sub-optimal nesting habitat may cause decreased nesting success, place an increased energy burden on nesting females, result in abnormal nest construction (Carthy, 1996), and reduce the survivorship of eggs and hatchlings. In addition, sand used in nourishing beaches may introduce lighter or darker sand that consequently affect nest temperatures (Ackerman 1997; Milton et al., 1997, Hayes et al., 2001).

Impacts of a nourishment project on sea turtle nesting habitat are typically short-term because natural processes will rework the beach in subsequent years. Beach compaction resulting from nourishment and the frequency of escarpment formation will decline over time (South Florida Multi-Species Recovery Plan (http://www.fws.gov/verobeach/index.cfm – Endangered Species Program). Ernest and Martin (1999) analyzing turtle nesting monitoring data for Martin County, Florida, found that reduction in marine turtle nest success fell the first year following construction compared to pre and post-construction year levels. The second nesting season after construction and thereafter, marine turtle reproductive success rebounded to pre-construction levels.

One needs to consider nesting success on Jupiter Carlin beach in the context of the turtle population nesting activity, weather, and human induced effects in addition to the impacts of beach nourishment. Examination of annual nesting reports between 2000 – 2010 (Palm Beach County ERM, 2000, 2001, 2002, 2003, 2004; EAI, 2007 and 2008; Loggerhead Marinelife Center, 2009 and 2010) indicate some similar findings to those reported by Ernest and Martin (1999) and Rumbold et al. (2001), who reported on the 1995 beach nourishment's effect on loggerhead nesting. Before the 2001 nesting season, sand trap and AIWW maintenance dredging material nourished part of the Project beach. The Palm Beach County reports indicate that while fill beach nesting was slightly lower than on the natural beach areas, the generally lower nesting on the beach nearest the jetty could have contributed to some of the changes. They also noted that hatching success of fill and non-fill beaches was very similar. The report concluded, "there was no evidence of JID or AIWW maintenance dredging impacts on sea turtles in the 2001 nesting season." Palm Beach County ERM (2002) concluded that while nesting on the "fill" (nourished) beach was lower than the natural beach "effects were less than expected and much less than those of the first [1995] nourishment project."

Palm Beach County ERM (2003) reported sharp declines in loggerhead nesting on the Project beach, but that occurred in the context of reduced nesting on most Florida beaches that year. The county also speculated that the nesting that year might have shifted from the "natural" to the nourished beach. In 2004, a very low nesting season, the filled beach produced twice the number of hatchlings as unfilled

portions. The county produced no reports for the 2005 and 2006 seasons. In 2007 (EAI, 2007) extensive erosion required construction of a limited dune restoration project that did not appear to have significantly impacted turtle nesting, although the survey season yielded insufficient data for detailed analysis. In 2008, Florida Inland Navigation District, as part of AIWW maintenance dredging, and the Jupiter Inlet District, as part of sand trap dredging, placed almost 200,000 cubic yards on Jupiter/Carlin Beach. Analysis of survey data (EAI, 2008) concluded that the data (nests per mile, nesting success, and hatchling emergent success) did not demonstrate any negative nourishment effects on sea turtle nesting. Based on reported nesting success, the Jupiter Inlet District sand trap dredging activity in winter 2009 did not negatively impact turtle nesting (Loggerhead Marinelife Center, 2009). The 2010 season nesting was slightly above the long-term average (Loggerhead Marinelife Center, 2010).

Beach nourishment will result in an increase in sea turtle nesting habitat; the new sand will be very similar to the pre-existing material; compaction and escarpment observation and remediation measures will ensure that the beach shape and sand density remain appropriate for nesting. In addition, the Project will reconstruct the sand dune in areas of reduced elevation due to erosion, and as necessary replant the dune with native vegetation.

The following measures shall be implemented to avoid and minimize impacts to nesting sea turtles:

- Constructing the Project outside of the primary sea turtle nesting season (May 1 through October 31).
- Educating the contractor and employees on possible environmental impacts and ways to minimize impacts to sea turtles.
- Incorporating sea turtle nest monitors to provide professional assistance.
- Relocating nests or sea turtles in immediate danger from construction activities.
- Stopping operation of beach equipment when sea turtles enter the immediate vicinity.
- Carefully selecting sand source to ensure the compatibility with the native beach sand.
- Requiring construction methods and materials have minimum impact (for example, limiting heavy machinery to defined areas).
- Compaction testing and, if necessary, tilling of the beach to achieve appropriate sand compaction for nesting turtles.

Daily monitoring must occur before initiation of sand placement if construction occurs during the nesting season. During preconstruction and construction monitoring periods, a certified and approved sea turtle monitor must relocate any nests within the Project area.

SEA TURTLES IN THE WATER

A hopper dredge may cause incidental takes of sea turtles, but the proper use of rigid sea turtle deflectors on dragheads can minimize the chance of incidental takes (Nelson and Schafer, 1996). All hopper dredging projects must employ the sea turtle deflecting draghead unless the NMFS grants a waiver.

The NMFS (1997a) mandates that year-round, 100% observer coverage is necessary for projects using a hopper dredge in southeast Florida. The Biological Opinion mandates 100% inflow screening and recommends 100% outflow screening when observers are required on hopper dredges. The dredger must maintain logs of any sea turtle injuries or deaths caused by hopper dredging activities. Other protective measures include the following:

- The contractor shall instruct all personnel associated with the Project of the potential presence of the species and need to avoid collisions with sea turtles. All construction personnel are responsible for observing water-related activities for the presence of sea turtles.
- The contractor shall advise all personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles, which are protected under the Endangered Species Act of 1973.
- Siltation barriers shall be made of material in which a sea turtle cannot become entangled, be properly secured, and be regularly monitored to avoid entrapment. Barriers may not block sea turtle entry or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.
- All vessels associated with the construction Project shall operate at "no wake/idle" speeds as all times while in the construction area and while in water depths where the draft of the vessels provides less than a four-foot clearance from the bottom. All vessels would preferentially follow deep-water routes (e.g., marked channels) whenever possible.
- If a sea turtle is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle. Operation of any mechanical construction equipment shall cease immediately if a sea turtle is seen within a 50-foot radius of the equipment. Activities may not resume until the protected species has departed the Project area on its own volition.
- Any collision with and/or injury to a sea turtle shall be reported immediately to the National Marine Fisheries Service Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

5.6.2 WEST INDIAN MANATEE

Manatees are not typically found in the Atlantic Ocean except in the extreme nearshore and very seldom during winter months, as manatees typically overwinter in warm water refuges during that period. During the winter of 2010, however, observers spotted relatively high numbers of manatees in the ocean along the coast. Such events, however unusual, suggest the need for caution and vigilance whenever working near the coastline as death or injury to manatees may result from contact, entanglement, or collision with the hopper dredge, construction vessels, and related equipment.

Protection measures to minimize environmental impacts to manatees include the following:

- All personnel associated with the Project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.
- All vessels associated with the construction Project shall operate at "Idle Speed/No Wake" at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

- Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

- All on-site Project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shut down if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the Project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.

- Any collision with or injury to a manatee shall be reported immediately to the FWC Hotline at 1-888-404-FWCC. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (904-731-3336) for north Florida or Vero Beach (1-772-562-3909) for south Florida.

- Temporary signs concerning manatees shall be posted prior to and during all in-water Project activities. All signs are to be removed by the permittee upon completion of the Project. Awareness signs that have already been approved for this use by the Florida Fish and Wildlife Conservation Commission (FWC) must be used (see MyFWC.com). One sign, which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 1/2" wide by 11" tall with rounded corners explaining the requirements for "Idle Speed/No Wake" and the shutdown of in-water operations must be posted in a location prominently visible to all personnel engaged in water-related activities. Additional sign information can be found at the following FWC website: http://myfwc.com/wildlifehabitats/managed/manatee/education-for-marinas/

5.6.3 SMALLTOOTH SAWFISH

Sawfish encounter a small risk of being entrained in the hopper dredge drag head as it extracts sand from the borrow area. To reduce the risk of impacts from dredging and vessel strikes, the Project would comply with the "Sea Turtle and Smalltooth Sawfish Construction Conditions" (NOAA Fisheries 2006). Mitigation measures would minimize entrainment risks. Measures would include the use of sea turtle deflecting drag head deflector, which would also help deflect smalltooth sawfish.

5.6.4 PIPING PLOVER & RUFA RED KNOT

Potential impacts to the piping plover and rufa red knot due to the proposed Project may include:

- Disruption of resting or foraging birds by excessive vehicle noise or movement
- Temporary degradation of feeding habitat in the intertidal zone

Per the USFWS letter dated February 7, 2017, the USACE agrees to implement to the maximum extent practicable the conservation measures listed within the PB3O for both the piping plover and the red knot. The USACE has also agreed to perform one preconstruction shorebird survey within a 10-day timeframe beginning the first Friday in February. If piping plovers are documented during the preconstruction survey, the Service will be contacted for potential implementation of additional conservation measures prior to construction commencement. In addition, a February winter shorebird survey will be conducted as outlined above, for 2 years post-construction. All shorebird survey data will be forwarded to the Service annually upon completion.

5.6.5 WHALES (NORTH ATLANTIC RIGHT WHALE)

The Project area does not include right whale critical habitat; therefore, the likelihood of an encounter between the dredge vessels and a whale is relatively unlikely.

An observer spotted and photographed a right whale offshore the Juno Beach Pier on January 1, 2010 (Palm Beach Post News) and a right whale also appeared several days later near the Juno Beach project pumpout location (USACE Turtle Data Warehouse, http://el.erdc.usace.army.mil/seaturtles/project.cfm?Id=639&Code=Project). Such visitations, though unusual, suggest that caution and constant vigilance are necessary to make sure that encounters do not occur.

Marine mammals are unlikely to incur injury from dredging as they can usually avoid contact with dredging vessels and equipment (Hammer et al., 2005). However, right whales are more susceptible to dredging-related injury because they rest on the water surface and often swim relatively slowly. In 1997, NMFS (1997b) issued regulations restricting vessel approaches to within 460 meters of any right whale.

Marine mammals may encounter increased turbidity in waters adjacent to dredging activity but could easily avoid these areas. Given the relatively small turbidity plume generated by dredging compared to the available habitat area, turbidity will not likely cause significant impacts to marine mammal behavior or survival (Hammer et al., 2005).

5.7 ESSENTIAL FISH HABITAT (EFH)

FUTURE WITH-PROJECT CONDITIONS

NEARSHORE/HARDBOTTOM RESOURCES

As previously stated, the Recommended Plan includes no expansion or increase in volume that would impact hardbottom resources outside of the authorized Project's equilibrium toe of fill. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the present Project should have no additional impact on hardbottom resources lying within the equilibrium toe of fill. Previous Projects have provided mitigation for all such affected resources.

Jacksonville District's Regulatory Division (RD) issued a permit for Palm Beach County's 1995 Project (federally cost-shared reimbursable event), and subsequent beach nourishment projects, as well as mitigation reefs. RD determined that previous Projects including mitigation reefs that were built to offset impacts to hardbottom resources are compliant with the permit (see Appendix H: Pertinent Correspondence).

All work conducted by the construction contractor within the offshore sand source, Jupiter Carlin A, as well as the pipeline used to convey sand to the beach placement area will include, but not necessarily be limited to, the following requirements:

- Prior to work, the Contractor shall submit a Hardground/Reef Protection Plan (Plan) that will be implemented for this Project. Acceptance by the Contracting Officer of the Protection Plan will not relieve the Contractor of responsibility of protection of the marine hardbottoms. The Contractor may be required to revise and resubmit plan. Lastly, the Plan shall list all the names, qualifications, and responsibilities of personnel involved with enforcing and conducting the Plan.

The Plan shall include but not be limited to the following:

a. Vessel, dredge, and equipment positioning systems that will be used to avoid identified hardbottom.

b. Include how position of all pipelines, anchors, moorings and other floating equipment will be documented and inventory will be maintained throughout the life of contract.

c. Include discussion how initial preparation of work crews and subcontractors will receive training on procedures to be used to avoid impacts to these areas.

d. Include how The Contractor will use scientific divers to survey the pipeline corridor areas and offshore work areas to locate and avoid hardground resources prior to pipeline and equipment placement.

e. The Plan shall indicate what remediation steps will be taken to avoid further impacts to hardgrounds if a pipeline leak is visually detected.

f. Methods on how the Contractor will mobilize and demobilize floating equipment through the ingress/egress corridor to Project area if applicable.

- The Contractor shall protect hardbottom (reefs) during all phases of the Project. The Contractor shall adhere to Dredge and Vessel exclusion zones and "no dredge areas" shown on the drawings. The Contractor shall not anchor, place spuds, lay pipeline or place any other object on the hardbottom. The Contractor shall train all subcontractors and work crews involved with dredging, pipeline installation, and equipment movements and storage on the procedures to be used to avoid impacts to offshore hardbottom communities. The training shall include methods or procedures to be used to avoid impacts and insure hardbottom protection.

- The Contractor shall not intentionally drag equipment along the nearshore sandy bottom during pumpout equipment relocation procedures. Furthermore, no cables, equipment or other objects shall sag or hang over the side of the dredge, any barges or tugs, or any other vessels, floating pipelines, pontoons or floating equipment. No floating equipment shall be allowed over the hardbottom (reef) systems, at any time. The Contractor shall directly push or tow with polypropylene (floating) lines all floating equipment that is not self-propelled, in the vicinity of hardbottom areas. These measures are required to avoid hardbottom damage from sagging cables or other objects.

- The Contractor shall use scientific divers to survey the pipeline corridor areas and offshore work areas to locate and avoid hardground resources prior to placement and anchoring of pipeline and equipment. These surveys shall include bounce dives on proposed pipeline placement routes and equipment anchoring and mooring locations to avoid damage to hardgrounds. If the Contractor elects to use side scan sonar or towed video transects for identification, scientific divers shall be used for bounce dives for verification of identified hardgrounds. Scientific divers shall also assist in the placement of any submerged pipelines to ensure that submerged pipelines are not placed over any significant hardbottom/reef areas. If pipeline leaks, mis-dumps, or spillage occurs, then scientific divers shall be used to verify the condition of nearby hardground areas.

