

Strategic Beach Management Plan

Southeast Atlantic Coast Region

Division of Water Resource Management
Florida Department of Environmental Protection
June 2015



Delray Beach Shore Protection Project being constructed in 2013.

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NORTHERN PALM BEACHES

There are 13.3 miles of beaches in the **Northern Palm Beaches** subregion, which extends from just north of the Martin-Palm Beach county line to Riviera Beach (R70) on Singer Island in Palm Beach County, as shown on Figure 1. There are 8.4 miles of critically eroded beaches in this subregion, of which 3.6 miles have been restored and maintained.

Erosion is attributed to frequent northeasters, occasional tropical storms and hurricanes, and the effects of Jupiter Inlet. The most erosive storms occurring in past years were Hurricane David (1979), the Thanksgiving Day Northeaster (1984), Hurricane Irene (1999), Hurricane Frances (2004), Hurricane Jeanne (2004), Hurricane Wilma (2005), Subtropical Storm Andrea (2007), October 2007 northeasters, Hurricane Noel (2007), Tropical Storm Fay (2008) and Hurricane Sandy (2012).

STRATEGIES FOR INLETS AND CRITICALLY ERODED BEACHES

BLOWING ROCKS BEACH, MARTIN COUNTY, R126-R127.4

This is a 0.2 mile segment of critically eroded beach on southern Jupiter Island, south of the Blowing Rocks Preserve public access in Martin County, where private development is threatened. Anastasia formation creates an exposed rock headland within the Preserve. The area south of the Preserve is subject to dynamic erosion and accretion cycles on the downdrift side of the rock headland. In response to the 2004 hurricanes, a dune restoration project was constructed in 2008. Hurricane Sandy in 2012 caused erosion to the dunes and repairs to the dune were necessary. The dune work was completed in November of 2012 with placing approximately 8,600 cubic yards (cy) that restored 1,100 ft of dune between R126-R127. In addition, roughly 200 cy of sand was placed within the seaward edge of the dune along each of the nine properties in that area. The upper limits of the placed sand was re-vegetated with sea oats.

Strategy: Maintain dune project and monitor.

CORAL COVE PARK, TEQUESTA, AND JUPITER INLET COLONY, PALM BEACH COUNTY, R1-R10

This is a 1.5 mile segment of critically eroded beach on southern Jupiter Island in Palm Beach County. It includes the communities of Tequesta and Jupiter Inlet Colony. In 1993, a dune restoration project

was completed in Coral Cove Park (R5-R7.6) using sand trucked to the site from an upland source. Armoring has been constructed along private development in Tequesta. This area was severely impacted by Hurricanes Frances and Jeanne in 2004. Following the 2004 hurricane season, emergency protective berms were constructed in 2005 using funds from FEMA and again in 2012 using state and local funds after the passage of Hurricane Sandy. A dune restoration project was completed in 2014 placing approximately 25,926 cy of material on the dune.

Strategy: Maintain dune project and monitor.

JUPITER INLET, PALM BEACH COUNTY, R12-R13

Jupiter Inlet is maintained by the Jupiter Inlet District. The 0.8 miles of inlet shoreline to the north and south of Jupiter Inlet have been designated as critically eroded inlet shoreline. The sediment impoundment basin located within the navigation channel is routinely dredged to a depth of -20 ft NGVD and the sand placed on the downdrift beach south of the inlet. The placement area (R12 – R19) is within the same template as the Jupiter-Carlin project limits. The Department of Environmental Protection (FDEP) adopted the [Jupiter Inlet Management Study Implementation Plan](#) in October 1997 that established an annualized bypassing objective of 75,000 cy. In 1999, the crests of both north and south jetties were raised, the south jetty was extended seaward, and the sediment impoundment basin was expanded as recommended in the adopted plan.

Strategy: Bypass sediment to downdrift beaches to meet an annualized bypassing objective of 75,000 cy; continue a physical monitoring program and, based on the results, update the sediment budget and then update inlet management plan.

JUPITER-CARLIN, PALM BEACH COUNTY, R12.5-R19

This is a 1.1-mile segment of critically eroded beach between Jupiter Beach Park and Carlin Park that is partially in the area of influence of Jupiter Inlet. The federal General Design Memorandum was approved in 1994, and the project history for this segment of shoreline is described in Table 1. Construction of the federally authorized **Jupiter Carlin Shore Protection Project** (R13.5-R19) was completed using sand from the ebb tidal shoal of Jupiter Inlet in April 1995. The project is authorized until 2039. The local sponsor is Palm Beach County. The project design consists of a beach berm at elevation +7.5 ft NAVD that constitutes seven years of advance nourishment to protect the existing dune and upland development. The project included construction of 3.5 acres of artificial reef to mitigate for

adverse impacts to ephemerally exposed nearshore hardbottom. The project generally met its performance goal of protecting the dune and upland property, except in the Jupiter Beach Park, which experienced severe erosion. After the 1995 restoration project, periodic placement of sand in the area coincided with maintenance dredging of Jupiter Inlet and the Intracoastal Waterway. Beach nourishment was conducted in March 2002, using sand from an offshore borrow site. A study to evaluate alternatives to address the erosional hotspot at Jupiter Beach Park was finalized in 2007. Dune restoration was completed in December of 2007 between R13-R17 as a result of damage from Subtropical Storm Andrea. The County completed a large-scale, non-federal dune maintenance project in January 2012, using 50,000 cy from an upland sand source. A dune maintenance project was completed in January 2013 to replace approximately 10,000 cy lost as a result of Hurricane Sandy. Prior to the next federal nourishment, a federal Section 934 report was required in order to evaluate economic feasibility of the project and approval is expected in August 2017.

The project received FCCE funding to repair damages sustained during Hurricane Sandy. In conjunction with the federal repair project which was to place approximately 132,638 cy of sand, the local sponsor conducted an additional project to place approximately 275,000 cy from an upland sand source. Construction of the federal project began in February 2014 but was delayed until winter. Both the federal and local project were completed in January 2015 and placed a total volume of 407,638 cy.

Table 1. Jupiter Carlin Shore Protection Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
April 1995	604,000	Ebb Tidal Shoal	R13-R19	1.05
March 2002	625,000	Offshore	R13-R19	1.05
January 2012	50,000	Upland	R13-R19	1.05
January 2013	10,000	Upland	Between R13-R19	0.4
January 2014	4,000	Offshore	Between R13-R19	0.4
January 2015	132,638	Offshore	R13-R15.5	0.4
January 2015	275,000	Upland	R15.5-R19	0.7

Strategy: Maintain the project through monitoring and nourishment.

TOWN OF JUPITER, PALM BEACH COUNTY, R19-R26

This is a 1.5 mile segment of critically eroded beach that is partially in the area of influence of Jupiter Inlet. No projects have been conducted in this segment of critically eroded beach. Jupiter Carlin is a feeder beach that has provided a degree of stability to the shoreline in this segment.

Strategy: Monitor

JUNO BEACH, PALM BEACH COUNTY, R26-R38

This is a 2.4-mile segment of critically eroded beach, and the project history for this segment of shoreline is described in Table 2. The local sponsor is Palm Beach County (County). Initial construction of the **Juno Beach Nourishment Project** (R26-R38) was completed in 2001 using 1,000,000 cy of sand obtained from an offshore borrow area. The project restored the beach berm at +9 ft NGVD and provided additional fill material equivalent to six years advance nourishment. A physical and environmental monitoring program was also required. Nourishment for this segment was completed in April of 2010 with 916,192 cy of sand from an offshore borrow area.

The project initially required construction of 4.47 acres of artificial reef to mitigate for adverse impacts to 3.77 acres of nearshore hardbottom. Post-construction aerial photography showed unanticipated coverage of hardbottom. The County proposed to construct an additional 0.75 acres within a permitted nearshore placement area near Singer Island to mitigate for the unintended impacts. Limestone rock boulders and experimental pre-fabricated reef modules were used in the reef design. The mitigation was completed in 2011.

Table 2. Juno Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
March 2001	1,000,000	Offshore Borrow Site	R26-R38	2.4
April 2010	916,192	Offshore Borrow Site	R26-R38	2.4

Strategy: Maintain the project through monitoring and nourishment.

SINGER ISLAND, PALM BEACH COUNTY, R60.5-R69

This is a 1.7 mile segment of critically eroded beach on Singer Island, and the project history for this segment of shoreline is described in Table 3. The local sponsor is Palm Beach County (County). A large rock outcrop (R-67) influences littoral sand transport and the width of the beach at Ocean Reef Park (R67-R68). North of the rock outcrop, erosion of the dune bluff threatens upland structures. Beginning in 2000, the County placed sand along the eroded dune bluff to protect upland structures. FDEP and the County initiated the first phase of a feasibility study of coastal erosion control structures in March 2001. Preliminary findings were inconclusive. An additional feasibility study was concluded in 2005, recommending the placement of beach erosion control structures. The County began permitting activities to construct 14 offshore breakwaters between R61-R68 in 2006. The project was modified to 11 breakwaters due to concerns of downdrift impacts. The breakwater design did not receive favorable approval by regulatory agencies. An alternatives analysis was completed in July of 2010 and proposed a submerged breakwater design. The project was permitted by FDEP, but was not pursued by the County. Numerous upland property owners have now pursued permits to armor their properties. Since 2013, seven upland properties have constructed seawalls to armor approximately 2,300 linear feet.