- The method of transporting the fill from the offshore borrow area to the fill area shall be approved by the Contracting Officer. Prior to pipeline or equipment placement, the Contractor shall submit

the hardbottom surveys conducted as described in the Contractor's Hardground/Reef Protection Plan.

- Any scow load or hopper dredge load that is released within State waters will be classified as a mis-dump and will result in a suspension of disposal operations and prompt monitoring of affected hardbottom areas. Redredging of such materials may be required as a prerequisite to the resumption of dredging unless the Contracting Officer, at their discretion, determines that redredging of such material is not practical or will impact more neighboring hardbottom. In addition, the Contractor shall notify the Contracting Officer within 24 hours of a misplaced dump. Corrective actions shall be implemented by the next offload at no additional expense to the Government, and the Contracting Officer shall be informed of actions taken.
- A pipeline dredge or hydraulic unloader may be used to transport material to the Project placement site. The Contractor shall maintain a tight discharge pipeline at all times. The joints shall be so constructed as to preclude spillage and leakage. If a dredging technique is used for this Project that requires anchoring, no anchoring shall occur within 500 feet of hardbottom or cultural resources. If pilings are used for anchorage at the beach fill site, the pilings shall be well marked and removed in their entirety upon completion of the Contractor's operation.
- Pipeline corridors will need to be field verified to avoid existing hardbottom areas. The Contractor shall not relocate these corridors. To avoid impacts to hardbottom areas, the Contractor shall field verify these corridors using side scan sonar and drop dives by scientific divers.
- Should any turbulence or siltation be found in the water along the pipeline route during inspections, the dredge shall immediately cease pumping sand and pump water until the pipeline is cleared. At this point, the dredge shall shut down until a dive team with scientific divers can inspect the pipeline and assess the impacts to the neighboring hardbottom/reef communities.
- Water and excavated material shall not be permitted to overflow or spill out of barges, dump scows, or hopper dredges while in route. Excessive leakage is defined by average loss of draft during transit from the dredging area to the offloading area (forward draft loss plus aft draft loss divided by 2) in excess of 1 foot. Excessive leakage may be classified as a mis-dump and will prompt monitoring of affected hardbottom areas.

SAND BOTTOM HABITATS

The USACE proposes to use an offshore sand source, Jupiter Carlin A, for the initial nourishment of the Jupiter Carlin beach. This is the most economical and time efficient method due to the larger volume of sand required. However, subsequent nourishments may utilize beach quality sand from permitted upland sand sources (please refer to Chapters 2.2.9 and 5.10 for more information).

The proposed Project would alter the bathymetric characteristics of the offshore sand source. This feature includes EFH for coastal pelagic species and some highly migratory species, particularly coastal sharks. In addition, offshore sand habitats have been shown to provide fundamental ecological functions for demersal/pelagic fish species and motile macrobenthic invertebrates that include categories of spawning, shelter, or foraging (CSA International et al. 2009). Studies (Gilmore 2009) have determined that 200 fish species use the sand habitats along southeast Florida. Gilmore (2009) postulates that the sand habitats are an intermediate habitat integrated in the cross-shelf migration used by many EFH managed groups. These habitats also function as aggregation areas for small pelagic fishes, important prey for the coastal pelagic fish, dolphin and wahoo, and highly migratory species groups.

Modification of the offshore sand source, Jupiter Carlin A, could impact EFH for multiple SAFMC-managed species groups that use this area. The proposed dredging action could conceivably alter the structure of the offshore sand source and change the fundamental ecological processes within and near this feature. Dibajnia and Nairn (2010) found that for shoals (perhaps similar to the Project offshore sand source) fewer than 30 meters deep, the shoal they studied reformed itself with the remaining (smaller) volume. They concluded, "There was no indication that there exists a critical threshold for dredging that once crossed, ridge and shoal features may deflate, losing their morphologic integrity."

Based on the geophysical and geotechnical data that is currently available, the proposed borrow area design includes a dredging template that is oriented with the long axis of the area to minimize impacts to the area. Additionally, USACE is currently investigating the feasibility of maintaining a refuge patch at maximum elevations to promote quicker biological recovery following dredging. However, additional analysis will need to be performed during the planning and design phase to better understand the cumulative volume of sediment within the area relative to the identified volume of sediment needed to support the Federal Project.

In addition, numerous studies have examined the impacts to the infaunal communities of borrow areas including (but not limited to) Turbeville and Marsh (1982), Byrnes et al. (2003), Hammer et al (2005), Byrnes et al. (2004), and Burlas et al. (2001). Those studies determined that the community composition, diversity, and abundance recovered to pre-dredge conditions within two years.

Hammer et al. (2005) found that physical, chemical, and biological factors influence the composition of benthic assemblages. Although excavation of sand borrow areas can expose underlying sediments and change the sediment structure and composition, their research found that the vertical sediment composition in the borrow pits offshore of central Florida tended to be uniform. In addition, recovery times of infaunal recolonization may be shorter in warmer (e.g., central Florida) waters than in colder waters.

Wilber and Stern (1992) found that while borrow sites may remain in an early successional stage for two to three years, within those years the sites they considered still developed infaunal biomass that provided a food source for fish and macrocrustaceans. In addition, Turbeville and Marsh (1982) examined an offshore dredging operation off Hillsboro Beach in 1972. They determined that although the faunal similarity analysis indicated that a qualitative change in the fauna of the borrow area had occurred the change was not detrimental. They concluded that the offshore dredging operations conducted caused no observable adverse effects in terms of reduced numbers of species, reduced faunal abundance, or reduced species diversity within the borrow area.

Dredging activities within the borrow area could also entrain multiple South Atlantic Fish Management Council (SAFMC) managed species groups, both fish and invertebrates, including the penaeid shrimp, and spiny lobster. Settle (2003) working for the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service, National Centers for Coastal Ocean Science, prepared a report entitled *Assessment of Potential Larval Entrainment Mortality Due to Hydraulic Dredging of Beaufort Inlet*. In this assessment, Settle estimated that entrainment mortality of larval fish, even under the worst-case scenario, is minimal (0.1 %/day). Under the worst case scenario the dredge operated 24 hours/day, all larvae were located in the navigation channel, on the bottom, and with poor retention in the estuary following flood stage. Settle further stated that "the impact at the population level (of larval fish) would be insignificant."

Similarly, Burton, Weisberg, and Jacobson (1992) utilized an Empirical Transport Model to simulate a "worst case scenario" of entrainment of striped bass (*Morone saxatilis*), herring (*Alosa spp.*) and white perch (*Morone americana*) larvae involving the simultaneous operation of four hydraulic dredges in the Delaware River. For species such as striped bass, the study concluded that less than 1 percent of the total larval population would be entrained by dredges. They concluded that the effects of these entrainment rates on larval populations for these and similar species would be minimal. It is expected that dredging activities within the offshore sand source would result in even less entrainment since it is a relatively large feature.

TURBIDITY

Beach nourishment activities can show localized effects, with sites in close proximity to dredging areas exhibiting significantly higher sediment collection rates when compared to control sites (Jordan et al., 2010). Construction activities will impart temporary water quality effects on the EFH by producing temporary, localized increases in turbidity in the Project area. Elevated turbidity levels resulting from dredging and beach placement, however, should not have a significant negative effect on organisms inhabiting the Project area. Given the naturally dynamic waters of the Atlantic Ocean, organisms inhabiting the nearshore zone adapt well to reasonable environmental changes such as moderate increases in turbidity. Fish and other mobile species may temporarily leave the adjacent surf zone if turbidity becomes too great. Construction noise may also drive fish away from the Project area.

Additionally, sediments disturbed during beach fill placement activities would settle on adjacent habitats. Loss of benthic fauna during these activities would temporally affect fish feeding habitat in the Project area. With their high fecundity and recruitment potential, the benthic fauna should repopulate the affected areas in a relatively short time.

5.8 COASTAL BARRIER RESOURCES

FUTURE WITH-PROJECT CONDITIONS

The Project will result in the maintenance of a protective beach for the Coastal Barrier Resource System Units associated with the Project beach. The Project will not encourage additional development, as the area is already fully developed outside the park areas.

5.9 OFFSHORE SAND SOURCE

FUTURE WITH-PROJECT CONDITIONS

The Project is projected to require approximately 804,000 cy of suitable sand through 2045. For planning and cost-estimating purposes the offshore sand source, Jupiter Carlin A, which is approximately 700 acres in size, has been identified as the primary sand source for the Project. If the cut depth is assumed to be 10 feet, a hole of approximately 31 acres will be created during dredging. Jupiter Carlin A does have the potential to contain rock and large shell that will require screening. Previous nourishment events with a different offshore sand source encountered rock. In those construction specs, the contractor was required to submit a "Rock Removal Plan," which included the method for which the quantity of rock removed is measured and the location of the rock disposal. The contractor's method of rock and/or large shell removal shall be submitted for review and approval by the contracting officer prior to commencement of work. The last bathymetric survey estimated the available volume of suitable to be

approximately 5 million cubic yards, sufficient quantity to support this Project and others for the foreseeable future.

Given the quantities of material for each of the Recommended Plan's periodic nourishment events, the determination was made to proceed with the offshore sand source for planning and cost-estimating purposes. A rough order magnitude cost comparison for dredging versus truck haul (costs are derived from recently completed projects in the area) proved to be the most economical, with dredging costing approximately $46 million, whereas truck haul was approximately $72 million in FY17 price levels.

5.10 UPLAND SAND SOURCE

FUTURE WITH-PROJECT CONDITIONS

In the event that an upland sand source or mine is utilized, the following sand specifications shall be required in order to ensure that the material is compatible with the native beach and minimizes potential turbidity issues:

- Sand shall be obtained from a source that is more than eight hundred (800) feet landward (towards land) of the Coastal Construction Control Line (CCCL).
- Sand shall be similar in color to the native beach material as specified herein. The predominant Munsell soil color in Palm Beach County for moist (5-10%) native sand is 10YR 7/2 (light gray). Acceptable Munsell soil colors for sand are 10YR 8/1 (white) to 10YR 7/3 (very pale brown), excluding Munsell Color Values with a chroma greater than 3; 2.5Y 8/1 (white) to 2.5 Y 8/3 (pale yellow); or 5Y 8/1(white), or 5y 8/2 (pale yellow).
- Sand shall be free of construction debris, rocks, clay, or other foreign matter.
- Sand shall have mean grain size between 0.30mm and 0.70mm.
- Sand shall have a sorting coefficient/standard deviation no greater than 0.9ϕ.
- Sand shall contain less than one percent (1%) organic material.
- Sand shall be free of coarse gravel (19-76mm) and cobbles (greater than 76mm).
- Sand shall be well-drained and free of excess water, and have moisture content no greater than ten percent (10%).
- Sand shall contain less than forty-five percent (45%) carbonate by weight.
- Sand shall have a particle size distribution ranging predominantly between 0.074mm (3.75ϕ) and 4.76mm (-2.25ϕ), and shall not contain greater than one percent (1%) by weight silt, clay, or colloids passing the #200 sieve; nor shall it have greater than zero point six percent (0.6%) by weight silt, clay, or colloids passing the #230 sieve (4.0ϕ) as determined by wet sieve analysis, or contain greater than five percent (5%) by weight fine gravel retained on the #4 sieve (-2.25ϕ).

The following quality assurance protocols shall also be implemented:

- During sand production, the Contractor shall conduct hourly sampling of sand from the processing belt and analyze the samples for compliance with sand specifications. Hourly testing results shall be electronically logged and available in hardcopy upon request.

- Each day of loading operations, the Contractor shall provide results of twice (2) daily geotechnical analysis of composite core samples taken from the stockpile at the source. Each composite shall consist of five (5) core samples taken around the stockpile using a 6 ft. tube 1.5 inches in diameter. The five core samples shall be combined and quartered (see Parameters Table). Analysis of the quartered composite shall include a Sieve Analysis at "Half Phi" intervals using the #4 Sieve

through the #230 (including the #200 Sieve), and a Wet Sieve Analysis using the #230 Sieve. Results shall include grain size distribution curve, mean grain size, sorting, color, and %fines. Results shall be certified by a Florida licensed professional engineer or by a Florida licensed professional geologist.

- The USACE, or its non-Federal sponsor, may collect random sand samples of delivered sand to assess mean grain size, color, and %fines. Each sample shall be archived with the date, time, load number of the sample, and project name. A record of these sand evaluations will be provided within the USACE, or its non-Federal sponsor's, inspection reports. If determined necessary by the USACE, or its non-Federal sponsor, additional assessments of the sand shall be conducted by the USACE, or its non-Federal sponsor, for mean grain size, color, and %fines for any load sample that does not pass the visual inspection. All costs associated with the additional assessments shall be the sole responsibility of the successful bidder.
- Immediately upon request by a USACE, or its non-Federal sponsor representative, the Contractor shall measure the moisture content of the stockpile to verify compliance with the Sand Specifications. Moisture content may be measured by using either a ProCheck Hand Held Reader with ECH20 Soil Moisture Sensor 10HS by Decagon Devices or a HydroSense Soil Water Measurement System from Campbell Scientific, or equal approved by the USACE, or its non-Federal sponsor. All moisture measurements and results shall be recorded in electronic logs and available to the USACE, or its non-Federal sponsor, upon request.

5.11 WATER QUALITY

FUTURE WITH-PROJECT CONDITIONS

The Project would temporarily impact water quality at the borrow site and in the intertidal swash zone at the sand placement site. Dredging and sand placement activities may temporarily increase turbidity by introducing additional fine material into the water column. The increased fines may increase biological oxygen demand, thus reducing water column oxygen levels. The FDEP rules, however, require the fill material to be very similar to existing beach sand to ensure minimization of turbidity during construction. Dredging and discharges from sand placement may also alter water temperatures in the immediate dredging and sand placement areas.

The FDEP requires intensive monitoring of turbidity at dredging and sand placement locations during the Project operations. If the monitoring detects turbidity exceeding permitted levels, the construction activity must halt until the contractor takes appropriate steps to reduce the turbidity to acceptable levels and the turbidity returns to those levels. Monitoring results demonstrating Project performance are submitted to the FDEP regularly during the construction period. Given the naturally dynamic waters of the Atlantic Ocean, organisms inhabiting the nearshore zone adapt to environmental changes such as moderate increases in turbidity. Fish and other mobile species may temporarily leave the dredging site or surf zone adjacent to the beach placement site if turbidity becomes too great.

5.12 HAZARDOUS, TOXIC & RADIOACTIVE WASTE

FUTURE WITH-PROJECT CONDITIONS

Dredging equipment, staging areas, construction equipment, and other motorized vehicles used during construction have the potential to spill for example, gasoline and lubricating oils. Accident and spill prevention plans provided in contract specifications should help avoid most spills. All motorized vehicles will be maintained and stored offsite the Project area and the contractor will take appropriate precautions to avoid accidental spills.

5.13 AIR QUALITY

FUTURE WITH-PROJECT CONDITIONS

The short-term impacts from emissions by dredges and other construction equipment associated with the Project are not anticipated to affect onshore or offshore air quality significantly. Exhaust emissions from vehicles, vessels, and construction equipment associated with the Project, including transport of sand from upland sand mines, would have a temporary and localized effect on air quality. Offshore sea breezes are anticipated to disperse pollutants. This Project requires no air quality permits.

An analysis was performed on a similar beach nourishment project in St. Lucie County to estimate emissions from that project (Taylor 2012; Table 28). The St. Lucie analysis included calculation of total project emissions of nitrogen oxides (NO_x), sulfur dioxide (SO_2), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter (PM) less than 10 microns and greater than 2.5 microns.

Any of the action alternatives may result in small, localized, and temporary increases in concentrations of NO_x, SO_2, CO, VOCs, and PM. Because the St. Lucie County CSRM project and the proposed Jupiter Carlin Segment of the Palm Beach County Shore Protection Project are both located in an air quality attainment area, the EPA requires no preliminary air quality conformity assessment. Due to its smaller size, the proposed Jupiter Carlin Segment of the Palm Beach County Shore Protection Project (191,900 cy) would result in less emissions than the St. Lucie County CSRM project (641,000 cy).

Emissions associated with the dredge plant would provide the largest contribution to the inventory. However, total Project emissions represent a minor percentage of the existing point and nonpoint and mobile source emissions. Prevailing winds would quickly disperse any pollutant released into the atmosphere from the Project area. Since the recommended plan of the proposed Project is smaller in size, the resulting emissions would be even less significant. Green House Gas emissions would minimally effect global emissions or total United States emissions.

Table 28: Estimated Emissions of the St. Lucie County Constructed Project.

Activity	Emissions (tons)					
	NO_x	SO2	CO	VOC	PM2.5	PM_{10}
Dredging/Operation	11.1	0.2	2.5	0.3	0.2	0.2
Turning/Sail	23.3	0.4	5.3	0.6	0.4	0.4
Pump-out	6.2	0.1	1.4	0.2	0.1	0.1
Idle/Connect- Disconnect	2.2	0.0	0.5	0.1	0.0	0.0
Supporting Offshore Activities	6.8	0.1	1.6	0.2	0.1	0.1
Beach Fill	4.6	0.8	2.2	0.3	0.4	0.4
Total Project Emissions	**54.2**	**1.7**	**13.5**	**1.6**	**1.2**	**1.2**
2002 Countywide Emissions Nonpoint + Mobile	9,509	1,661	70,230	12,636	1,480	6,646
2002 Countywide Emissions Point and Nonpoint + Mobile	10,037	1,681	70,777	14,162	1,551	6,743

St. Lucie County 2002 emissions from EPA National Emission Inventory http://www.epa.gov/air/data/

5.14 NOISE

FUTURE WITH-PROJECT CONDITIONS

Dredging noise can affect marine mammals, sea turtles, and fishes. Possible effects of dredging noise can vary depending on a variety of internal and external factors, and can be divided into masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, discomfort, hearing loss, and injury. Deeper water operations may propagate sound over greater distances than those in confined nearshore areas (Hildebrandt, 2004).

Dredging to extract sand produces broadband and continuous sound, mainly at lower frequencies. The little available data indicates that dredging is not as noisy as seismic surveys, pile driving, and sonar;

however, it is louder than most shipping, operating, offshore wind turbines, and drilling. Noise associated with dredging activities can be placed into five categories:

1. Collection noise – The noise generated from the collection of material from the sea-floor; for example, the scraping of the buckets on a bucket ladder dredge or the operation of the drag head. This noise is dependent on the structure of the sea floor and the type of dredge used.

2. Pump noise – The noise from the pump driving the suction through the pipe.

3. Transport noise – The noise of the material being lifted from the sea floor to the dredge. For trailing suction hopper and cutter suction dredges, this would be the noise of the material as it passes up the suction pipe. For clamshell dredges, it would be the sound of the crane dropping/lifting the bucket.

4. Deposition noise – This noise is associated with the placement of the material within the barge or hopper.

5. Ship/machinery noise – The noise associated with the dredging ship itself. For stationary dredges, the primary source will be the onboard machinery. Mobile dredges will also have propeller and thruster noise.

Field investigations have been undertaken to characterize underwater sounds typical of bucket, hydraulic cutterhead, and hopper dredging operations (Dickerson et al., 2001). Preliminary findings indicate that cutterhead dredging operations are relatively quiet as compared to other dredging operations in aquatic environments. Hopper dredges produce somewhat more intense sounds similar to those generated by vessels of comparable size. Bucket dredges create a more complex spectrum of sounds, very different than either cutterhead or hopper dredges. Hopper dredge noises consist of a combination of sounds emitted from two relatively continuous sources: engine and propeller noise similar to that of large commercial vessels, and sounds of dragheads moving in contact with the substrate.

Reported source levels for dredging operations range from 160 to 180 dB re 1 uPa @ 1 m for 1/3 octave bands with peak intensity between 50 and 500 Hz (Greene and Moore, 1995). The intensity, periodicity, and spectra of emitted sounds differ greatly among dredge types. Components of underwater sounds produced by each type are influenced by a host of factors including substrate type, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and skill of the dredge plant operator (Dickerson et al., 2001).

Noise generated by the dredge may minimally impact those living near the beaches during construction, but will likely not be too noticeable over ambient noise of wind and waves. Noise generated on the beaches by equipment placing the dredged material will be relatively low level and will be of a short duration. Construction equipment such as booster pumps will be properly maintained to minimize effects of noise. Once dredging and beach placement have concluded, noise levels will return to normal for the beach area. Since the increases to the current level of noise as a result of the Project will be localized and minor, there will only be a temporary impact associated with the Project and no expectation of adverse effects to the environment as a result of construction-related noise.

The noise associated with mining and transporting sand from commercial sand mines is not expected to change from what was included in the permits issued by the USACE and the State.

5.15 AESTHETIC RESOURCES

FUTURE WITH-PROJECT CONDITIONS

During construction, aesthetic qualities of the Project beach will be diminished with the operation of construction equipment and with construction activities. In the longer term, the nourishment of the beach in accordance with the design considerations included in the 1995 and 2002 nourishments will result in an improved aesthetic quality after completion of the Project. The placement of material on the shore would restore the natural pleasing visual appearance of 1.1 miles of shoreline. During construction, short-term construction impacts will include turbidity in the immediate vicinity of the dredge and discharge point on the beach, construction equipment on the beach along with their associated audio impacts, pipeline placement on the beach, and fill containment berms. For safety reasons, access to certain parts of the beach will be temporarily restricted. No other adverse impacts to aesthetics are expected from nourishment of the Project beach. Sand samples of sand source material were generally slightly darker in color than the existing beach sand. The placed and the existing beach sand are expected to eventually blend so that the net result will not detract from the long-term aesthetic appearance of the beach. The Project protects existing dunes and restores those sections of dune destroyed by storm erosion.

5.16 RECREATION RESOURCES

FUTURE WITH-PROJECT CONDITIONS

Once completed, the Project would provide a large, dry beach, which will supply more area for active and passive recreational activities.

The overall Project area, popular for a variety of recreational activities, accommodates surfing and fishing. A majority of surfing occurs in the area south of the Jupiter Inlet south jetty to about the northern two-thirds of Jupiter Beach Park and at the north end of Carlin Park. For a short time, the construction process would limit surfing opportunities, especially near the dredge discharge point along the beach.

The Project is not expected to adversely impact surfing or recreational fisheries activities, except during dredging operations. During construction, there will be short-term construction impacts including turbidity in the immediate vicinity of the dredge. Fishermen will be unable to access the area immediately around the dredge while it remains on site. No other adverse impacts are anticipated.

5.17 CULTURAL RESOURCES AND HISTORIC PROPERTIES

FUTURE WITH-PROJECT CONDITIONS

Archival research, archeological field investigations, and consultation with the SHPO demonstrate that two recorded archaeological sites are located in the nearshore close to the Project placement area. The Jupiter Wreck (8PB0234) is reported to lie approximately 300 feet south of the inlet and just northeast of the placement area and has been managed under a salvage agreement between the State of Florida and Jupiter Wreck Inc. since 1987. The artifact scatter of the wreck extends seaward from the nearshore for approximately 3000 feet, and is purported to be the remains of the seventeenth century *San Miguel de Archangel*, a Spanish dispatch vessel sunk in 1659. A second wreck, the nineteenth century steamer *Victor* (8PB0102) is located near the south end of the Project area approximately 900 feet offshore. Neither site has been affected by previous shore protection projects for this placement area, and the SHPO concurred

with a finding of no effect for placement along this shoreline in 2013 (SHPO, 2013). The USACE will insure that these sites are avoided during nourishment operations. If dredge delivery pipe operations are planned to be routed near the known sites, then buffers will be placed around the known features. Additionally, no documented historic structures or resource groups exist adjacent to the west of the shoreline placement area. The SHPO concurred with a finding of no effect for placement along this shoreline in 2013 (DHR Project 2013-03795 letter, Appendix H).

The sand sources for the Project include the offshore sand source, Jupiter Carlin A, and upland sand sources from various sand mines in South Florida, if needed. The USACE surveyed Jupiter Carlin A for this Project in 2015. The survey identified no significant magnetometer, sub-bottom, or sonar anomalies in the borrow area. The USACE determined that use of this borrow are will have no effect on historic resources, and the SHPO concurred with this determination in a letter dated January 13, 2016 (DHR Project 2015-6227 letter, Appendix H) . Any upland sand mines employed for this Project are subject to the requirement of proving compliance with the State of Florida's Chapter 267 requirements for protection of historical resources in the sand source footprints before the USACE will approve utilizing the source. Consultation under Section 106 of National Historic Preservation Act with Florida SHPO and appropriate federally-recognized tribes will be maintained for any unforeseen issues that may arise with respect to cultural resources. The USACE has determined that the FWP conditions will have no effect on historic resources.

5.18 NATIVE AMERICANS

FUTURE WITH-PROJECT CONDITIONS

No portion of the Project area exists within or adjacent to known Native American-owned lands, reservation lands, or Traditional Cultural Properties. However, Native American groups have lived throughout this region in the past and their decedents continue to live within the State of Florida and throughout the United States. Pursuant to Section 106 of the National Historic Preservation Act (16 USC 470) and obligations regarding the USACE' Trust Responsibilities to Federally-recognized Native American Tribes, prior consultation on the Project has not indicated any historic Native American use of the Project area. Consultation with the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida has been undertaken (Appendix H). The Miccosukee Tribe replied by phone stating no further concerns, and the Seminole Tribe declined to provide comment on the proposed action. The USACE has determined that the FWP conditions will have no effect on Native American sites.

5.19 PUBLIC SAFETY

FUTURE WITH-PROJECT CONDITIONS

The Project would provide for an increase in public safety because of increased storm protection from the widened beach. Dredging operations and beach restoration mandate rigid application of safety and health requirements. Dredging with deep draft equipment, operating in relatively shallow water, requires extreme skill to stay within safe operating tolerances. Additionally, heavy equipment and transport operators must employ the same extreme caution on the beach, where the public may not truly appreciate the inherent danger. Accordingly, the Project sponsors require contractors to submit extensive health, safety, and accident prevention plans to protect the onsite personnel, public, and environment.

5.20 NATURAL OR DEPLETABLE RESOURCES

FUTURE WITH-PROJECT CONDITIONS

Sand is a natural and depletable resource. Removing sand for this Project would deplete the sand from the offshore sand source, Jupiter Carlin A. Over an extended period of time, the excavated site will be expected to, at least, partially refill with sand.

5.21 LOCAL SHORT-TERM USES & MAINTENANCE / ENHANCEMENT OF LONG-TERM PRODUCTIVITY

FUTURE WITH-PROJECT CONDITIONS

The Jupiter Carlin segment of the Palm Beach County, Florida SPP site will experience localized, temporary turbidity plumes, and sedimentation adjacent to the beach fill and offshore sand source. Beach fill projects have short-term impacts on benthic and fishery communities, and marine turtle nesting. However, the impacts are typically short-lived; benthos recover quickly and extended periods of improved conditions for turtle nesting follow re-equilibration of the beach profile. Appropriate mitigation and monitoring should ensure that these populations remain sustainable.

5.22 INDIRECT IMPACTS

FUTURE WITH-PROJECT CONDITIONS

The Project should not result in adverse indirect effects. Beach nourishment may result in indirect impacts such as formation of scarps, sand migration over time, and long-term changes in sand composition. Because a large portion of the beachfront is within county-owned parks and most of the remainder is already developed, the Project will not likely cause significant additional development to occur.

Appropriate post-nourishment management (also required by state and federal permits) will ensure scarp knockdown occurs. Monitoring of turtle nesting since the original 1995 nourishment Project have indicated that nourishment may result in a temporary reduction in turtle nesting (although this does not always occur) and a temporary loss of benthic communities. The last two federally cost-shared nourishments have not resulted in decreased nesting. Marine turtle nesting frequency and success are clear indicators of habitat quality. Continuing careful conduct of future projects will ensure that future nourishment projects will not result in indirect impacts.