Table 3. Dune maintenance events in Singer Island.

YEAR	Volume (CY)	Source	Location	Length
2000-2001	10,000	Upland	R60.5 to R69	1.7
2003-2004	13,000	Upland	R60.5 to R69	1.7
2004-2005	56,000	Upland	R60.5 to R69	1.7
2005-2006	30,000	Upland	R60.6 to R63.5	0.5
2006-2007	49,338	Upland	R60.5 to R69	1.7
2007 Emergency Placement	49,955	Upland	R60.5 to R65.5	1.0
2007-2008	50,697	Upland	R60.5 to R65.5	1.0
2010-2011	30,313	Upland	R60.5 to R65.5	1.0
2012-2013	55,581	Upland	R60.5 to R65.5	1.0

Strategy: Maintain the dune project and monitor; reevaluate beach erosion control alternatives.

REGIONAL STRATEGIES FOR BEACH AND INLET MANAGEMENT

SPONSORS AND FUNDING

[Palm Beach County](#), the local sponsor of both the Jupiter-Carlin Park and Juno Beach projects, constructed the Jupiter-Carlin Park project with reimbursement funding provided by FDEP. Palm Beach County decided not to seek federal participation in the Juno Beach project in order to shorten the time between the planning phase and project construction. [Palm Beach County's Shoreline Protection Plan](#) dated 2014, highlights the Counties initiatives to preserve and manage their coastline. FDEP also participates with [Jupiter Inlet District](#) on inlet management activities at Jupiter Inlet and with Palm Beach County on dune construction projects. Project cost estimates and schedules may be found in [FDEP's Beach Management Funding Assistance Program](#) - Long Range Budget Plan.

PROJECT COORDINATION

Regionalization is the funding and coordination of multiple beach nourishment and inlet management activities to take advantage of identifiable cost savings through economies of scale, reduced equipment mobilization and demobilization costs, and elimination of duplicative administrative tasks.

Opportunities in this subregion include:

1. Coordination of maintenance dredging of Jupiter Inlet and the adjacent Atlantic Intracoastal Waterway with maintenance of the Jupiter-Carlin project.
2. Jointly soliciting bids for the nourishment of the Jupiter-Carlin Park and Juno Beach projects with other projects in the region.
3. A regional beach, inlet and offshore data collection and processing program to be used by the local sponsor for project monitoring is recommended.

ENVIRONMENTAL PROTECTION

The protection of marine turtles and hardbottom/reef habitat are the primary environmental concerns within this subregion. The projects have been designed and implemented to avoid or minimize adverse impacts to marine turtles and hardbottom and reef habitat. The timing of construction activities has been restricted during the sea turtle nesting season of March 1 through October 31. Some parts of Palm Beach County are reporting record nesting events through 2012. Artificial reefs have been constructed

as mitigation to offset adverse impacts to nearshore hardbottom caused by the Jupiter-Carlin and Juno Beach projects and are being monitored.

SAND SOURCES

Due to the fact that there are limited sand resources existing in State waters in Southeast Florida, FDEP and the [USACE](#) completed the [Sediment Assessment and Needs Determination \(SAND\) study](#). This study was conducted in a collaborative manner and was reviewed by and vetted through all the participating stakeholders. The SAND study determined that the regional offshore supply of sand in state and federal waters is more than adequate to meet the needs of all the beach nourishment projects in the five southeastern coastal counties, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade, for the next 50 years (year 2062), according to Ousley et al. (2014). Subsequently, FDEP analyzed the need for sand over the next 10 to 20 years for the five southeastern counties and determined that approximately 20 to 30 million cy will be needed for beach nourishment projects. Due to the narrow continental shelf adjacent to Florida's southeastern shoreline, it is expected that some counties may need to look for sand resources in upland sand mines and/or offshore borrow sites in neighboring counties; Miami-Dade County has already initiated this process.

It is recommended that continued coordination between FDEP, the USACE, [Bureau of Ocean Energy Management \(BOEM\)](#) and Local Governments to use best management practices with these offshore resources. For additional information on sand sources, FDEP manages a database named the [Regional Offshore Sand Source Inventory \(ROSSI\)](#).

ADDITIONAL INFORMATION

The introduction at the beginning of the state's Strategic Beach Management Plan provides additional information including overviews of:

- The principals followed to help guide the state's management strategies
- The miles of critically eroded beaches under active management
- Statewide sand source studies
- Statewide monitoring programs
- Innovative technologies examined
- Basic suggestions for emergency response plans

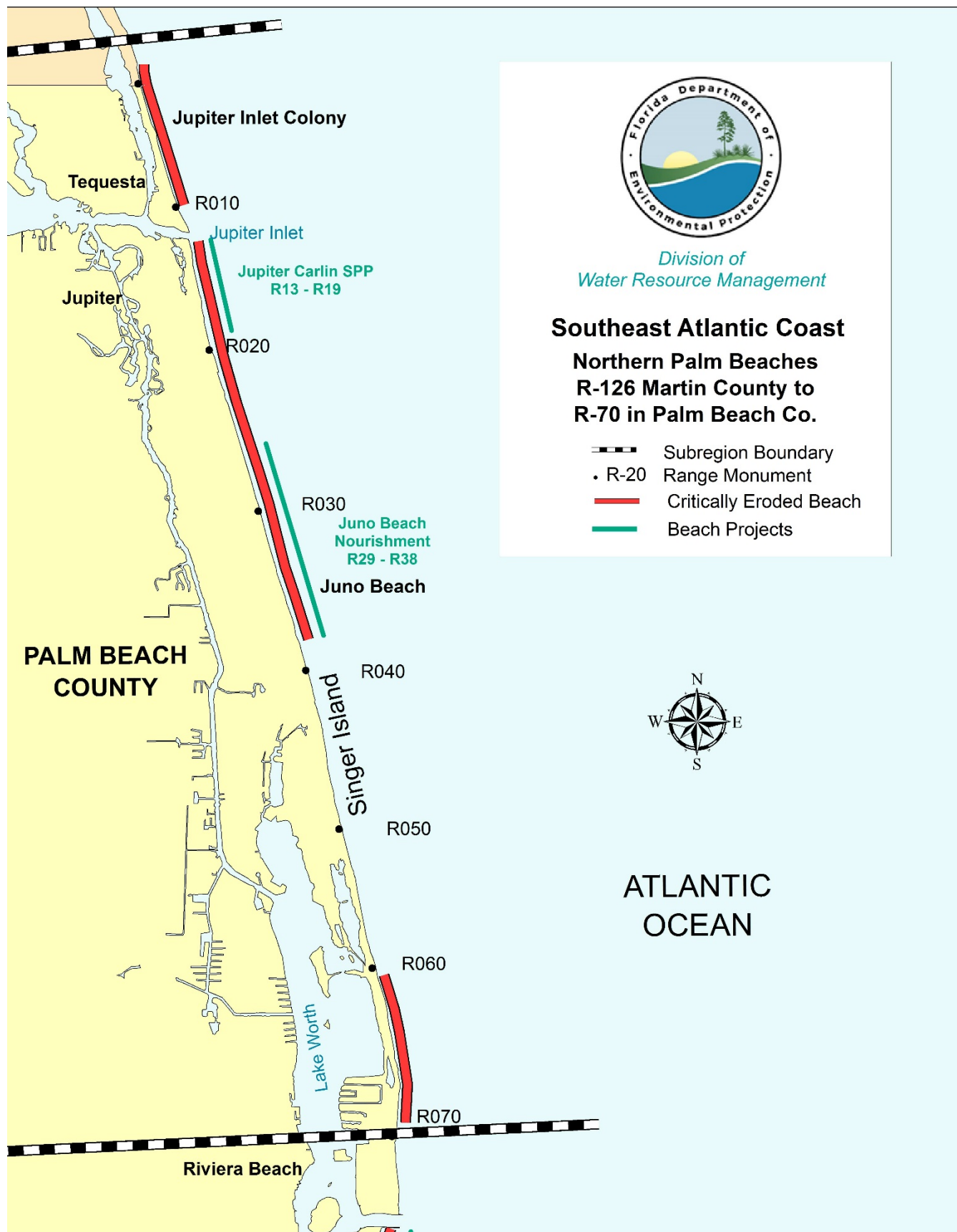


Figure 1. Northern Palm Beaches subregion of the Southeast region of Florida.