5.23 UNAVOIDABLE ADVERSE ENVIRONMENTAL IMPACTS

FUTURE WITH-PROJECT CONDITIONS

Unavoidable adverse environmental impacts resulting from the proposed action include a temporary loss of beach habitat, a localized increase in turbidity levels, a temporary reduction in sea turtle nesting, and a temporary loss of benthic communities in the nearshore area and the offshore sand source.

5.24 CUMULATIVE IMPACTS

FUTURE WITH-PROJECT CONDITIONS

Overall cumulative impacts, defined as the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7), may result in both beneficial and adverse impacts. Primary benefits from beach and dune management mainly consist of beach or dune habitat restoration previously eroded by natural and artificial causes. Secondary benefits may include mitigation planting, wildlife species monitoring, and habitat enhancement.

Beach management can also result in environmental impacts to species and the areas they inhabit. However, a thorough understanding of the habitat and the species involved can help minimize or avoid environmental impacts. Methods to minimize environmental impacts caused by beach management practices include species observation, trapping and relocation, relocation of nest, nest identification/marking, avoidance of species and/or sensitive areas, lighting restrictions, noise abatement, and time constraints. If one implements adequate environmental protection measures, environmental impacts from beach management activities are generally short-term and minimal.

PAST CONDITIONS AND ACTIVITIES

JUPITER INLET

The morphology of the shoreline south of Jupiter Inlet has been influenced to some extent by the following factors:

1) The presence of the Inlet. As with all inlet systems, shorelines adjacent to the Inlet are an inseparable part of the system. At Jupiter, sediment from the shoreline north of the Inlet migrates south (due to both incident waves and currents from tidal flows through the Inlet) through the Inlet complex. More often than not, an inlet behaves as a "sediment sink" which is evidenced by the growth of the ebb shoal and shoaling in the AIWW. Sediment that is not either entrapped in the inlet complex is bypassed to beaches to the south. A sediment budget created with historical shoreline positions, beach profile, ebb shoal and flood shoal volumes, and an accounting of mechanical transfer of sand must be constructed to determine the bypassing rates (if any) of sediments to the south.

2) Local fill events. Since 1947, maintenance material from the Inlet has been placed on the shoreline just south of the Inlet. Beginning in 1970, this material was supplemented with maintenance material from the AIWW. On average, Inlet material (placed at intervals of 1 to 2 years) accounts for an average annual volume of approximately 41,000 cy. AIWW material (placed at intervals typically ranging from 2 to 4 years) accounts for an average annual volume of approximately 29,000 cy. Individually, local placement events vary in volume, cross-shore dimension, long shore extent, and timing.

3) Federal Project. Beginning in 1995, as part of the federally cost-shared project, approximately 1,362,000 cy of material was placed in the Project area between R-13 and R-19 (1995 Initial Construction: 604,000 cy, 2002 Nourishment Event: 625,000 cy, 2015 FCCE Nourishment Event: 133,000 cy.

4) Extension of the south jetty. In 1998, the south jetty was lengthened by approximately 175 feet. While not as dramatic of a change as the original construction, the lengthening of the structure likely had an influence on the shoreline to the south by changing the wave climate and nearshore current patterns.

The longer jetty also aides in decreasing the amount of material entering the channel from the south. While north to south transport is dominant, south to north transport in the vicinity of the Inlet does occur.

During the course of this analysis, it became apparent that the shoreline south of Jupiter Inlet, which includes the Project shoreline, has realigned to a more north-south orientation since initial construction of the Federal Project in 1995. While each of the above listed components have an impact on the morphology of the shoreline immediately south of the Inlet, the degree to which each contributes to changes in overall orientation that have occurred since initial Project construction in 1995 varies.

The presence of the Inlet is a constant. The Inlet intercepts sediment migrating from north to south and influences local wave-driven currents through interaction with tidal currents. The interception of sediment and the localized currents generally has an erosional effect on the down drift side of the Inlet. This is the case at Jupiter Inlet. Because the Inlet effects are a constant, they likely did not play a direct role in the realignment of the shoreline since 1995. It should be noted, however, that since the Inlet and shorelines are part of a system, the Inlet will have interacted with the shoreline as it reoriented. This may have added to the morphological changes taking place (either hindering or exacerbating them).

Because the local fill events have occurred since 1947 through present day, their effect may be considered to be relatively constant and as such are a major contributing factor to reorientation of the shoreline since 1995. These events contribute to the overall sediment transport system through mechanical placement of sediment to the adjacent shoreline. There is also the possibility that placement of the Federal Project from R-13 to R-19 has influenced the historic placement location(s) of the locals fills, which would have a localized impact on the morphology.

The Federal Project is the largest change to the system that has occurred since 1995. The placement of 500,000+ cubic yards of material over 1.1 miles of shoreline is a significant change to the overall sediment budget for the system. The maintenance of the Federal Project has contributed to the long term change to the pre-Project morphology.

Extension of the south jetty occurred shortly after initial construction of the Federal Project. Given that the extension was made to the jetty at the down drift side of the inlet, it is not likely to be a significant contributor to the reorientation of the shoreline. The Inlet itself intercepts the north to south longshore transport. Therefore, there is no active path of sediment migration for the jetty extension to interrupt. The extension would have a localized effect on incident waves and nearshore current patterns, offering some shielding from wave and current energy immediately adjacent to the jetty (in the vicinity of R-13). While this is a definite contributor to morphological changes to the shoreline, it is not sufficient to account for the reorientation of the shoreline extending as far south as R-15 and R-16.

Because of the complexity of the inlet system, where the channel, shoals, and adjacent shorelines interact inextricably, it is not a trivial task to separate each of the contributing elements and quantify their contributions to the morphological changes that have occurred to the south shoreline since 1995.

PRE-PROJECT

Jupiter Inlet began as a natural waterway connecting the Loxahatchee River with the Atlantic Ocean. Subject to natural closing, Jupiter Inlet required periodic maintenance to keep it open before 1922. A special act of the Florida Legislature established the Jupiter Inlet District (JID) in 1921 to provide maintenance by means of a local taxing district. In 1922, forty years before this Project was authorized, the JID constructed two, parallel jetties to help keep the Inlet open. In 1998, the south jetty was lengthened by approximately 175 feet. While not as dramatic of a change as the original construction,

the lengthening of the jetty structure likely had an influence on the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project shoreline south of the Inlet by changing the wave climate and nearshore current patterns.

EXISTING

The following paragraphs present the Inlet's history and a record of the Inlet's dredging and sand bypassing history to assist in understanding the effects of the Inlet on the beach.

Currently stabilized with jetties to support navigation and to maintain the outflow of the Loxahatchee River and the C-18 drainage canal, Jupiter Inlet lies in northern Palm Beach County, approximately 16 miles south of the St. Lucie Inlet and 11.7 miles north of the Lake Worth Inlet. The Atlantic Intracoastal Waterway (AIWW) crosses the Loxahatchee River immediately west of the Inlet.

Jupiter Inlet contributes to beach erosion by acting as a sediment sink. The stabilized inlet interrupts the net southerly longshore sediment transport that would otherwise nourish the Project area. Tidal flood currents divert sediment from the coast to inside the inlet. Once inside the inlet, sediments tend to settle out into flood shoals. Tidal ebb currents also divert sediments along the coast farther seaward. These sediments also tend to settle out into ebb shoals as the tidal velocity decreases. The inlet's south jetty and the location of the ebb shoal return bar have historically dictated the limits of severe erosion. The ebb shoal, attaching to the shore between R-16 and R-19, has migrated over the years. Aerials from 2008 depict the ebb shoal return bar attached to the shore between R-18 and R-19 at Carlin Park. While severe erosion will occur immediately down drift of inlets, slow long-term erosion may also occur further down drift of the inlet due to the littoral drift deficit.

MAINTENANCE

Three governmental entities routinely dredge near Jupiter Inlet. Palm Beach County acts as the local sponsor of the Jupiter Carlin Segment of the Palm Beach County, Florida Shore Protection Project. The Florida Inland Navigation District (FIND), as the local sponsor for the AIWW, disposes of material from routine AIWW maintenance dredging near Jupiter Inlet along the Project shoreline. Finally, the JID acts as local sponsor of Jupiter Inlet, and as such periodically dredges a sand trap located in the Inlet throat. Table 3 presents a history of dredging in the sand trap, ebb shoal, and AIWW since 1947. Most of these dredging events disposed of material on the beach south of the Inlet. From 1947 to 1996, the average total dredged material placed on the beach south of the inlet exceeded 71,000 cubic yards/year (cy/yr), including ebb shoal dredging. From 1997 to 2010 (since the state of Florida's adoption of the Jupiter Inlet Management Plan), the average total material placed on the south beach exceeded 148,000 cy/yr (including ebb shoal and offshore sand source dredging for the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project). Furthermore since 1997, the JID and FIND have dredged and placed on the south beach about 96,500 cy/yr, which exceeds the inlet management plan's 75,000 cy/yr sand bypassing requirement.

PROJECT PERFORMANCE - INITIAL CONSTRUCTION (1995)

Initial construction began in 1995 of the Jupiter Carlin Segment of the Palm Beach County Shore Protection Project, and restored approximately 1.1 miles of shoreline from Jupiter Beach Park to Carlin Park (R-13 – R-19) with nearly 603,800 cubic yards (cy) of beach-quality sand from Jupiter Inlet's ebb shoal. Approximately seven years after initial construction, the first Federal periodic nourishment occurred between December 2001 and March 2002, placing approximately 625,000 cy of beach-quality sand from an offshore sand source approximately two miles northeast of Jupiter Inlet.

Table 29 summarizes cumulative impacts by identifying the past, present, and reasonably foreseeable future condition of the various resources with and without the Project.

Table 29: Cumulative Impacts Summary.

Resource	Past and Present (Baseline/Existing Condition)	Future Without-Project	Future With-Project
Threatened and Endangered Species: Sea Turtles	Five sea turtle species occur in the area (loggerhead, green, hawksbill, Kemp's ridley, and leatherback). Loggerhead, green, and leatherback turtles nest on area beaches. Juvenile green turtles use nearshore hardbottom areas for feeding (macroalgae), resting, and shelter from predators. Past and current threats to sea turtle populations include artificial lighting, beach armoring, anthropogenic disturbance, trawling, dredging, vessel strikes, fishing gear entanglement, and ingestion of discarded anthropogenic marine debris.	Sea turtle nesting and nearshore habitat use would continue in the area. Project-specific impacts would be avoided, but ongoing threats to sea turtle populations would continue. In the absence of the Project, property owners may armor their shoreline to protect their property, which may result in loss of nesting habitat and possible impacts on nearshore hardbottom habitat.	In addition to ongoing threats, the Project would result in loss of a small defined area of juvenile developmental habitat (nearshore hardbottom). Sea turtles may be disturbed by turbidity and noise during construction. There is a small risk of sea turtles being struck by a construction vessel or entrained in the hopper dredge draghead; these risks would be minimized through vessel-strike avoidance and dredge related impact mitigation measures. Due to the small spatial extent and short duration of Project impacts, no significant cumulative impacts are anticipated.
Threatened and Endangered Species: Marine Mammals	Two Federally listed marine mammal species may occur in the area: West Indian manatee and North Atlantic right whale. Only the manatee is common. Past and current threats to marine mammal populations include vessel strikes, fishing gear entanglement, ingestion of	Marine mammals would continue to occur in the area. Project-specific impacts would be avoided, but ongoing threats to marine mammal populations would continue.	In addition to ongoing threats, marine mammals may be disturbed by turbidity and noise during construction. There is a small risk of marine mammals being struck by a construction vessel or entrainment within a hopper dredge draghead. Mortality of a manatee or North Atlantic right

Resource	Past and Present (Baseline/Existing Condition)	Future Without-Project	Future With-Project
	marine debris, pollution, and underwater noise.		whale would represent a significant cumulative impact due to the small population of these species. The risk would be minimized through vessel-strike avoidance and dredge impact – related mitigation measures.
Threatened and Endangered Species: Smalltooth Sawfish	The smalltooth sawfish is an endangered species inhabiting shallow, nearshore waters. Historically, its population and range have declined, mainly due to fisheries bycatch. Other past and current threats are habitat loss and degradation, entanglement in marine debris, pollution, and anthropogenic disturbance.	Smalltooth sawfish would continue to inhabit the area. Project-specific impacts would be avoided, but ongoing threats to sawfish populations would continue and may result in further decreases in population size and range.	In addition to ongoing threats, sawfish may be disturbed by turbidity and noise during construction. There is a small risk of sawfish being entrained in the hopper dredge draghead, which would be minimized through mitigation measures. Due to the small spatial extent and short duration of Project impacts, the smalltooth sawfish would not likely incur other than minor impacts.
Nearshore Hardbottom	Two nearshore hardbottom communities occur in the area. One consists of low- to medium-relief habitat with worm rock and supports hydroids, encrusting sponges, macroalgae, and turf algae. The other consists of low-relief coquina ledges with little or no epibiotic cover. These communities have historically been subjected	Nearshore hardbottom areas would continue to exist in the area, subject to the natural dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure. In the absence of the Project, property owners may construct shoreline armoring to protect their	Impacts to the nearshore hardbottom from previous beach placement activities have been mitigated.

Resource	Past and Present (Baseline/Existing Condition)	Future Without-Project	Future With-Project
	to the dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure.	property, which may result in impacts to nearshore hardbottom.	
Fish and Wildlife Resources	Nearshore soft bottom habitats including sand areas that support a variety of invertebrates and demersal fishes. Invertebrates using sand habitat include infaunal and epifauna species represented primarily by annelid worms, gastropods, bivalves, crustaceans, and echinoderms. Most of these species are used as food by demersal fishes.	Project-specific impacts would be avoided, but soft bottom communities would continue to be affected by natural sand movement. In the absence of the Project, property owners may armor their shoreline to protect their property, which may result in impacts to nearshore soft bottom communities. Regionally, other sand areas are likely to be used in support of future beach nourishment projects.	In addition to ongoing processes affecting soft bottom fish and wildlife resources, there would be localized effects of dredge and fill activities along the beach and in the offshore borrow area that may persist for a few months to a few years. Major long-term effects are not anticipated because resident fish and wildlife species are wide-foraging or migratory and spend only a portion of their life cycle at the borrow area and beach fill sites.
Essential Fish Habitat	Managed species and species groups in the Project area include *Sargassum*; coral, and live/hardbottom habitats; penaeid shrimp; spiny lobster; coastal pelagic fishes; reef fishes; dolphin and wahoo; and highly migratory pelagic species. Habitats of Particular Concern (HAPCs) for coral, coral reefs, and live/hardbottom habitats of the eastern Florida area include the	Project-specific impacts would be avoided, but the acreage of nearshore hardbottom Essential Fish Habitat (EFH) would fluctuate with natural sand movement. Increased exposure of hardbottom may provide increased habitat for surf zone fishes, increased foraging habitat for green sea turtles, and increased refuge for juvenile fishes. In the absence of the Project, property owners	Approximately 8 acres of exposed nearshore hardbottom habitat within the study area was impacted by prior sand placement activities. Palm Beach County provided mitigation to offset these impacts. The Recommended Plan, with its smaller placement area, would not exceed previous impacts and, therefore, additional mitigation is not proposed.

Resource	Past and Present (Baseline/Existing Condition)	Future Without-Project	Future With-Project
	Phragmatopoma worm reefs found in nearshore waters; nearshore hardbottom found in water depths of 0 to 4 m; and hardbottom found in water depths of 5 to 30 m.	may construct armoring to protect their property, which may result in impacts to nearshore EFH.	
Water Quality	The Project area consists of Class III waters, which are designated as suitable for recreation, propagation, and maintenance of a healthy, well balanced population of fish and wildlife. The predominant issue that affects water quality in the area is turbidity, which varies significantly under natural conditions (e.g., during storms), sometimes exceeding 29 NTU. Historically, coastal water quality has been affected by unrelated anthropogenic sources such as stormwater and effluent runoff resulting in increased nutrients and freshwater inputs. Urbanization and population growth in the region contributes to coastal water quality degradation.	Project-specific impacts would be avoided, but turbidity would continue to occur intermittently due to storm activity, rainfall, currents, and other natural phenomena. Water quality may deteriorate due to unrelated anthropogenic sources such as stormwater and effluent runoff.	In addition to the ongoing natural and anthropogenic fluctuations in water quality, local, short-term turbidity would occur adjacent to the beach fill sites and offshore borrow area. BMPs would be implemented during construction to reduce the magnitude and extent of turbidity, and adverse effects on water quality are expected to be minor. Turbidity would be monitored during construction to ensure that State water quality standards are met at the mixing zone boundary. Due to the small spatial extent and short duration of Project impacts, no long-term effects are expected.
Air Quality	The Project area is in attainment with air quality criteria. Historically, air quality has been affected in a minor way by urbanization.	Temporary Project-specific impacts would be avoided. Palm Beach County is expected to remain in attainment with air quality criteria.	Any impacts to air quality would result from construction and would be temporary. The total increases in air pollutants would be relatively minor

Resource	Past and Present (Baseline/Existing Condition)	Future Without-Project	Future With-Project
			to the existing point-and mobile-source emissions in the five southeast Florida counties. Palm Beach County is in a designated attainment area and a conformity statement would not be required. No foreseeable future actions leading to an increase in emissions would result from the Project.
Noise	Present noise levels within the Project area are associated primarily with recreational and periodic construction activities, or natural sounds such as surf and wind. Historically, noise levels have increased due to urbanization.	Temporary project-specific impacts would be avoided. Minor increases in recreation or construction levels may occur if the Project area is more densely urbanized.	Noise impacts would be temporary with construction activities and the Project would result in only a minor incremental impact of the Project due to noise and as a result a minor increase in cumulative impact is expected.
Recreation	Present recreational activities consist of beach or water borne activities. Historically, recreation has increased with increases in adjacent urbanization.	Temporary Project-specific impacts would be avoided. Recreational use of the Project area may increase if the Project area is more densely urbanized.	Only temporary adverse effects to recreation would occur during construction; therefore there would be no adverse cumulative effect to recreation resulting from this Project.

5.25 IRREVERSIBLE & IRRETRIEVABLE COMMITMENT OF RESOURCES

FUTURE WITH-PROJECT CONDITIONS

5.25.1 IRREVERSIBLE COMMITMENT OF RESOURCES

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. One example of an irreversible commitment might be the mining of a mineral resource. For the proposed action, the fossil fuels for construction and public funds represent an irreversible commitment of resources, defined as forever losing the ability to use and/or enjoy the resource.

5.25.2 IRRETRIEVABLE COMMITMENT OF RESOURCES

An irretrievable commitment of resources is one in which, due to decisions to mandate the resource for another purpose, opportunities to use or enjoy the resources as they presently exist are lost for a period of time. An example of an irretrievable loss might be where a type of vegetation is lost due to road construction. Temporary reductions of benthic communities, aesthetics, recreational opportunities, water quality, and air quality represent irretrievable commitments of resources for the proposed action.

5.26 CONFLICTS & CONTROVERSY

No conflicts and/or controversy have been identified through the public and agency review period.

5.27 REAL ESTATE REQUIREMENTS

FUTURE WITH-PROJECT CONDITIONS

In the State of Florida for beach nourishment, beach restoration, and erosion control projects, Florida Statute, Section 161.141, Property Rights of State and Private Upland Owners in Beach Restoration Project Areas, requires a MHW line be determined between state sovereign lands and the adjacent upland property. This line is referred to as an erosion control line (ECL). Florida Statute, Section 161.191, Vesting of Title to Lands, states that title to all lands seaward of the ECL shall be vested to the state by right of its sovereignty. The lands landward of the ECL remain vested to the upland owner.

The Florida Governor and Cabinet approved the ECL between FDEP monuments R-13 and R-19 in 1992, and in accordance with the Interagency Coordination Agreement for Civil Works Projects, executed by the Florida Department of Environmental Protection and the U.S. Army Corps of Engineers, Mobile and Jacksonville Districts, on February 28, 2006, the State of Florida issues a Sovereign Submerged Lands Authorization (SSLA) to the Project sponsor. The SSLA is contained within the Consolidated Joint Coastal Permit (JCP) for placement areas located seaward of the ECL. The State of Florida issued the permit for 15 years in connection with use of the Project lands and costs associated with obtaining the permit from the State are administrative. The SSLA expires 10 September 2028 and allows Palm Beach County:

> *… to use sovereign submerged lands owned by the Board of Trustees of the Internal Improvement Trust Fund (Board of Trustees) to conduct a federally authorized beach nourishment project along approximately 1.0 mile of the Atlantic Coast shoreline south of Jupiter Inlet*
>
> *… the [Florida] Department [of Environmental Protection] has reviewed the activity described above, and has determined that the beach placement activities qualify for a letter of consent to use sovereign,*

submerged lands, as long as the work performed is located within the boundaries as described herein and is consistent with the terms and conditions herein. Therefore, consent is hereby granted, pursuant to Chapter 253.77, F.S., to perform these activities on the specified sovereign submerged lands.

The authorized footprint impacts two privately-owned and three publicly-owned properties landward of the ECL. In 1999, Palm Beach County acquired Easement Agreements for Beach Restoration (Agreements) over the one public and two private properties. The Agreements contain language consistent with the Perpetual Beach Storm Damage Reduction Easement estate including public use and access. SAJ has determined that the easements acquired for the Project provide sufficient rights to continue Federal participation. See Appendix E, Real Estate Plan, for further information.

Palm Beach County owns the remaining two publicly owned parcels in fee. The parcels are referred to as Jupiter Beach Park and Carlin Park and include public use and access.

Temporary work area easements are required for the one construction access at Dubois Park located north of the beach construction area and the staging area located at Jupiter Beach Park. Palm Beach County owns both parks in fee.

The designated offshore sand source, Jupiter Carlin A, is within State of Florida waters and permission to use the area will require a Sovereign Submerged Lands Easement (SSLE) issued to the sponsor by the State of Florida. Sand sources required for more than a single use require an easement from the State of Florida.

Upland domestic sand sources may be considered for future nourishments at a later time. Real estate acquisition is not required as the sand is purchased and trucked onto the site.

Palm Beach County will be required to re-certify the lands after the new Project Partnership Agreement execution and prior to construction contract award. The certification will re-confirm public use and access for the Project.

Public access within the Project has been reviewed and is determined to meet Federal access requirements for Federal participation. The real estate map located behind Exhibit E-1 in the Appendix E identifies public access and parking.

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CHAPTER 6

COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

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6 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS*

This chapter shows that the study coordination of the Recommended Plan is in compliance with all environmental requirements and the process has been shared with the public at the required intervals, through the National Environmental Policy Act (NEPA). Additionally, it shows how the Recommended Plan meets USACE environmental operating principles.

6.1 SCOPING*

A scoping letter dated October 6, 2016 was sent to agencies and the general public on the proposed Project. A Notice of Availability (NOA) of the Draft Integrated Section 934 Report and Environmental Assessment was also issued on March 10, 2017 to relevant stakeholders (see Appendix H: Pertinent Correspondence). As stated in the NOA, the draft document was placed on the USACE Jacksonville District's website and hard copies were placed in the Palm Beach County – Jupiter Branch Library. The comment period on the Draft Integrated Section 934 Report and Environmental Assessment ended on April 10, 2017. Pertinent correspondence associated with this NEPA scoping process is included in Appendix H.

6.2 COOPERATING AGENCIES

This Project has been coordinated with, but not limited to the following agencies: U.S. Fish and Wildlife Service, National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency, Florida State Clearinghouse, Florida State Historic Preservation Officer (SHPO), Florida Department of Environmental Protection, and Florida Fish and Wildlife Conservation Commission. No agency accepted USACE's invitation to participate as a cooperating agency. Correspondence from all Federal and State agencies is included in Appendix H.

6.3 LIST OF RECIPIENTS

The mailing list for the scoping letter dated October 6, 2016 and the NOA of the draft document can be found in Appendix H.

6.4 COMMENTS RECEIVED AND RESPONSES

NMFS Comments on Draft EA (see Appendix H)

Recommended updates to the analysis of effects in Section 5.7

COMMENT: The District should summarize the findings from past post-construction monitoring reports to support a conclusion that no additional impacts have occurred beyond those previously mitigated in the previously authorized fill template.

RESPONSE: A summary of findings has been added to Section 2.2.3 since this addresses the existing condition.

COMMENT: Life history stage information on the managed species affected should be provided for a complete EFH assessment.

RESPONSE: Additional information has been added on managed species and effects to Chapter 5.7. Pursuant to 50 CFR Part 600, Subpart K, Paragraph (3) mandatory contents for an EFH assessment, an analysis of the potential adverse effects of the action on EFH and the managed species has been provided.

COMMENT: Clarify which of the Tomlinson et al. (2006) (full citation not included in Chapter 8.1 References) actions identified on pages 5-9 and 5-10 to minimize and avoid impacts to fisheries and EFH would be part of the Project design. In particular, in the case the borrow area is near coral reef and hardbottom habitats, the NMFS recommends the dredging occur during times of year when coral spawning and heat stress are less likely to occur, e.g., July through October, based on Trnka and Moulding (2006). This would also be in line with the U.S. Coral Reef Task Force's Resolution 12-1: *Recommendations to Help Coral Spawning and Recruitment Events*. This Resolution acknowledges the structure and function of coral reefs depend on successful reproduction and survival of corals and early life history stages of corals are sensitive to sediments. The Resolution recognizes the timing and extent of spawning periods are known and can be predicted into the future, and this information can be used during the planning of human activities [dredging] to reduce or eliminate potential impacts to coral reproduction and recruitment (available at: *www.coralreef.gov/meeting12/res12-1.pdf*).

RESPONSE: Clarification on effects to EFH has been added. In regard to effects to hardbottom resources (i.e. hard corals), the USACE has determined that the recommended plan includes no expansion or increase in volume that would impact hardbottom resources outside of the authorized Project's equilibrium toe of fill. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the present Project should have no additional impact on hardbottom resources lying within the equilibrium toe of fill. Previous projects have provided mitigation for all such affected resources. All work within the offshore sand source, Jupiter Carlin A, and the beach placement location will be performed in compliance with Florida Department of Environmental Protection Joint Coastal Permit 0303863-002-JC (see Appendix H, Pertinent Correspondence).

COMMENT: The final EA should include a figure of the borrow area and any surrounding hardbottom areas. If there are hardbottom habitats with 400 meters of the borrow area, they should be monitored for sedimentation impacts. Depending on known oceanographic feature patterns in the area, a larger buffer distance may be needed.

RESPONSE: Figure 1 shows the location of hardbottom habitat, and Figure 4 shows the location of the offshore sand source, Jupiter Carlin A. As stated above, all work within the offshore sand source, Jupiter Carlin A, and the beach placement location will be performed in compliance with Florida Department of Environmental Protection Joint Coastal Permit 0303863-002-JC (see Appendix H, Pertinent Correspondence).

COMMENT: The final EA should include plans to monitor hardbottom habitats located adjacent to the fill template to ensure sedimentation and turbidity impacts to do not result.

RESPONSE: As stated above, the USACE has determined that the recommended plan includes no expansion or increase in volume that would impact hardbottom resources outside of the authorized Project's equilibrium toe of fill. Based on the equilibrated profile determination and the equivalence of sand grain size characteristics proposed for placement and those previously placed, the present Project should have no additional impact on hardbottom resources lying within the equilibrium toe of fill. Previous projects have provided mitigation for all such affected resources. All work within the offshore sand source, Jupiter Carlin A, and the beach placement location will be performed in compliance with Florida

Department of Environmental Protection Joint Coastal Permit 0303863-002-JC (see Appendix H, Pertinent Correspondence), which includes monitoring requirements.

COMMENT: The reference to red drum on page 5-10 can be moved to a non-EFH section of the draft EA because the Atlantic fishery for this species is no longer managed under the Magnuson-Stevens Act.

RESPONSE: Reference to red drum has been deleted from the EFH section.

COMMENT: The draft EA does not include any references published after the mid-1990s on relevant topics such as hardbottom habitats or the effects of dredging or beach fill on hardbottom habitats.