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PALM BEACHES

There are 20.7 miles of beach in the **Palm Beaches** subregion, which extends from Palm Beach Shores (R70) on Singer Island to Gulfstream (R170) in Palm Beach County, as shown on Figure 2. There are 15.2 miles of critically eroded beaches in this subregion, of which 6.1 miles have been restored or maintained.

Erosion is attributed to frequent northeasters, occasional tropical storms and hurricanes, and the effects of Lake Worth Inlet and South Lake Worth Inlet. The most erosive storms occurring in past years were Hurricane David (1979), the Thanksgiving Day Northeaster of 1984, Hurricane Irene (1999), Hurricanes Frances (2004), Hurricane Jeanne (2004), Hurricane Wilma (2005), Subtropical Storm Andrea (2007), October northeasters (2007), Hurricane Noel (2007), Tropical Storm Fay (2008) and Hurricane Sandy (2012).

STRATEGIES FOR INLETS AND CRITICALLY ERODED BEACHES

LAKE WORTH INLET, PALM BEACH COUNTY, R75-R76

Lake Worth Inlet, part of the federal **Palm Beach Harbor Navigation Project**, is periodically dredged to maintain a navigation channel depth of -35 ft MLLW. The channel is dredged typically every one or two years and the sand is placed either on the downdrift beach within 3,000 ft of the south jetty or in a permitted nearshore location. A sand transfer plant, maintained by the Town of Palm Beach and operated by Palm Beach County, was constructed on the north jetty in 1958 by the USACE. The USACE built a settling basin north of the north jetty between 1958 and 1968. The south jetty received repairs along with sand tightening in 1986. The sand transfer plant bypasses sand to the downdrift beach immediately south of the south jetty. FDEP adopted the [*Lake Worth Inlet Management Study Implementation Plan*](#) in 1996, but a bypassing objective was not established at that time.

A sediment budget study completed in 2000 recommended bypassing an average annual volume of 202,000 cy to the downdrift beaches. This volume has been bypassed through the downdrift placement of material dredged from the navigation channel and operation of the sand transfer plant

The USACE completed a navigation study in May 2001 that recommended sand tightening the north and south jetties, construction of a larger sediment impoundment basin, and renovation of the existing sand transfer plant to include a new motor, flood-proofing, and the southerly extension of the discharge

pipeline. The study recommended that Palm Beach County design and construct the sand transfer plant with reimbursement funding from the federal government. In February 2003, design and permitting for sand tightening of the jetties was completed and construction was completed later in 2003. FDEP issued a joint coastal permit authorizing expansion of the settling basin on the north side of Lake Worth Inlet. The expansion was not completed, but the Town of Palm Beach has already constructed a 3.1 acre artificial reef (2004) to address anticipated impacts from the expansion. During the 2004 hurricane season, the sand transfer plant was damaged and became inoperable. To reestablish sediment bypassing, repair of the facility was completed in March of 2005 using FEMA emergency funds. Repairs included a new motor and jet pump, new electrical, well and discharge lines and a larger sump pump. In August 2009, sand bypassing was suspended to begin a full rehabilitation of the sand transfer plant. The first phase of the rehabilitation included mechanical and electrical improvements, including a new electric motor, pump and crane. Sand bypassing began again in December 2009 while the second phase continued for the structural and architectural rehabilitation of the sand transfer plant. The rehabilitation was completed in April 2010. In October 2012, the sand transfer plant was damaged by Hurricane Sandy and was rendered inoperable until September 2013. For 18 years or since 1996, the sand transfer plant has bypassed approximately 2.6 million cy of sand to the downdrift beaches of Mid-Town.

Strategy: Bypass an average annual volume of 202,000 cy of sand to the downdrift beaches through a combination of the operation of the sand transfer plant and beach placement of maintenance dredge material from the federally authorized navigation channel; place all beach compatible material dredged during channel maintenance on downdrift beaches in Reach 1, in an extended beach placement in Reach 2, and when feasible, at Mid-Town and Phipps Ocean Park projects; dredging placement should be limited to dry beach; extension of the discharge pipeline to discharge points located at the south jetty, and approximately 3,600 ft south of the south jetty; expand the settling basin; comply with the Palm Beach Island Beach Management Agreement (BMA), 2013; update the sediment budget and the inlet management plan.

TOWN OF PALM BEACH, PALM BEACH COUNTY, R76-R134.4

This is a 12.2 mile segment of critically eroded beach where erosion is attributed to the effects of Lake Worth Inlet as far south as R121, approximately 50,000 ft. Most of this shoreline is armored with seawalls, bulkheads, and revetments. There are also numerous relic and functional groins. The Town of Palm Beach is the local sponsor for projects in this area. The area has been divided into eight reaches (Reaches 1 through 8). In 2001, the Palm Beach Island Feasibility Study of beach nourishment

alternatives commenced for three areas including Reach 2, Reach 5, and Reach 8. Efforts underway in Reaches 2, 3, 4, 5, 7 and 8 are discussed below.

On September 26, 2013, a pilot [Beach Management Agreement \(BMA\)](#) was signed to promote regionalization and incorporate cell wide management of the Palm Beach Island. The cell on Palm Beach Island is 15.7 miles of beach and is between Lake Worth Inlet and South Lake Worth Inlet at R76 through R151. The BMA includes the Lake Worth Inlet maintenance dredging placement, the Mid-town project, Phipps Project, groin maintenance and rehabilitation, and dune work throughout the island. The BMA incorporates net ecosystem benefits such as annual hardbottom, turtle and physical monitoring throughout the cell, retrofitting and minimizing outfalls that release waters onto the coastal system, and improved inlet management practices. The BMA is a perpetual and adaptively managed agreement that is reviewed annually, and a more detailed review every 5 years. The Mid-Town and Northern Reach 8 Projects, as well as dune restoration in reaches 7 and 8 are planned for the winter of 2014-2015.

Reach 1, (R76-R78.5) is a 0.5 mile segment of critically eroded shoreline. This area is directly south of Lake Worth Inlet in the Town of Palm Beach. This project area is maintained by inlet sand bypassing. Sandy material is bypassed to this project area on an annual basis. Recent bypass activities have indicated a deficit of sandy material reaching the settling basin on the north side of Lake Worth Inlet. The Town of Palm Beach has indicated it will investigate why this sand deficit is occurring at the settling basin with goals of improving the annual bypassing objectives.

Reach 2, (R78.5-R90.4) is a 2.5 mile segment of critically eroded shoreline. This area includes the beach between Onondaga Avenue and El Mirasol in the Town of Palm Beach. The Mid-Town beach restoration project was recommended based upon studies conducted in association with the Lake Worth Inlet Management Plan as a means to reestablish littoral transport to mitigate the effects of the inlet. Restoration in Reach 2 has not been conducted due to the vicinity of nearshore hardbottom and lack of public access. Future beach management alternatives may include construction of a sand bypassing discharge pipe from the Lake Worth Inlet sand transfer plant and rehabilitation or removal of derelict groins.

The **Mid-Town Beach Nourishment Project, also known as Reach 3, (R90.4-R95) and Reach 4 (R95-R102.3)**, is a 2.6 mile segment of critically eroded shoreline in the Town of Palm Beach and the project history for this segment of shoreline is described in Table 4. In December 1995, restoration of the Reach 4 segment was completed using 880,000 cy of sand from an offshore borrow site located south of Lake Worth Inlet ebb shoal. The project included construction of eleven groins that were

completed in April 1996. The beach fill design restores a 25 foot wide beach at elevation +9 ft NGVD and provides eight years of advance nourishment to offset future erosion losses. The restoration maintained a beach berm along most of the project length during the nourishment interval but experienced significant erosion at the north and south limits of the project. In February 2003, the project was expanded (R90.4-R101.4) to include a restoration in Reach 3 and a nourishment in Reach 4. The 2004 hurricane season caused significant beach erosion to the project and, in 2005, FEMA provided emergency funding to replace the lost sand. Nourishment of the project was performed in 2006 and restored the beach to the design template. A physical and environmental monitoring program has documented secondary impacts as a result of sand burial on nearshore hardbottom. Construction of artificial reef as mitigation for secondary impacts was required. In March 2011, a FEMA dune restoration project placed 52,000 cy of sand within the Reach 4 template using an upland sand source. The Town constructed an expanded Mid-Town Project in 2015 that extend the project northward to R89 into Reach 2 and southward to R100 in Reach 4 that placed approximately 966,587 cy of material on the beach.

Table 4. Mid-Town Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
December 1995	880,000	Offshore	R95 - R100	1.0
February 2003	1,273,100	Offshore	R90.4 - R101.4	2.2
February 2006	918,320	Offshore	R90.4 – 101.4	2.1
March 2010	52,000	Upland	R95-R100	1.0
April 2015	966,587	Offshore	R89-R100.6	2.2

Reach 5 (R102.3-R110.1) is a 1.7 mile segment of critically eroded beach between Banyan Road and Widener's Curve in the Town of Palm Beach. Much of the shoreline along this segment is hardened by seawalls and revetments with no significant public access. Restoration has not been conducted along this segment. Future beach management alternatives may include rehabilitation or removal of derelict groins.