RESPONSE: Additional information from more recent references has been added.

Recommended updates to the description of the compensatory mitigation in Chapter 2.2.3

COMMENT: The District has provided conflicting information to the NMFS on the amount of mitigation reef created to offset the impacts to approximately eight acres of nearshore hardbottom habitat. As described above, the District describes the mitigation for the original authorization as including creation of 1.16 acres of artificial reef habitat, by letter dated August 14, 2015. However the draft EA, describes the construction of 4.28 acres of artificial reef habitat. Specifically, 3.30 acres is referred to as Cloth Reef and is composed of limestone boulders placed on geotextile cloth and 0.98 acres is referred to as Concrete Reef, and is composed of concrete rubble produced from the demolition of a bridge. The draft EA also summarizes results from the monitoring that occurred at the artificial reef habitat sites between 2000 - 2005. The NMFS recommends the District clarify in the final EA the amount of artificial reef constructed to date to mitigate impacts to natural nearshore hardbottom habitat along the Jupiter-Carlin stretch of beach.

RESPONSE: Chapter 2.2.3 has been revised to more clearly state the amount of artificial reef constructed to date to mitigate impacts to natural nearshore hardbottom habitat along the Jupiter-Carlin stretch of beach.

COMMENT: Lindeman et al. (2000) is cited in the document but not included in the References Chapter. Presumably this is a reference to the work titled *Developmental patterns within a multispecies reef fishery: management applications for Essential Fish Habitats and Protected Area*, Bulletin of Marine Science 66:929-956. If so, this paper does not speak to artificial reefs in the manner cited in the text, e.g., the paper does not call out artificial reefs, specifically mitigation reefs, as contributing to the cross-shelf habitat utilization by various species and life history stages of species managed in the snapper-grouper complex. The paper (on page 948) suggests artificial reefs could play a role, but excludes mitigation reefs constructed for shoreline projects. The citation should be removed or corrected.

RESPONSE: The citation has been removed.

NMFS ESSENTIAL FISH HABITAT (EFH) CONSERVATION RECOMMENDATIONS/COMMENTS REGARDING PALM BEACH COUNTY'S PROPOSED NORTH COUNTY COMPREHENSIVE SHORE PROTECTION PROJECT (INCLUDING JUPITER-CARLIN) (see Appendix H)

COMMENT: The District clarify and provide a map depicting the acreage of hardbottom impacts from past and proposed projects and the acreage of past mitigation actions successfully completed for beach nourishment at Jupiter-Carlin and Juno Beach (Segments I and III). See Table 1 for a summary of the discrepancies. If the mitigation amounts have fallen short of the amounts needed to offset the impacts, the NMFS recommends construction of additional mitigation reef.

RESPONSE: Palm Beach County steadfastly maintains that they have mitigated for all impacts associated with previous projects along Juno Beach and Jupiter-Carlin. Further, all predicted impacts associated with the presently proposed project have been previously mitigated by these efforts. The proposed project is not expected to impact any unmitigated hardbottom communities. A complete discussion and depiction of proposed impacts associated with the currently proposed project along with all mitigation previously constructed for the Jupiter-Carlin and Juno Beach projects was included in the original JCP Application submitted 30 November 2016 (DEP File No. 0303863-006-JM). The complete JCP application and all attachments were previously provided to USACE Regulatory Division on DVD. Portions of the Biological Assessment (BA) -- included as Attachment 18A of the JCP Application -- which are specifically relevant to mitigation reef construction are provided in Palm Beach County's Memorandum dated August 25, 2017 to Ms. Linda Knoeck (USACE Regulatory Division)(Appendix H: Pertinent Correspondence).

COMMENT: The District provide a copy of the pre-, during, and post-construction biological monitoring plan for the nearshore hardbottom communities located within and adjacent to the fill sites. The NMFS request an opportunity to comment on the plan before it is considered final.

RESPONSE: A proposed Biological Monitoring Plan was included with the original JCP Application as Attachment 24. Exposed reefs located adjacent to the fill sites have been previously mitigated. The County has proposed continuation of their well-established annual monitoring program as proposed in the Biological Monitoring Plan and reproduced as follows:

NEARSHORE REEFS

Palm Beach County presently commissions annual aerial photography of the project beaches and nearshore waters. These orthorectified photographs are used to digitize and catalog the extent of presumed hardbottom. Collection of photos and digitization of presumed hardbottom shall continue throughout the physical monitoring period following project construction: biennially until the next beach nourishment event or the expiration of the project life, whichever occurs first.

The project design life is planned to be 6 to 7 years. Aerial photographs are included in the list of deliverable items associated with the proposed physical monitoring plan. No additional in situ monitoring of nearshore hardbottom south of the project limits (R-38) is planned.

COMMENT: The District require best management practices to minimize effects from sedimentation and turbidity into the project design. This should include providing a compatibility analysis, with overfill ratios, of the proposed beach fill and native sediments.

RESPONSE: The District has been provided with a copy of the geotechnical summary of the sediments contained within the proposed offshore and upland borrow areas. This summary was included as Attachment 17 (and attending appendices) in the original JCP Application. The geotechnical report, without appendices, is included herein as **Attachment B**. Due to the large file size, the complete report will be resubmitted to USACE regulatory under separate cover.

COMMENT: In the case the borrow site is determined to be the source of the fill material, the standard best management practices for dredging in coastal waters are implemented:

Daily inspection of equipment for conditions that could cause spills or leaks; cleaning of equipment prior to operation near the water; proper location of storage, refueling, and servicing sites; and implementation of adequate spill response procedures and stormy weather preparation plans.

No staging, mobilization, demobilization, or anchoring of work vessels occurs over coral, coral reef, or hardbottom. The pipeline to be installed from the borrow site to the beach placement site should be installed in a manner that avoids impacts to coral, coral reef, and hardbottoms.

Monitoring of the pipeline from the borrow area to the beach placement sites for leaks no less than twice daily and for repair of leaks in a timely manner.

Limiting movement of the transport barges to corridors lacking hardbottom and coral habitat and for securing all towlines prior to movement to avoid contact with hardbottom or coral habitats.

RESPONSE: Standard best management practices for dredging in coastal waters shall be implemented during construction of this project. Specifically,

Leak detection shall be monitored on the dredge.

Placement of submerged pipeline utilized for hopper dredge pump out activities shall be limited to pipeline corridors and shall not cross reef tracts which have not been previously mitigated.

Pipeline corridors shall be depicted in the construction plans and established based upon pre-construction conditions.

FLORIDA STATE HISTORIC PRESERVATION OFFICER (see Appendix H)

COMMENT: A review of the Florida Master Site File indicates there are four (4) previously recorded sites in or adjacent to the proposed project area (8PB234, 8PB102, 8PB553, and 8PB16159); however, project plans indicate that the proposed beach nourishment areas do not coincide with or overlap any of the four resource locations. Therefore, it is the opinion of this office that the proposed project is unlikely to adversely affect historic properties.

However, unexpected finds may occur during ground disturbing activities, we request that project activities involving ground disturbing activities implement the following special condition regarding inadvertent discoveries:

If prehistoric or historic artifacts, such as pottery or ceramics, projectile points, dugout canoes, metal implements, historic building materials, or any other physical remains that could be associated with Native American, early European, or American settlement are encountered at any time within the project site area, the permitted project shall cease all activities involving subsurface disturbance in the vicinity of the discovery. The applicant shall contact the Florida Department of State, Division of Historical Resources, Compliance Review Section at (850)-245-6333. Project activities shall not resume without verbal and/or written authorization. In the event that unmarked human remains are encountered during permitted activities, all work shall stop immediately and the proper authorities notified in accordance with Section 872.05, Florida Statutes.

RESPONSE: The USACE will include construction contract requirements that address the objective and intent of the State's request. The State shall be notified if inadvertent discovery of cultural resources or human remains occurs.

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION-SOUTHEAST OFFICE COMMENTS (see Appendix H)

COMMENT: The proposed activity will require a Joint Coastal Permit from the Florida Department of Environmental Protection's Beaches Inlets & Ports Program.

RESPONSE: The non-Federal sponsor (Palm Beach County) has been issued a Joint Coastal Permit (0303863-002-JC) for the proposed work. However, the sponsor must apply for a modification to their permit in order to use the offshore sand source Jupiter Carlin "A."

COMMENT: The proposal should investigate and identify the presence of municipal and private stormwater discharge pipes to ensure these pipes are not filled in, and if so, alternative means of discharges are provided so as to not result in adverse flooding up gradient of the outfall pipes.

RESPONSE: Concur, the USACE shall investigate and identify the presence of municipal and private stormwater discharge pipes to ensure these pipes are not filled in.

6.5 ENVIRONMENTAL COMMITMENTS

The USACE shall comply with all terms and conditions of the biological opinions issued by the USFWS and NMFS, as well as the State permit, including but not limited to the following:

NEARSHORE HARDBOTTOM

All work conducted by the construction contractor within the offshore sand source, Jupiter Carlin A, as well as the pipeline used to convey sand to the beach placement area will include, but not necessarily be limited to, the following requirements:

- Prior to work, the Contractor shall submit a Hardground/Reef Protection Plan (Plan) that will be implemented for this Project. Acceptance by the Contracting Officer of the Protection Plan will not relieve the Contractor of responsibility of protection of the marine hardbottoms. The Contractor may be required to revise and resubmit plan. Lastly, the Plan shall list all the names, qualifications, and responsibilities of personnel involved with enforcing and conducting the Plan.

  The Plan shall include but not be limited to the following:

  a. Vessel, dredge, and equipment positioning systems that will be used to avoid identified hardbottom.

  b. Include how position of all pipelines, anchors, moorings and other floating equipment will be documented and inventory will be maintained throughout the life of contract.

  c. Include discussion how initial preparation of work crews and subcontractors will receive training on procedures to be used to avoid impacts to these areas.

  d. Include how The Contractor will use scientific divers to survey the pipeline corridor areas and offshore work areas to locate and avoid hardground resources prior to pipeline and equipment placement.

  e. The Plan shall indicate what remediation steps will be taken to avoid further impacts to hardgrounds if a pipeline leak is visually detected.

  f. Methods on how the Contractor will mobilize and demobilize floating equipment through the ingress/egress corridor to Project area if applicable.

- The Contractor shall protect hardbottom (reefs) during all phases of the Project. The Contractor shall adhere to Dredge and Vessel exclusion zones and "no dredge areas" shown on the drawings. The Contractor shall not anchor, place spuds, lay pipeline or place any other object on the hardbottom. The Contractor shall train all subcontractors and work crews involved with dredging, pipeline

installation, and equipment movements and storage on the procedures to be used to avoid impacts to offshore hardbottom communities. The training shall include methods or procedures to be used to avoid impacts and insure hardbottom protection.

- The Contractor shall not intentionally drag equipment along the nearshore sandy bottom during pumpout equipment relocation procedures. Furthermore, no cables, equipment or other objects shall sag or hang over the side of the dredge, any barges or tugs, or any other vessels, floating pipelines, pontoons or floating equipment. No floating equipment shall be allowed over the hardbottom (reef) systems, at any time. The Contractor shall directly push or tow with polypropylene (floating) lines all floating equipment that is not self-propelled, in the vicinity of hardbottom areas. These measures are required to avoid hardbottom damage from sagging cables or other objects.

- The Contractor shall use scientific divers to survey the pipeline corridor areas and offshore work areas to locate and avoid hardground resources prior to placement and anchoring of pipeline and equipment. These surveys shall include bounce dives on proposed pipeline placement routes and equipment anchoring and mooring locations to avoid damage to hardgrounds. If the Contractor elects to use side scan sonar or towed video transects for identification, scientific divers shall be used for bounce dives for verification of identified hardgrounds. Scientific divers shall also assist in the placement of any submerged pipelines to ensure that submerged pipelines are not placed over any significant hardbottom/reef areas. If pipeline leaks, mis-dumps, or spillage occurs, then scientific divers shall be used to verify the condition of nearby hardground areas.

- The method of transporting the fill from the offshore borrow area to the fill area shall be approved by the Contracting Officer. Prior to pipeline or equipment placement, the Contractor shall submit the hardbottom surveys conducted as described in the Contractor's Hardground/Reef Protection Plan.

- Any scow load or hopper dredge load that is released within State waters will be classified as a mis-dump and will result in a suspension of disposal operations and prompt monitoring of affected hardbottom areas. Redredging of such materials may be required as a prerequisite to the resumption of dredging unless the Contracting Officer, at their discretion, determines that redredging of such material is not practical or will impact more neighboring hardbottom. In addition, the Contractor shall notify the Contracting Officer within 24 hours of a misplaced dump. Corrective actions shall be implemented by the next offload at no additional expense to the Government, and the Contracting Officer shall be informed of actions taken.

- A pipeline dredge or hydraulic unloader may be used to transport material to the Project placement site. The Contractor shall maintain a tight discharge pipeline at all times. The joints shall be so constructed as to preclude spillage and leakage. If a dredging technique is used for this Project that requires anchoring, no anchoring shall occur within 500 feet of hardbottom or cultural resources. If pilings are used for anchorage at the beach fill site, the pilings shall be well marked and removed in their entirety upon completion of the Contractor's operation.

- Pipeline corridors will need to be field verified to avoid existing hardbottom areas. The Contractor shall not relocate these corridors. To avoid impacts to hardbottom areas, the Contractor shall field verify these corridors using side scan sonar and drop dives by scientific divers.

- Should any turbulence or siltation be found in the water along the pipeline route during inspections, the dredge shall immediately cease pumping sand and pump water until the pipeline is

cleared. At this point, the dredge shall shut down until a dive team with scientific divers can inspect the pipeline and assess the impacts to the neighboring hardbottom/reef communities.

- Water and excavated material shall not be permitted to overflow or spill out of barges, dump scows, or hopper dredges while in route. Excessive leakage is defined by average loss of draft during transit from the dredging area to the offloading area (forward draft loss plus aft draft loss divided by 2) in excess of 1 foot. Excessive leakage may be classified as a mis-dump and will prompt monitoring of affected hardbottom areas.

SEA TURTLES

- Constructing the Project outside of the primary sea turtle nesting season (May 1 through October 31).
- Educating the contractor and employees on possible environmental impacts and ways to minimize impacts to sea turtles.
- Incorporating sea turtle nest monitors to provide professional assistance.
- Relocating nests or sea turtles in immediate danger from construction activities.
- Stopping operation of beach equipment when sea turtles enter the immediate vicinity.
- Carefully selecting sand source to ensure the compatibility with the native beach sand.
- Requiring construction methods and materials have minimum impact (for example, limiting heavy machinery to defined areas).
- Compaction testing and, if necessary, tilling of the beach to achieve appropriate sand compaction for nesting turtles.
- All hopper dredging projects must employ sea turtle deflectors on the draghead unless the NMFS grants a waiver.
- Endangered Species Observers shall be present on all hopper dredges.
- The Contractor shall install baskets or screening over the hopper inflow(s) with no greater than 4" x 4" openings. The method selected shall depend on the construction of the dredge used and shall be approved by the Contracting Officer prior to commencement of dredging. The screening shall provide 100% screening of the hopper inflow(s). The screens and/or baskets shall remain in place throughout the performance of the work.
- The contractor shall instruct all personnel associated with the Project of the potential presence of the species and need to avoid collisions with sea turtles. All construction personnel are responsible for observing water-related activities for the presence of sea turtles.
- The contractor shall advise all personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles, which are protected under the Endangered Species Act of 1973.
- Siltation barriers shall be made of material in which a sea turtle cannot become entangled, be properly secured, and be regularly monitored to avoid entrapment. Barriers may not block sea turtle entry or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

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

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

- Any collision with and/or injury to a sea turtle shall be reported immediately to the National Marine Fisheries Service Protected Resources Division (727824-5312) and the local authorized sea turtle stranding/rescue organization.

MANATEES

- All personnel associated with the Project shall be instructed about the presence of manatees and manatee speed zones, and the need to avoid collisions with and injury to manatees. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act, the Endangered Species Act, and the Florida Manatee Sanctuary Act.

- All vessels associated with the construction Project shall operate at "Idle Speed/No Wake” at all times while in the immediate area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

- Siltation or turbidity barriers shall be made of material in which manatees cannot become entangled, shall be properly secured, and shall be regularly monitored to avoid manatee entanglement or entrapment. Barriers must not impede manatee movement.

- All on-site Project personnel are responsible for observing water-related activities for the presence of manatee(s). All in-water operations, including vessels, must be shut down if a manatee(s) comes within 50 feet of the operation. Activities will not resume until the manatee(s) has moved beyond the 50-foot radius of the Project operation, or until 30 minutes elapses if the manatee(s) has not reappeared within 50 feet of the operation. Animals must not be herded away or harassed into leaving.

- Any collision with or injury to a manatee shall be reported immediately to the FWC Hotline at 1-888-404-FWCC. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service in Jacksonville (1-904-7313336) for north Florida or Vero Beach (1-772-562-3909) for south Florida.

- Temporary signs concerning manatees shall be posted prior to and during all in-water Project activities. All signs are to be removed by the permittee upon completion of the Project. Awareness signs that have already been approved for this use by the Florida Fish and Wildlife Conservation Commission (FWC) must be used (see MyFWC.com). One sign, which reads *Caution: Boaters* must be posted. A second sign measuring at least 8 1/2" wide by 11" tall with rounded corners explaining the requirements for “Idle Speed/No Wake” and the shutdown of in-water operations must be posted in

a location prominently visible to all personnel engaged in water-related activities. Additional sign information can be found at the following FWC website:

http://myfwc.com/wildlifehabitats/managed/manatee/education-for-marinas/

SMALLTOOTH SAWFISH

- The permittee shall instruct all personnel associated with the Project of the potential presence of the species and need to avoid collisions with smalltooth sawfish. All construction personnel are responsible for observing water related activities for the presence of smalltooth sawfish.
- The contractor shall advise all personnel that there are civil and criminal penalties for harming, harassing, or killing smalltooth sawfish, which are protected under the Endangered Species Act of 1973.
- Siltation barriers shall be made of material in which a smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid entrapment. Barriers may not block smalltooth sawfish or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.
- All vessels associated with the construction Project shall operate at "No Wake/Idle" speeds as all times while in the construction area and while in water depths where the draft of the vessels provides less than a four-foot clearance from the bottom. All vessels will preferentially follow deep-water routes (e.g., marked channels) whenever possible.
- If a smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a smalltooth sawfish is seen within a 50foot radius of the equipment. Activities may not resume until the protected species has departed the Project area on its own volition.
- Any collision with and/or injury to a smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

TURBIDITY

- The Contractor shall monitor water quality (turbidity) at the dredging and beach placement sites, as required by the JCP and the 401 Water Quality Certification.
- If turbidity values at the dredging site exceed permitted values, the Contractor shall suspend all dredging activities. Dredging shall not continue until water quality meets state standards.

In addition the USACE commits to the following:

- Migratory birds (adult birds, eggs and chicks) shall be protected during construction activities.
- In the event that cultural resources are discovered (i.e., at new or expanded upland quarries), then protective measures shall be utilized.
- Air emissions such as vehicular exhaust and dust shall be controlled.

- The contracting officer would notify the contractor in writing of any observed noncompliance with Federal, state, or local laws or regulations, permits and other elements of the contractor's Environmental Protection Plan.
- The contractor would train his personnel in all phases of environmental protection.
- The environmental resources within the Project boundaries and those affected outside the limits of permanent work would be protected during the entire period of work.
- An oil spill prevention plan shall be required.

6.6 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) of 1969 (42 U.S.C. §4321 *et seq.,* P.L. 91-190)

An Environmental Assessment has been prepared and integrated into this report. As previously stated, a scoping letter dated October 6, 2016 was mailed out to all Federal, State, and local agencies and all adjacent property owners. A Notice of Availability (NOA) dated March 10, 2017 of the Draft Integrated Section 934 Report and Environmental Assessment was also issued to relevant stakeholders for review and comment (see Appendix H). Comments received from these sources have been addressed in this document. This Project is in full compliance with the National Environmental Policy Act.

6.7 ENDANGERED SPECIES ACT of 1973 (16 U.S.C. §1531 *et. seq.,* P.L. 93-205, 16 U.S.C. §1538)

This Project falls under the scope of the 1997 South Atlantic Regional Biological Opinion (as amended) for federally listed marine species. No additional coordination is required with NOAA Fisheries for these species. USACE has determined that the sand placement activities associated with this Project fall within the scope of the USFWS SPBO (2011), as amended in 2015, and the P3BO (2013). USACE has coordinated with USFWS for Project effects to species under their jurisdiction. USFWS, by letter dated February 7, 2017, concurred with the use of the SPBO and P3BO for the proposed work as well as effects determination of the rufa red knot (see Appendix H). This Project is in full compliance with the Endangered Species Act.

6.8 FISH & WILDLIFE COORDINATION ACT of 1958 also known as WILD LIFE CONSERVATION ACT (16 U.S.C. §§661-665; 665a; 666; 666a-666c)

A Coordination Act Report (1995) was prepared for the previously authorized Jupiter Carlin Segment of the Palm Beach County, Florida Shore Protection Project. For this study, the USFWS and the USACE, by agreement signed January 31, 2017 (see Appendix H), shall use the NEPA process and the Endangered Species Act consultation process to fulfill the requirements of this Act. This Project is in in full compliance with the Fish and Wildlife Coordination Act of 1958.

6.9 ANADROMOUS FISH CONSERVATION ACT (16 U.S.C. §§757A-757G)

Anadromous fish species would not be affected. The Project has been coordinated with NMFS and complies with the Anadromous Fish Conservation Act.

6.10 NATIONAL HISTORIC PRESERVATION ACT of 1966 (54 U.S.C. §306108)

The Proposed Action is in compliance with Section 106 of the National Historic Preservation Act, as amended (PL89-665). As part of the requirements and consultation process contained within the National Historic Preservation Act implementing regulations of 36 CFR 800, this Project is also in compliance with the Archaeological and Historic Preservation Act, as amended (PL93- 29), Archeological Resources Protection Act (PL96-95), American Indian Religious Freedom Act (PL 95- 341), Native American Graves Protection and Repatriation Act (NAGPRA), Executive Order 11593, 13007, and 13175, the Presidential Memo of 1994 on Government to Government Relations and appropriate Florida Statutes. The USACE issued a final consultation letter to the SHPO, the Seminole Tribe of Florida, and the Miccosukee Tribe of Indians summarizing the recommended plan, specifically for this EA on January 19, 2017, noting that the placement area and offshore sand source has already been approved in prior Section 106 reviews, and that the Project will not affect historic properties included in or eligible for inclusion in the National Register of Historic places (see Appendix H).

6.11 CLEAN WATER ACT of 1972 (33 U.S.C. §1344(b))

The non-Federal sponsor (Palm Beach County) has been issued a Joint Coastal Permit (0303863-002-JC) from the Florida Department of Environmental Protection (DEP) for the proposed work (see Appendix H). However, the sponsor must apply for a modification to their permit in order to use the offshore sand source Jupiter Carlin A. All state water quality requirements would be met. A Section 404(b) evaluation is included in this report as Appendix G, Attachment 1. The Project is in full compliance with this Act.

6.12 CLEAN AIR ACT of 1972 (42 U.S.C. §7506(c))

No air quality permits would be required for this Project. The Project is located within an attainment area and, therefore, a general conformity determination is not required.

6.13 COASTAL ZONE MANAGEMENT ACT of 1972 (15 CFR Part 930, Subpart C)

A Federal consistency determination in accordance with 15 CFR 930 Subpart C is included in this report as Appendix G, Attachment 2. The Joint Coastal Permit (0303863-002-JC) issued by the Florida Department of Environmental Protection has determined that the proposed work is consistent with the State's Coastal Zone Management Program. The Project is in full compliance with the Act.

6.14 FARMLAND PROTECTION POLICY ACT of 1981 (7 U.S.C. §4201 *et. seq.)*

No prime or unique farmland would be impacted by implementation of this Project. This act is not applicable.

6.15 WILD AND SCENIC RIVER ACT of 1968 (28 U.S.C. §1271 *et. seq.*)

No designated Wild and Scenic River reaches would be affected by project-related activities. This act is not applicable.

6.16 MARINE MAMMAL PROTECTION ACT of 1972 (16 U.S.C. §1361 *et. seq.*)

Incorporation of the safeguards used to protect threatened or endangered species during dredging and disposal operations will also protect any marine mammals in the area, therefore, this Project complies with the Marine Mammal Protection Act of 1972.

6.17 ESTUARY PROTECTION ACT of 1968 (16 U.S.C. §§1221-26)

No designated estuary would be affected by Project activities. This act is not applicable.

6.18 FEDERAL WATER PROJECT RECREATION ACT (16 U.S.C. §460l-12 *et seq.*, P.L. 89-72)

The principles of the Federal Water Project Recreation Act (Public Law 89-72), as amended, have been fulfilled by complying with the recreation cost-sharing criteria as outlined in Section 2 (a), paragraph (2). Another area of compliance includes the public beach access requirement on which the Project hinges [Section 1, (b)].

6.19 SUBMERGED LANDS ACT of 1953 (43 U.S.C.A. § 1312 *et. seq.*)

The Project would occur on submerged lands within of the State of Florida. The Project has been coordinated with the State and complies with the Submerged Lands Act of 1953.

6.20 COASTAL BARRIER RESOURCES ACT & COASTAL BARRIER IMPROVEMENT ACT of 1990 (16 U.S.C. §3501 *et. seq.*, PL 101-591)

The Coastal Barrier Resources Act (CBRA) and the Coastal Barrier Improvement Act of 1990 (CBIA) limit Federally subsidized development within the CBRA Units to limit the loss of human life by discouraging development in high risk areas, to reduce wasteful expenditures of Federal resources, and to protect the natural resources associated with coastal barriers. CBIA provides development goals for undeveloped coastal property held in public ownership, including wildlife refuges, parks, and other lands set aside for conservation ("otherwise protected areas," or OPAs). These public lands are excluded from most of the CBRA restrictions, although they are prohibited from receiving Federal Flood Insurance for new structures. This Project complies with the Coastal Barrier Resource Act and Coastal Barrier Improvement Act of 1990.

6.21 RIVERS AND HARBORS ACT of 1899 (33 U.S.C. §400 *et. seq.*)

The proposed work would temporarily obstruct navigable waters of the United States. The proposed action will be subject to the public notice, public hearing, and other evaluations normally conducted for activities subject to the Act. The Project is in compliance with this Act.

6.22 MIGRATORY BIRD TREATY ACT & MIGRATORY BIRD CONSERVATION ACT (16 U.S.C. §§703-712, 16 U.S.C. §715)

Migratory birds would be minimally affected by dredging at the proposed sand source locations. The USACE will include our standard migratory bird protection requirements in the Project plans and specifications and will require the Contractor to abide by those requirements. Nourishment activities at the beach placement site will be monitored at dawn or dusk daily during the nesting season to protect nesting migratory birds. If nesting activities occur within the construction area, appropriate buffers will be placed around nests to ensure their protection. The Project shall be in compliance with these Acts.

6.23 MARINE PROTECTION, RESEARCH & SANCTUARIES ACT (OCEAN DUMPING ACT) (33 U.S.C. §1401 *et. seq.*)

The term "dumping" as defined in the Act does not apply to the disposal of material for beach nourishment or to the placement of material for a purpose other than disposal (i.e. placement of material as an artificial reef or the construction of artificial reefs as mitigation). Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project.

6.24 MAGNUSON-STEVENS FISHERY CONSERVATION & MANAGEMENT ACT OF 1976 (16 U.S.C. §801 *et. seq.*, PL 104-208)

Pursuant to the 1999 Finding between USACE and NMFS, consultation with NMFS was conducted during the public review and comment period of the draft Environmental Assessment and draft Finding of No Significant Impact. NMFS, by letter dated April 10, 2017, provided comments on the draft Environmental Assessment. NMFS, by letter dated June 26, 2017, also provided Essential Fish Habitat conservation recommendations to USACE Regulatory Division regarding Palm Beach County's proposed beach nourishment of Segment 1 (the Jupiter Carlin segment of Palm Beach County shoreline). The Project is in full compliance with the Act.