Reach 6, (R110.1-R116.5) is a 1.3 mile segment of critically eroded shoreline in the Town of Palm Beach. This shoreline segment has remained stable due to the downdrift effects of the Mid-Town nourishment projects that has provided a sediment source for both Reaches 5 and 6.

The **Phipps Ocean Park Beach Restoration Project, also known as Reach 7**, (R116.5-R128.5) is a 2.3 mile segment of critically eroded shoreline in the Town of Palm Beach. In 2002, the design of an extended project (R116-R126) was completed and permitted by the FDEP. Issuance of the final federal permit was delayed pending completion of an environmental impact statement required by a settlement agreement of an administrative hearing challenging construction of the project. The project was subsequently reduced in length (R119-R126) and volume. The 2006 project restored 1.4 miles of beach at elevation +9 ft NGVD using 1.1 million cy of sand from two borrow sites located approximately 3,500 ft offshore and approximately 1.5 and 2.6 miles south of the beach placement area. The restoration was completed in 2006 and combined the construction of a dune from 450 ft south of R116 to R119, and from R126 to 100 ft south of R133.5 (excluding Lake Worth Pier Park). The beach fill design provided eight years of advance nourishment to offset future erosion. The project included construction of 3.1 acres of artificial reef to mitigate for adverse impacts to 3.1 acres of ephemerally exposed nearshore hardbottom. Another 0.8 acre deep-water mitigation reef was completed in 2006 as a federal requirement for the Project. This area experienced erosion during the 2008 storm season. Construction of a FEMA dune repair project using 56,000 cy from an upland sand source was completed in March 2011. The Town constructed again in January through February of 2015 for a beach nourishment project placing approximately 68,832 cy of material above the mean high water line within the Phipps project template.

Reach 8 (R128.5-R134.1) is a 1.3 mile shoreline segment in the Town of Palm Beach with an approximate 1,335 ft gap along the City of Lake Worth and the City's Municipal Pier area (R127.5-R128.7). The project segments between T125 and R128 and picking up again at R128.8 through R134.1 are designated critically eroded. The Lake Worth Pier Park recreational area is not designated critically eroded (R128 through R128.8). A permit application for beach restoration was denied in July 2009. The segment continued to experience erosion through storms and northeasters. Dune nourishment projects have been conducted to replace some of the sand losses. In December 2010, the Town of Palm Beach was permitted to construct dune restoration in the southern segment of the project using an upland sand source. A permit was issued for the northern segment of the project from R125-R127. The permit application states that the southern segment will not be included for beach restoration. However, the segment has been combined in an environmental impact study along with the County's South Palm Beach Island Restoration Project. Dune restoration was completed in April 2015 placing approximately 34,902 on the dune. Of the total volume, 18,540 cy was excavated from the existing beach and the remainder, 16,362 cy was excavated from the dredge sand stockpile from offshore material.

Strategy: Maintain the Town's restored projects through monitoring and nourishment using sand from offshore sources and upland sources; construct a feeder beach to reestablish littoral transport for Reach 2; and construct restoration projects in environmentally suited areas of Reach 5 and Reach 8. Comply with BMA (2013).

SOUTHERN PALM BEACH, LANTANA AND MANALAPAN, PALM BEACH COUNTY, R134.1-R145.8

The South Palm Beach Island Restoration Project, also known as the Central Palm Beach County Comprehensive Erosion Control Project, is a 2.3 miles of critically eroded beach along the shoreline of the Towns of South Palm Beach, Lantana, and Manalapan. This project area is listed in the [BMA](#) and is also known as Reach 9, 10 and a small portion of 11, as described on page 7 in Table 2. The critical erosion area (R134.1-R145.8) is slightly shorter in length than the project area as listed in the BMA. The Local Sponsor is Palm Beach County. The project has experienced severe erosion and has received several dune maintenance nourishments. A majority of the project is armored by bulkheads and revetments, some of which were compromised during storms and other significant erosion events. Damage to the dune and the threat to upland structures at Lantana Public Beach resulted in the construction of a sheet pile wall at this location in 2009. Palm Beach County completed a feasibility study to assess beach management alternatives in 2000. The selected project from the study was beach restoration with coastal erosion control structures to reduce the volume of fill material and thereby reduce adverse effects to extensive nearshore hardbottom. The offshore breakwaters were proposed to extend north into the Town of Palm Beach to R132. An interlocal agreement was executed between the Town of Palm Beach and Palm Beach County as a result of this design change. The project was never constructed by Palm Beach County. As of July 2012, Palm Beach County continues with additional modeling to explore sand-based alternatives. The results of the modeling studies are to be included in an Environmental Impact Statement. Hurricane Sandy in October of 2012 inflicted severe beach erosion and structural damages along 1.4 miles (R138.4-R145.8) of coastline at Manalapan. The segment is now designated critically eroded.

Strategy: Conduct dune restoration where feasible; complete feasibility study to determine environmentally acceptable designs for beach restoration. Comply with BMA (2013).

SOUTH LAKE WORTH INLET, PALM BEACH COUNTY, R151-R152

South Lake Worth Inlet (also known as Boynton Inlet and Ocean Ridge Inlet) is a man-made inlet managed by Palm Beach County. A sand transfer plant constructed on the north jetty bypasses sand to the downdrift beach south of the inlet. Strong tidal currents prevent shoaling of the channel, which has a hard rock bottom at a nominal depth of -12 ft NGVD. A sediment impoundment basin (sand trap) is located along the south side of the interior entrance channel. FDEP adopted the [South Lake Worth Inlet Management Study Implementation Plan](#) in March 1999, which established an annualized bypassing objective of 88,000 cy of sand, including a minimum of 60,000 cy of sand bypassed by the sand transfer plant.

In July 2001, an engineering study was completed that identified design parameters and provided cost estimates to reconstruct the plant. In August 2002, construction was completed on an expansion of the sand trap as recommended in the adopted inlet management plan. In 2011, the construction of the sand transfer plant upgraded the engine from diesel to electric, increased the size of the discharge pipe, and improved the efficiency of the bypassing system at the inlet as recommended in the 1999 adopted inlet management study. Dredging and expansion of the sand trap are anticipated for completion in fall 2014. Seagrass mitigation for the expansion is ongoing. Palm Beach County is currently working on developing a local updated inlet management plan.

Strategy: Continue to bypass suitable sediment to the downdrift beaches to meet an annualized bypassing objective of 88,000 cy, including a minimum of 60,000 cy mechanically bypassed by the sand transfer plant; maintain the sand transfer plant and extend the discharge pipeline along the beach south of the inlet; provide multiple discharge points to optimize placement of fill implement a comprehensive monitoring plan; update the sediment budget and the inlet management plan.

OCEAN RIDGE, PALM BEACH COUNTY, R152-R168

The **Ocean Ridge Beach Nourishment Project** is within a 3.3 mile segment of critically eroded beach that is partially within the area of influence of South Lake Worth Inlet. The project is within the limits of the Town of Ocean Ridge but the local sponsor is Palm Beach County. The project is authorized until 2039 and has a 6 year nourishment interval, and the project history for this segment of shoreline is described in Table 5. In April 1998, construction of the federally authorized **Ocean Ridge Beach Nourishment Project** (R152-R159) was completed along 1.4 miles of beach using 784,300 cy of sand from a borrow site located 2,100 ft offshore of the project area. The project included construction of

eight groins. The project restored a beach berm at elevation +9 ft NGVD, and provided six years of advance nourishment (assuming a minimum of 60,000 cy of sand is bypassed annually by the inlet sand transfer plant). The project included construction of 2.0 acres of artificial reef to mitigate for adverse impacts to 2.0 acres of nearshore hardbottom. A physical and environmental monitoring program was conducted to verify the predicted impacts to nearshore hardbottom. Through 2004, the project met its performance goal of preserving a beach berm to the design parameters.

This area sustained impacts during the 2004 hurricane season. The USACE provided emergency funding to accelerate the maintenance nourishment and replace the material lost to storms. Construction of the nourishment project (R153-R159) was completed in November 2005 along 1.1 miles of beach using 558,000 cy of sand from the same offshore borrow site. The 2005 nourishment project excluded the R152-R153 project limits since the sand transfer plant maintained the beach in the groin field and to avoid additional coverage of the hardbottom areas located to the north of the project area (between R152 and R153) near the groin field. Environmental monitoring of the restoration project indicated additional impacts as a result of the 1998 project beyond the 2.0 acres of predicted impacts. Palm Beach County constructed 2.25 acres of artificial reef to mitigate for these impacts. The project was nourished again in 2014 with placement of 503,690 cy of sand. The stems of the eight T-head groins at Ocean Ridge were reduced in elevation from +7.5 ft NAVD 88 to +4.5 ft NAVD 88 to increase bypassing.

Table 5. Ocean Ridge Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1998	784,300	Offshore	R152-R159	1.4
2005	558,000	Offshore	R153-R159	1.1
2014	503,690	Offshore	R153-R159	1.1

Strategy: Maintain the project through inlet bypassing, monitoring and nourishment using sand from offshore sources.

REGIONAL STRATEGIES FOR BEACH AND INLET MANAGEMENT

SPONSORS AND FUNDING

There are two federally-authorized Beach Erosion Control Projects that provide for federal cost sharing in Palm Beach County: a 1958 authorization for beach restoration and nourishment of Palm Beach

Island, construction and operation of a sand transfer plant at Lake Worth Inlet; and a 1962 authorization for beach restoration and nourishment of the remainder of the county. The [Town of Palm Beach](#), the local sponsor of the Mid-Town Beach and Phipps Ocean Park projects, is not seeking federal participation in the costs of these projects, based upon the additional administrative expenses required to obtain the relatively small percentage of federal cost sharing in these projects. [Palm Beach County](#), the local sponsor of the Ocean Ridge project, constructs the project with reimbursement funding provided by the state and federal government. [Palm Beach County's Shoreline Protection Plan](#) dated 2014, highlights the Counties initiatives to preserve and manage their coastline. Project cost estimates and schedules may be found in [FDEP's Beach Management Funding Assistance Program](#) - Long Range Budget Plan.

PROJECT COORDINATION

Regionalization is the funding and coordination of multiple beach nourishment and inlet management activities to take advantage of identifiable cost savings through economies of scale, reduced equipment mobilization and demobilization costs, and elimination of duplicative administrative tasks. Palm Beach County has been actively coordinating the management of inlets within this subregion with the USACE. The Town of Palm Beach has executed an agreement with the Corps to place dredged material from the maintenance of the Lake Worth Inlet navigation channel at the Mid-Town Beach project. The Ocean Ridge beach restoration project is designed to use sand transferred by the plant at South Lake Worth Inlet to maintain the beach between nourishment events. A regional beach, inlet and offshore data collection and processing program is recommended to be used by the project sponsors in their monitoring programs.

ENVIRONMENTAL PROTECTION

The protection of marine turtles and hardbottom habitat are the primary environmental concerns within this subregion. The projects have been designed and implemented to avoid or minimize adverse impacts to marine turtles and hardbottom habitat. The timing of construction activities has been restricted during the marine turtle nesting season of March 1 through October 31. Artificial reefs were constructed as mitigation to offset adverse impacts to nearshore hardbottom caused by the Ocean Ridge project and for the Phipps Ocean Park project. Environmental impact statements will be prepared during the design phase of all projects selected from the Palm Beach Island Feasibility Study.

SAND SOURCES

Due to the fact that there are limited sand resources existing in State waters in Southeast Florida, FDEP and the USACE completed the [*Sediment Assessment and Needs Determination \(SAND\) study*](#). This study was conducted in a collaborative manner and was reviewed by and vetted through all the participating stakeholders. The SAND study determined that the regional offshore supply of sand in state and federal waters is more than adequate to meet the needs of all the beach nourishment projects in the five southeastern coastal counties, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade, for the next 50 years (year 2062), according to Ousley et al. (2014). Subsequently, FDEP analyzed the need for sand over the next 10 to 20 years for the five southeastern counties and determined that approximately 20 to 30 million cy will be needed for beach nourishment projects. Due to the narrow continental shelf adjacent to Florida's southeastern shoreline, it is expected that some counties may need to look for sand resources in upland sand mines and/or offshore borrow sites in neighboring counties; Miami-Dade County has already initiated this process.

It is recommended that coordination between FDEP, the [*USACE*](#), [*BOEM*](#) and Local Governments to use best management practices with these offshore resources. For additional information on sand sources, FDEP manages a database named the [*Regional Offshore Sand Source Inventory \(ROSSI\)*](#).

ADDITIONAL INFORMATION

The introduction at the beginning of the state's Strategic Beach Management Plan provides additional information including overviews of:

- The principles followed to help guide the state's management strategies
- The miles of critically eroded beaches under active management
- Statewide sand source studies
- Statewide monitoring programs
- Innovative technologies examined
- Basic suggestions for emergency response plans

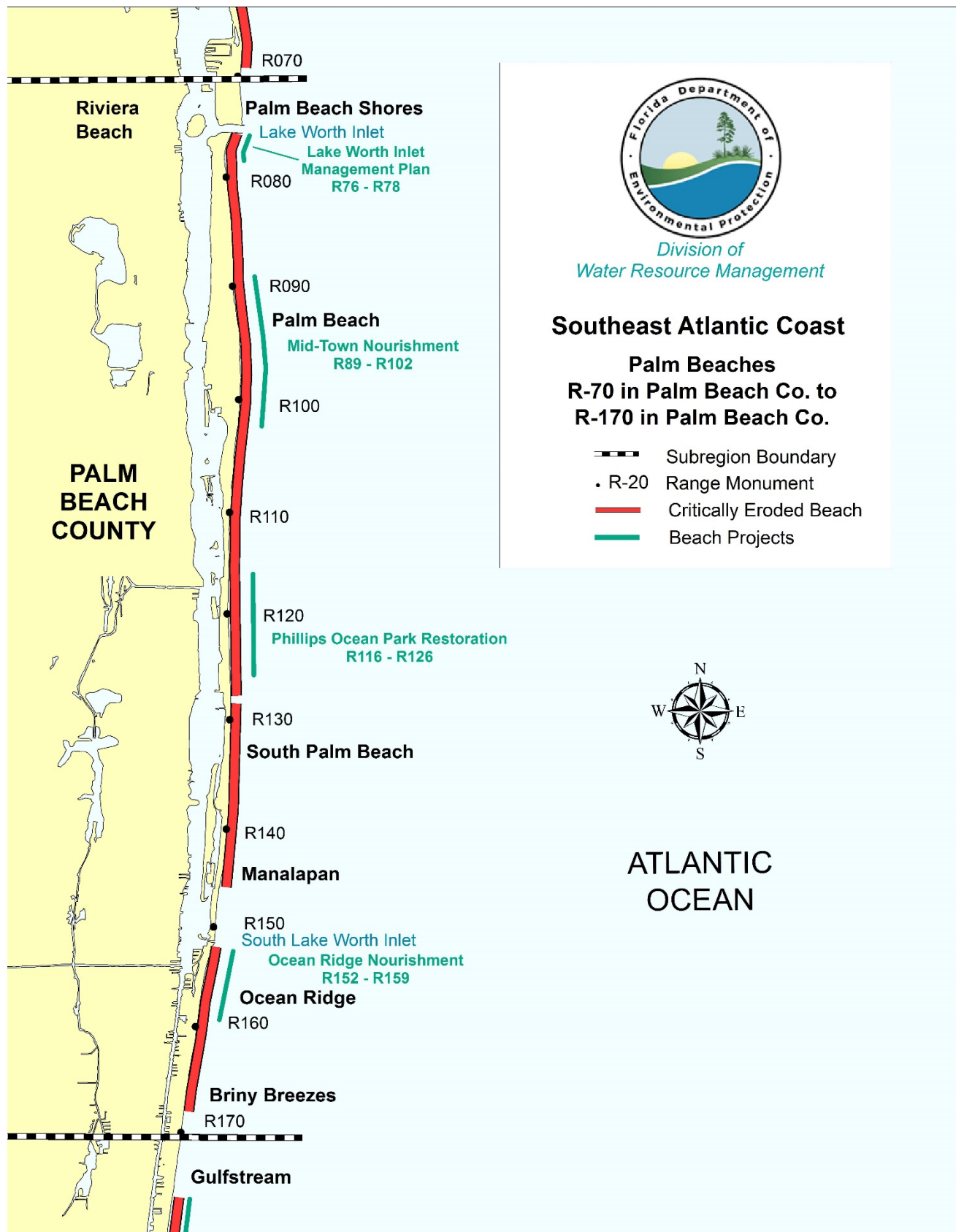


Figure 2. Palm Beaches subregion of the Southeast region of Florida.

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SOUTHERN PALM BEACHES

There are 11.8 miles of beaches in the **Southern Palm Beaches** subregion, which extends from Gulfstream (R170) to the Palm Beach – Broward County line, as shown on Figure 3. There are 7.9 miles of critically eroded beaches in this subregion, of which 6.7 miles have been restored or maintained.

Erosion is attributed to frequent northeasters, occasional tropical storms and hurricanes, and the effects of Boca Raton Inlet. The most erosive storms occurring in past years were Hurricane Irene (1999), Hurricane Frances (2004) and Hurricane Jeanne in (2004), Hurricane Wilma (2005), Subtropical Storm Andrea (2007), October northeasters (2007), Tropical Storm Noel (2007), Tropical Storm Fay (2008) and Hurricane Sandy (2012).