6.25 UNIFORM RELOCATION ASSISTANCE & REAL PROPERTY ACQUISITION POLICIES ACT OF 1970 (42 U.S.C. §4601 *et. seq.*, PL 91-646)

The purpose of PL 91-646 is to ensure that owners of real property to be acquired for Federal and federally-assisted projects are treated fairly and consistently and that persons displaced as a direct result of such acquisition will not suffer disproportionate injuries as a result of projects designed for the benefit of the public as a whole. This Project does not involve any real property acquisition or displacement of property owners or tenants. Therefore, this act is not relevant to this Project.

6.26 EXECUTIVE ORDER (EO) 11990, PROTECTION of WETLANDS

No wetlands would be affected by Project activities. This Project complies with the goals of this Executive Order 11990.

6.27 E.O. 11988, FLOOD PLAIN MANAGEMENT

Executive Order 11988 requires Federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities."

The Water Resources Council Floodplain Management Guidelines for implementation of E.O. 11988, as referenced in USACE ER 1165-2-26, require an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to, or within, the floodplain. The eight steps reflect the decision-making process required in Section 2(a) of the EO. The eight steps and responses to them are summarized below.

1. Determine if a proposed action is in the base floodplain; the area which has a one percent or greater chance of flooding in any given year.

Yes, the Recommended Plan is within the base floodplain. However, this Project reduces damages caused by erosion, and flooding (or inundation) does not cause significant future without-project damages.

2. If the action is in the base floodplain, identify and evaluate practicable alternatives to the action, or to location of the action, in the base floodplain.

The purpose of a 934 analysis is to determine whether continued Federal participation in the authorized Project is economically justified. Beach nourishment projects are inherently located in coastal areas, and are often located in Coastal High Hazard Areas (CHHAs) based on the problems the Project is seeking to alleviate. The primary objective of this Project is to reduce infrastructure damage. There is no practicable alternative that could be located outside of the CHHA that would achieve this objective.

3. If the action must be in the floodplain, advise the general public in the affected area and obtain their views and comments.

All comments received during the public review of the draft report, as well as USACE responses, have been compiled within this report.

4. Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base floodplain will affect the base floodplain, impacts resulting from these actions should also be identified.

Potential impacts associated with the Recommended Plan are summarized in Chapters 3, 4, and 5 of this report. The Project will result in no net impact or similar impact.

5. If the action is likely to induce development in the base floodplain, determine if a practicable non-floodplain alternative for the development exists.

The Project will not encourage development in the floodplain. Development is expected to continue whether or not the action is taken, as demonstrated by coastal development around the State of Florida in areas both with, and without, constructed Federal CSRM projects. The Project provides benefits for existing development. The Project will not change the base floodplain. Furthermore, two-thirds of the study area lies within a Coastal Barrier Resources Act area which inhibits development and is a protective instrument, by design.

6. As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action, including any likely induced development for which there is no practicable alternative, and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.

The Project will not induce development in the floodplain, and the Project will not impact the natural or beneficial floodplain values. No-action alternative is, in effect, the existing and future without-project, as Federal participation in cost-sharing concluded in 2005. This report will determine whether continued Federal participation in the authorized Project is still economically justified.

7. If the final determination is made that no practicable alternative exists to locating the action in the floodplain, advise the general public in the affected area of the findings.

No comments were received in response to the October 6, 2016 scoping letter. All comments received during the public review of the draft report, as well as USACE responses, shall be compiled within the final report.

8. Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.

The Recommended Plan is the most responsive to all of the study objectives and is consistent with the requirements of EO 11988. This Project reduces damages caused by erosion, and flooding (or inundation) does not cause significant future without-project damages.

6.28 E.O. 12898, ENVIRONMENTAL JUSTICE

On February 11, 1994, the President of the United States issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. The Executive Order mandates that each federal agency make environmental justice part of the agency mission and to address, as appropriate, disproportionately high and adverse human health or environmental effects of the programs and policies on minority and low-income populations.

Any potential adverse effects of the proposed action would be more likely to affect those of higher socioeconomic status, such as large watercraft owners or those living in the coastal area surrounding the Project. The beneficial effect of a wider, more sustainable beach would benefit all members of the public who visit the beach. The storm damage reduction benefits are primarily benefitting the landowners in this area. There are no disproportionate adverse impacts to minority or low income populations resulting from the implementation of the Project.

6.29 E.O. 13089, CORAL REEF PROTECTION

The offshore sand source will seek to avoid impacts to hardbottom resources by implementing protective conditions as described in this document. Mitigation reefs constructed by Palm Beach County have offset impacts to nearshore epibenthic species. The Project is in compliance with Executive Order 13089.

6.30 E.O. 13112, INVASIVE SPECIES

The proposed action will require the mobilization of dredge equipment from other geographical regions. Dredge equipment has the potential to transport species from one region to another, introducing them to new habitats where they are able to out-compete native species. The benefits of the proposed Project

outweigh the risks associated with the very slight potential for introducing non-native species to this region. The action takes place primarily in Atlantic Ocean waters, minimizing risk to more sheltered coastal habitats. Beach placement would occur seaward of the dune vegetation. This area is periodically inundated with sea water which greatly reduces the risk of any invasive terrestrial plant from becoming established.

6.31 E.O. 13045, DISPARATE RISKS INVOLVING CHILDREN

On April 21, 1997, the President of the United States issued Executive Order 13045, *Protection of Children from Environmental Health Risks and Safety Risks*. The Executive Order mandates that each Federal agency make it a high priority to identify and assess environmental health risks and safety risks that may disproportionately affect children and ensure that its policies, programs, activities, and standards address disproportionate risks to children that result from environmental health risks or safety risks.

As the proposed action does not affect children disproportionately from other members of the population, the proposed action would not increase any environmental health or safety risks to children.

6.32 E.O. 13186, MIGRATORY BIRDS

This Executive Order requires, among other things, a Memorandum of Understanding (MOU) between the Federal Agency and the U.S. Fish and Wildlife Service concerning migratory birds. Neither the Department of Defense MOU nor the USACE's Draft MOU clearly address migratory birds on lands not owned or controlled by the USACE. For many USACE Civil Works projects, the real estate interests are provided by the non-Federal sponsor. Control and ownership of the Project lands remain with a non-Federal interest. Measures to avoid the destruction of migratory birds and their eggs or hatchlings shall be implemented.

6.33 ENVIRONMENTAL OPERATING PRINCIPLES

1. Foster sustainability as a way of life throughout the organization.

   The Recommended Plan incorporates RSM strategies by integrating into the Beach-*fx* engineering and economics model the placement of material that is already in the sediment system from the shoal complex, AIWW, and Inlet by non-Federal entities. This reduces the dredging need from offshore, previously undisturbed sediments.

2. Proactively consider environmental consequences of all USACE activities and act accordingly.

   The integration of the EA into the feasibility study requires all members of the Project Delivery Team to acknowledge the impact that the Project will have on the environment. This helps to ensure the Project is designed with the environment in mind.

3. Create mutually supporting economic and environmentally sustainable solutions.

   The use of the shoal complex in the Recommended Plan incorporates RSM strategies, which inherently incorporate outcomes that are economically and environmentally preferable.

4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by the USACE, which may impact human and natural environments.

This document includes all information necessary to document how the Project meets the USACE's corporate responsibility and accountability requirements for actions that may impact human and natural environments.

5. Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.

   The Project biologist is involved throughout the study process to ensure that environmental considerations are taken into account for the life of the Project.

6. Leverage scientific, economic and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.

   The entire Project Delivery Team understands the need to consider the environment during its decision-making process.

7. Employ an open, transparent process that respects views of individuals and groups interested in USACE activites.

   The actions taken to involve the public, resource agencies, and non-governmental organizations who may be interested in the Project are outlined in Chapter 6.

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CHAPTER 7

Recommendation

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7 RECOMMENDATION

After giving full consideration to all significant aspects in the overall public interest including engineering feasibility, economic, social, cost and risk analysis, and environmental effects of the Recommended Plan, I have concluded that continued Federal participation in this Project to 2045 is economically justified and environmentally acceptable. I recommend that Federal participation in the Jupiter Carlin Segment of the Palm Beach County, Florida, Shore Protection Project be extended, with such modification as in the discretion of the Commander, Headquarters, U.S. Army Corps of Engineers (HQUSACE), may be advisable.

The Recommended Plan is the National Economic Development (NED) Plan for the Jupiter Carlin Segment of the Palm Beach County, Florida, Shore Protection Project. The northern limit of the 1.1-mile Project is a 700 foot taper beginning at R-13 which extends south to approximately R-13.7. The Project's southern terminus concludes with a 1,200-foot taper between R-18 and R-19. The Project design consists of a 30-foot equilibrated sacrificial berm extension from the 1990 Mean High Water Line, a periodic nourishment volume of approximately 193,300 cy, and an average periodic nourishment interval of 6 years. A total of four periodic nourishment events are estimated for the remaining 26-year period of Federal participation, concluding in 2045. The Project First Costs are $47,551,000 (FY18 price levels) and will be cost shared 63% Federal and 37% non-Federal. Note, periodic nourishment cost sharing will be adjusted based on the conditions of shore ownership and use at the time of construction. The average annual net benefits for the Recommended Plan are $1,014,000 and the benefit cost ratio (BCR) is 1.49 to 1. The Recommended Plan, as described in this final report, provides the optimum solution for coastal storm risk management benefits within the study area that can be developed within the framework of the formulation concepts.

7.1 Items of Local Cooperation

Recommendations for provision of Federal participation in the recommended plan described in this report would require the Project sponsor to enter into a written Project Partnership Agreement, as required by Section 221 of Public Law 91-611, as amended, to provide local cooperation satisfactory to the Secretary of the Army. Such local cooperation shall include:

a. Per WRDA 1986, as amended, provide up to 35% of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100% of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits and as further specified below:
   1) Enter into an agreement that provides, prior to construction, up to 35% of design costs;
   2) Provide all lands, easements, and rights-of-way, and perform or ensure the performance of any relocations determined by the Federal Government to be necessary for the operation and maintenance of the Project;
   3) Provide, during construction, any additional amounts as are necessary to make their total contribution equal up to 35% of periodic nourishment costs assigned to hurricane and storm damage reduction, plus 100% of periodic nourishment costs assigned to protecting undeveloped private lands and other private shores which do not provide public benefits;
b. For so long as the Project remains authorized, operate, maintain, and repair the completed Project, or functional portion of the Project, at no cost to the Federal Government, in a manner compatible with the Project's authorized purposes and in accordance with applicable Federal and state laws and regulations, and any specific directions prescribed by the Federal Government;
c. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor, now or hereafter, owns or controls for access to the Project

for the purpose of inspecting, operating, maintaining, repairing, replacing, rehabilitating, or completing the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall relieve the non-Federal sponsor of responsibility to meet the non-Federal sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance;

d. Hold and save the United States free from all damages arising from the periodic nourishment, mitigation, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project related betterments, except for damages due to the fault or negligence of the United States or its contractors;

e. Keep and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

f. 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), Public Law 96-510, as amended, 42 U.S.C. 9601-9675, that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for the periodic nourishment, operation, and maintenance of the Project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

g. Assume complete financial responsibility for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the periodic nourishment, operation, or maintenance of the Project;

h. Agree that the non-Federal sponsor shall be considered the operator of the Project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, and repair the Project in a manner that will not cause liability to arise under CERCLA;

i. If applicable, comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the periodic nourishment, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said act;

j. Comply with all applicable Federal and state laws and regulations, including, but not limited to, Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d), 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 requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial 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 *et seq.*);

k. Provide the non-Federal share of that portion of the costs of data recovery activities associated with historic preservation that are in excess of 1% of the total amount authorized to be appropriated for the Project in accordance with the cost sharing provisions of the agreement;
l. Participate in and comply with applicable Federal floodplain management and flood insurance programs;
m. 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 authorized;
n. Prescribe and enforce regulations to prevent obstruction of or encroachment on the Project that would reduce the level of protection it affords or that would hinder future periodic nourishment and/or the operation and maintenance of the Project;
o. Not less than once each year inform affected interests of the extent of protection afforded by the Project;
p. Publicize floodplain information in the area concerned, provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the floodplain, and adopt such regulations as may be necessary to prevent unwise future development and to ensure compatibility with protection levels provided by the Project;
q. For so long as the Project remains authorized, the non-Federal sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based;
r. Provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms;
s. Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 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;
t. At least annually, and after storm events, perform surveillance of the beach to determine losses of nourishment material from the Project design section and provide the results of such surveillance to the Federal government; and
u. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires the non-Federal sponsor to participate in and comply with applicable Federal floodplain management and flood insurance programs, prepare a floodplain management plan within one year after the date of signing the Project Partnership Agreement, and implement the plan no later than one year after construction is complete.

7.2 Disclaimer

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 higher authority as proposals for Project modification and/or implementation funding. The recommendations herein for provision of a shore protection project for Palm Beach County, Florida do not include any provisions for work which would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Resources Act (Public Law 97-348); nor were funds obligated in past years for this Project for purposes prohibited by this act.

7.3 Certification of Public Accessibility

As part of the obligations established in the new Project Partnership Agreement for the Palm Beach County, Florida, Shore Protection Project, the non-Federal sponsor shall assure continued conditions of public ownership and public use of the shore upon which Federal participation is based during the economic life of the Project. The non-Federal sponsor shall also provide and maintain necessary access roads, parking areas, and other public use facilities, open and available to all on equal terms. In the determination of the Federal interest in cost sharing, Federal participation was limited to areas where public beach access and adequate parking are available. For shoreline reaches farther than ¼ mile from public access with adequate parking, Federal participation was not provided. The maximum Federal participation allowable for each land use category is applied for cost sharing. I, therefore, conclude that there is reasonable public availability of the project beaches in all areas where Federal participation is provided.

Jason A. Kirk, P.E.
Colonel, U. S. Army
District Commander

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CHAPTER 8
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CHAPTER 9
REFERENCES & INDEX

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