STRATEGIES FOR INLETS AND CRITICALLY ERODED BEACHES

DELRAY BEACH, PALM BEACH COUNTY, R176-R190

In July 1973, construction of the federally-authorized **Delray Beach Shore Protection Project** (R175-R188) was completed on this 2.9 mile segment of beach using sand from an offshore borrow area. The project is authorized until 2023, and the project history for this segment of shoreline is described in Table 6. The project restored a beach berm at elevation +9 ft NGVD and provided six years of advance nourishment. In addition to the restoration, six nourishments have been performed by the City of Delray Beach. Beginning with the 1992 beach nourishment, the design interval between beach nourishment events increased to eight years. The project has exceeded its performance goal of preserving a beach berm through the eight year nourishment interval. This area was eroded during the 2004 hurricane season. The USACE provided emergency funding to replace the material lost to storms. Construction of the emergency nourishment project was completed in 2005. Beach nourishment was conducted again in 2013 and in 2014, due to erosion caused by Hurricane Sandy.

Table 6. Delray Beach Shore Protection Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
July 1973	1,635,000	Offshore	R175.5-R188.5	2.7
May 1978	701,000	Offshore	R177.2-R182.7 and R185.5-R188.5	1.8

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
October 1984	1,300,000	Offshore	R175.5-R188.5	2.7
December 1992	1,196,500	Offshore	R180-R188.5	1.7
April 2002	1,230,000	Offshore	R180-R188.5	1.7
April 2005	411,600	Offshore	R175.5-R188.5	2.7
April 2013	1,158,500	Offshore	R179 – R188A	1.9
April 2014	380,000	Offshore	R179 – R188A	1.0

Strategy: Maintain the project through monitoring and nourishment using sand from offshore or upland sources.

BOCA RATON, PALM BEACH COUNTY, R204-R223

This is a 3.8 mile segment of critically eroded beach in the City of Boca Raton. Beach restoration and nourishment have been conducted within a portion of this area, and the project history for this segment of shoreline is described in Table 7. In August 1988, construction of the federally-authorized North **Boca Raton Shore Protection Project** (R205-R212) was completed using sand from an offshore borrow site. The North segment of the project is authorized until 2038. The local sponsor is the City of Boca Raton. The project restored the beach berm at elevation +7.4 ft NAVD 88 and provided ten years of advanced nourishment. The project included construction of six artificial reef modules as mitigation for impacts to nearshore hardbottom and a rock groin to protect the nearshore hardbottom known as Red Reef Rock. In April 1998, beach nourishment was completed and no additional impacts to nearshore hardbottom were indicated by environmental monitoring; however, continued physical and environmental monitoring was conducted to measure the effects of the project. The project met its performance goal of preserving a beach berm through the ten year nourishment interval. This area was eroded during the 2004 hurricane season. In 2006, the design and permitting of a maintenance nourishment event was initiated. Construction of the second nourishment was completed in March of 2010. The third nourishment was constructed in coordination with the federal Hurricane Sandy storm repair, initiated in spring 2014 and completed in December 2014.

Table 7. North Boca Raton Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
August 1988	1,100,000	Offshore	R205-R212	1.5
April 1998	680,000	Offshore	R205-R212	1.5
March 2010	782,200	Offshore	R201-R205	0.8
December 2014	561,611	Offshore	R205-R212	1.5

In April 2004, construction of the **Central Boca Raton Beach Nourishment Project** (R216-R222) was completed using a borrow site located 2,500 ft offshore. The local sponsor of the project is the City of Boca Raton, and the project history for this segment of shoreline is described in Table 8. The project restored the beach berm at an elevation of +7.4 ft NAVD 88 and provided eight years of advance nourishment along 1.5 miles of shore using 480,000 cy of sand. The project included construction of a groin 1,500 ft north of the Boca Raton Inlet to stabilize a highly erosional area and reduce the spreading loss of fill material into the inlet. The north jetty was reconstructed and the weir was relocated 50 ft seaward to accommodate for the nourishment and extension of the MHW line. This area was eroded during the 2004 hurricane season. A maintenance nourishment event to refill the template was completed in March 2006 using sand from the Boca Raton Inlet ebb shoal. The first nourishment project is scheduled to be constructed during the 2015/16 construction window.

Table 8. Central Boca Raton Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
April 2004	480,000	Offshore	R-216 to R-222	1.5
March 2006	340,000	Ebb Shoal	R-216 to R-222	1.5

Strategy: Maintain the North and Central projects through monitoring and nourishment using sand from offshore sources; monitor the remaining critically eroded beach located between the north and central project portions of Boca Raton.

BOCA RATON INLET, PALM BEACH COUNTY, R222-R223

This inlet is maintained by the City of Boca Raton. A city-owned hydraulic dredge transfers sand from the inlet channel to the downdrift beach south of the inlet maintaining an average channel depth of approximately -6 ft MLW. FDEP adopted the [Boca Raton Inlet Management Study Implementation Plan](#) in 1997 that established an annualized bypassing objective of 71,300 cy, which has been achieved. FDEP and local sponsor initiated a study in October 2002 to update the inlet sediment budget and validate the bypassing objective and inlet management practices. In 2004, the bypassing objective was revised and increased to 83,000 cy per year and was formally adopted in the 2008 SBMP. The bypassing objective is achieved through a combination of maintenance dredging using the City-owned dredge and nourishment of downdrift beaches using the inlet ebb shoal as a borrow source. In conjunction with the Central Boca Raton Beach Restoration Project, the weir in the north jetty was relocated 50 ft seaward. The north jetty, which was damaged in the 2004 hurricane season, was rehabilitated in 2008. The Department conducted a regional sediment budget analysis in 2015 and determined the inlet sand bypassing activities have balanced the sediment budget of Boca Raton Inlet and Hillsboro Inlet with the adjacent beaches. It is recommended that biennial, synoptic surveys of the beaches and inlets be conducted, and after the collection of sufficient data, a sediment budget then be prepared using a methodology from the Army Corps of Engineers' Coastal Engineering Manual.

Strategy: Through a combination of mechanical sand bypassing by the City-owned dredge and nourishment of the South Boca Raton project using the ebb shoal as a borrow source, bypass sediment to downdrift beaches to meet an annualized bypassing objective of 83,000 cy; update the sediment budget and the inlet management plan; conduct a feasibility study to evaluate options of beach placement locations at South Boca Raton Beach, Deerfield Beach and Hillsboro Beach.

SOUTH BOCA RATON, PALM BEACH COUNTY, R223-R227.9

This is a 1-mile segment of critically eroded beach in the City of Boca Raton, and the project history for this segment of shoreline is described in Table 9. In July 1985, the construction of the non-federal **South Boca Raton Beach Nourishment Project** was completed using sand from the ebb tidal shoal of Boca Raton Inlet. The local sponsor is the City of Boca Raton. The project restored a beach berm at elevation +8.4 ft NAVD 88 and consists entirely of advance nourishment to maintain the historic 1975 shoreline position and to serve as a feeder beach that bypasses sand to the downdrift shore. Subsequent nourishment in 1996 and 2002 also used the ebb tidal shoal. The length of the 2002 project was

extended to the south county line and is the current project limits that included construction of 2.4 acres of artificial reef to mitigate for adverse impacts to 2.4 acres of nearshore hardbottom from the 1996 and 2002 project. The third nourishment was completed in March 2010. Due to Hurricane Sandy in October 2012, significant erosion occurred and the fourth nourishment was constructed in 2013.

The project design specifies a six year interval between nourishment events. A physical and environmental monitoring program is being conducted to verify the predicted impacts to nearshore hardbottom. The project has met its performance goal of preserving a beach berm seaward of the 1975 shoreline through the nourishments and inlet sand bypassing to the downdrift shore.

Table 9. South Boca Raton Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
July 1985	221,000	Ebb tidal shoal	R223.3-R225.6	0.6
December 1996	220,000	Ebb tidal shoal	R223.3-R225.6	0.6
April 2002	343,000	Ebb tidal shoal	R223.3-R227.9	0.96
March 2010	183,800	Ebb tidal shoal	R223.3-R227.9	0.96
December 2013	168,900	Ebb tidal shoal	R223.3-R227.9	0.96

Strategy: Maintain the project through monitoring and nourishment using inlet channel and ebb shoal material.

REGIONAL STRATEGIES FOR BEACH AND INLET MANAGEMENT

SPONSORS AND FUNDING

Two federally-authorized Beach Erosion Control Projects in Palm Beach County provide for Federal cost sharing: Palm Beach Island between Lake Worth and South Lake Worth Inlets was authorized in 1958; and the remainder of the County north of Lake Worth Inlet and south of South Lake Worth Inlet was authorized in 1962. This subregion is within the 1962 authorization which provides for beach restoration and nourishment. The [*City of Delray Beach*](#) constructs its project with reimbursement funding provided by the State and Federal government. In 1991, the [*USACE*](#) federal participation in the Delray Beach project was extended to 50 years following completion of initial construction. The City of Boca Raton constructs the North Project with reimbursement funding provided by the State and Federal

government, but has not sought federal funds for the Central or South projects. [Palm Beach County](#) has participated with the municipalities in the collection and processing of monitoring data in this subregion. [Palm Beach County's Shoreline Protection Plan](#) dated 2014, highlights the Counties initiatives to preserve and manage their coastline. Project cost estimates may be found in [FDEP's Beach Management Funding Assistance Program](#) - Long Range Budget Plan.

PROJECT COORDINATION

Regionalization is the funding and coordination of multiple beach nourishment and inlet management activities to take advantage of identifiable cost savings through economies of scale, reduced equipment mobilization and demobilization costs, and elimination of duplicative administrative tasks.

Opportunities in this subregion include:

1. Jointly soliciting bids for the nourishment of Delray Beach and Boca Raton beach segments.
2. A regional monitoring data collection and processing program to be used by the local sponsors for project monitoring required by permits.
3. Studying bypassing alternatives at Boca Inlet with the Towns of Hillsboro and Deerfield Beach in Broward County.

ENVIRONMENTAL PROTECTION

The protection of marine turtles and hardbottom habitat are the primary environmental concerns within this subregion. The timing of construction is restricted during the marine turtle nesting season of March 1 through October 31. Project design and method of construction are restricted to avoid or minimize adverse impacts to marine turtles and hardbottom habitat. Artificial reefs were constructed as mitigation to offset impacts to nearshore hardbottom caused by the North and South Boca Raton projects. A physical and environmental monitoring program is being conducted to verify the expected effects of the projects.

SAND SOURCES

Upon completion of the 2015/16 Central Boca Raton Beach Nourishment Project, the City of Boca Raton will have depleted all permitted and viable sand resources for the North and Central segments.

The City is scheduled to begin a geotechnical sand search in early 2015. The City anticipates permitting the new borrow areas in early 2016.

Due to the fact that there are limited sand resources existing in State waters in Southeast Florida, FDEP and the USACE completed the [*Sediment Assessment and Needs Determination \(SAND\) study*](#). This study was conducted in a collaborative manner and was reviewed by and vetted through all the participating stakeholders. The SAND study determined that the regional offshore supply of sand in state and federal waters is more than adequate to meet the needs of all the beach nourishment projects in the five southeastern coastal counties, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade, for the next 50 years (year 2062), according to Ousley et al. (2014). Subsequently, FDEP analyzed the need for sand over the next 10 to 20 years for the five southeastern counties and determined that approximately 20 to 30 million cy will be needed for beach nourishment projects. Due to the narrow continental shelf adjacent to Florida's southeastern shoreline, it is expected that some counties may need to look for sand resources in upland sand mines and/or offshore borrow sites in neighboring counties; Miami-Dade County has already initiated this process.

It is recommended that continued coordination between FDEP, the USACE, [*BOEM*](#) and Local Governments to use best management practices with these offshore resources. For additional information on sand sources, FDEP manages a database named the [*Regional Offshore Sand Source Inventory \(ROSSI\)*](#).

ADDITIONAL INFORMATION

The introduction at the beginning of the state's Strategic Beach Management Plan provides additional information including overviews of:

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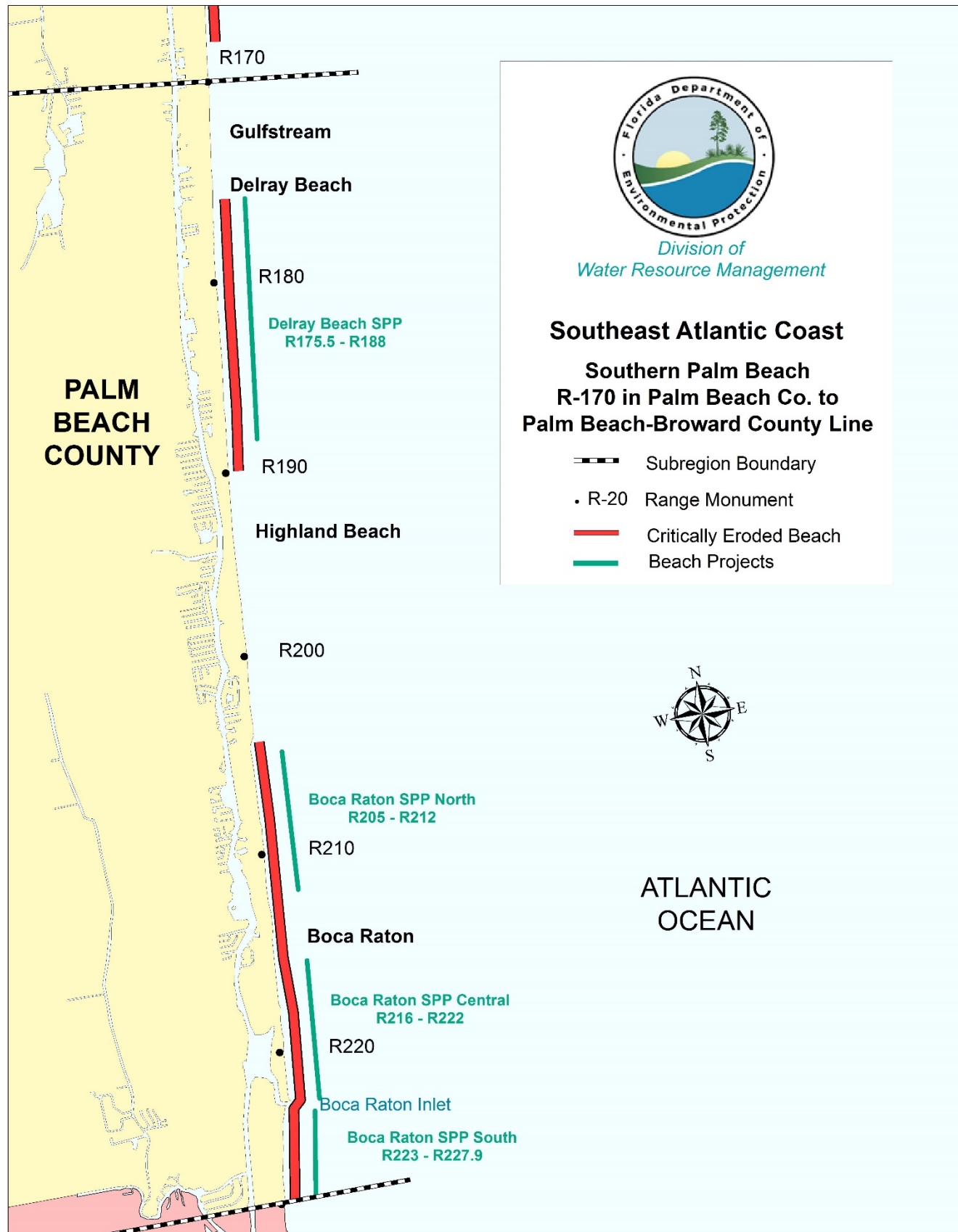


Figure 3. Southern Palm Beaches subregion of the Southeast region of Florida.

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BROWARD – MIAMI-DADE BEACHES

There are 38.9 miles of beaches in the **Broward through Miami-Dade Beaches** subregion, which extends from the Palm Beach-Broward County line (R1) to Government Cut, in Miami-Dade County (R74.4), as shown on Figure 4. There are 21.3 miles of critically eroded beaches in Broward County, of which 13.5 miles are restored and maintained. There are 14.5 miles of critically eroded beaches in Dade County, of which 13.3 miles are restored and maintained.

Erosion is attributed to frequent winter northeasters, occasional tropical storms and hurricanes, and the effects of Boca Raton Inlet, Hillsboro Inlet, Port Everglades Entrance, and Bakers Haulover Cut. The most erosive storms in recent years were Hurricane Andrew (1992), Hurricane Wilma (2005), Subtropical Storm Andrea, October northeasters, Tropical Storm Noel (2007) and Hurricane Sandy (2012).

STRATEGIES FOR INLETS AND CRITICALLY ERODED BEACHES

HILLSBORO BEACH, BROWARD COUNTY, R6-R23

This is a 3.2 mile segment of critically eroded beach that includes south Deerfield Beach and Hillsboro Beach south to Hillsboro Inlet, and the project history for this segment of shoreline is described in Table 10. Some armoring exists in Hillsboro Beach and a boulder mound groin field exists in Deerfield Beach. Beach restoration and nourishment has been conducted at Hillsboro Beach (R6-R12). The inlet sand bypassing activity at Boca Raton Inlet and material placed for the South Boca Raton project aids in maintaining the beach at Deerfield Beach, but the northern beaches of Hillsboro Beach require nourishment. The southern portion of Hillsboro Beach is relatively stable, but remains critically eroded and is part of the Broward County Beach Erosion Control Project. Segment I of Broward County is located Between R1 (County Line) and R24 (Hillsboro Inlet), but a federal feasibility study has not yet been completed for this segment.

In 1972, a non-federal nourishment project at Hillsboro Beach (R7-R12) was constructed using sand from an offshore borrow site. In March 1998, the non-federal **Hillsboro Beach Nourishment Project** (R6-R12) was completed. The local sponsor is the Town of Hillsboro Beach. The project design consists of restoration of a 30 foot beach berm at an elevation of +9 ft NGVD plus beach fill equivalent to ten years of advance nourishment. Significant material has been eroded from the beach berm, and

monitoring surveys are continuing to determine if beach nourishment will be necessary in less than the ten year cycle. The most recent nourishment was completed in the winter of 2011.

Table 10. Hillsboro Beach Nourishment Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1972	360,000	Offshore	R7 - R12	1.0
March 1998	555,000	Offshore	R6 - R12	1.2
April 2011	339,151	Offshore	R6.4-R-12.5	1.2

Strategy: Maintain the project through monitoring and nourishment using sand from offshore sources and in coordination with sand bypassing activities; conduct a feasibility study to clearly determine the cause of erosion and to develop design alternatives to address the erosion.

HILLSBORO INLET, BROWARD COUNTY, R24-R25

Hillsboro Inlet is a stabilized inlet maintained by the Hillsboro Inlet District. A district-owned hydraulic dredge transfers sand from the inlet channel and sediment settling basin to the downdrift beach south of the inlet. FDEP adopted the Hillsboro Inlet Management Study Implementation Plan in September 1997. The plan established an annualized bypassing objective of 120,000 cy, which has been achieved. In December 2002, the District completed the expansion of the exterior entrance channel and excavation of a sediment impoundment basin within the channel to elevation -20 ft NGVD. The project included construction of 1.6 acres of artificial reef to mitigate for adverse impacts to 0.4 acres of nearshore hardbottom. The Department conducted a regional sediment budget analysis in 2015 and determined the inlet sand bypassing activities have balanced the sediment budget of Boca Raton Inlet and Hillsboro Inlet with the adjacent beaches. It is recommended that biennial, synoptic surveys of the beaches and inlets be conducted, and after the collection of sufficient data, a sediment budget then be prepared using a methodology from the Army Corps of Engineers' Coastal Engineering Manual.

Strategy: Continue to bypass sediment to downdrift beaches to meet an annualized bypassing objective of 120,000 cy; implement a physical monitoring program and update the sediment budget and the inlet management plan.

POMPANO BEACH TO FT LAUDERDALE, BROWARD COUNTY, R25-R77

This is a 10 mile segment of critically eroded beach partially within the area of influence of Hillsboro Inlet. It includes the communities of Pompano Beach, Sea Ranch Lakes, Lauderdale-by-the-Sea, and Ft Lauderdale. Restoration and nourishment have been conducted within this segment, and the project history for this segment of shoreline is described in Table 11. Numerous bulkheads and retaining walls also exist along this stretch of coast. Minimizing or avoiding impacts to nearshore hardbottom may determine the feasibility and scope of beach restoration along remaining portions of the shoreline.

In 1970, restoration of Pompano Beach (R32-R49), **Segment II** of the federal **Broward County Shore Protection Project** was completed using sand from an offshore borrow site. The project is authorized until 2020. The beach berm was constructed at elevation +9 ft NGVD and extended the 1970 MHW shoreline seaward by 134 ft

In 1983, restoration and nourishment of Pompano Beach and Lauderdale-By-The-Sea (R25-R53) was constructed using sand from offshore borrow sites. The beach berm was constructed at elevation +9 ft NGVD and extended the existing MHW shoreline seaward by 45 ft. The 1983 nourishment project provided storm protection during Hurricane Andrew and the advance nourishment significantly exceeded the five year performance expectation; however, nourishment is now needed to maintain storm protection and recreation benefits. Additional erosion occurred in this area during the 2004, 2005 and 2012 hurricane seasons; nourishment is planned for 2015.

Design and permitting were completed for nourishment of Pompano Beach and Lauderdale-By-The Sea (R36-R43) and restoration of northern Fort Lauderdale (R51-R72) (also collectively known as Segment II of the **Broward County Shore Protection Project**) using 935,000 cy of sand from offshore borrow sites in 2004. The Pompano Beach design specified a berm at elevation +9 ft NGVD that would extend the MHW shoreline 100 ft seaward of the Erosion Control Line plus additional fill material equivalent to six years of advance nourishment. The beach fill design for the Fort Lauderdale reach called for a 20 foot seaward extension of the 1998 MHW shoreline plus fill material equivalent to six years of advance nourishment. The project plan included 3.0 acres of artificial mitigation reef for permanent coverage impacts to 2.5 acres of nearshore hardbottom. The Notice to Proceed (NTP) was withheld for the Segment II project to evaluate the performance of the 2006 beach nourishment for the Segment III project and the results of the post-project monitoring of the nearshore hardbottom offshore of Broward County. The permit expired for the Segment II reach prior to constructing this segment of shoreline.

Hurricane Sandy in 2012 contributed to significant erosion along most of the project shoreline and extensively damaged 2,000 ft of SR A1A (R-65 to R-67), the area’s only hurricane evacuation route that is within the project limits. A small 20,000 cy beach fill project was constructed seaward of the damaged portion of SR A1A to offer limited protection to the roadway in advance of the proposed restoration project, which utilized an upland sand source. Also, a significant seawall was constructed by FDOT seaward of A1A between R65 and R67 following Hurricane Sandy to improve protection to the roadway. Although this roadway continues to be vulnerable to coastal storm impacts, the significance of the seawall constructed by FDOT following Hurricane Sandy is assumed to be sufficient to protect the road from a 25-yr storm event.

FDEP issued a new permit for the Segment II (R25-R85) project in January 2014. This project is planned for construction in the winter of 2014/2015 with expected placement volume of approximately 750,000 cy from an upland sand source. The project will place the material on two critically eroded beaches located at R36 to R41.3 and R53 to R72 and the project will include both beach and dune fill placement along 4.9 miles of shoreline. The dune features will have a crest width of 10 ft and a crest height of 11 ft NAVD. An initial dune construction project in 2014 was completed using 130,000 cy of upland material to restore the designed beach berm above the mean high water line (MHWL) along the Segment II project boundary. Also, the Segment II project will construct 6.8 acres of artificial reef in the nearshore between R44 and R46 as mitigation for direct impact to 4.9 acres of nearshore hardbottom. The permit also required a hardbottom monitoring plan to measure an unanticipated impacts that could occur from the project.

Table 11. Pompano Beach - Lauderdale-By-The-Sea - Ft Lauderdale Beach Nourishment (Segment II) Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1970	1,076,000	Offshore	R32- R49	3.2
1983	1,900,000	Offshore	R25 - R53	5.4
2012	20,000	Upland	R65-R67	0.4
2014	130,000	Upland	R25-R49	4.5

Strategy: Complete beach restoration and nourishment; maintain the project through monitoring and nourishment using offshore or upland sand source.

PORT EVERGLADES INLET, BROWARD COUNTY, R85-R86

Port Everglades Inlet (also known as the Port Everglades Entrance) is a man-made, federally-maintained navigation project and the entrance to Port Everglades. The entrance channel depth is -45 ft MLW. Rock spoil from a 1962 excavation of the inlet entrance channel was placed in the nearshore north of the inlet and acts as a partial littoral barrier to shoaling of the navigation channel. The most recent maintenance dredging events have occurred in 2006 and 2013. FDEP adopted the [Port Everglades Inlet Management Study Implementation Plan](#) in May 1999. The plan established an annualized bypassing objective of 44,000 cy which has been historically done by periodic maintenance dredging of the channel. Currently, the Port Everglades Inlet Sand Bypass Project is in the design and permitting phase and is proposing to achieve this bypassing objective. In 2002, design of a spur groin attached to the south jetty and two groins located on the shore south the inlet (in lieu of breakwaters) was completed as recommended in the adopted inlet management plan. Construction was conducted as part of the 2005/06 Broward County Shore Protection Project - Segment III described below.

FDEP and Broward County completed a feasibility study in 2004 of structural improvements to facilitate inlet sand bypassing. This study recommended modifications to the north jetty, construction of a sediment impoundment basin, and removal of the rock spoil located north of the inlet as recommended in the inlet management plan. Preliminary engineering was initiated in 2006 to refine the recommendations of the feasibility study and a JCP application was submitted in 2008. However the application was withdrawn and the project was redesigned to address the blasting concerns of property owners immediately adjacent to the project and inlet. In order to address these concerns, a new application was resubmitted to FDEP in summer of 2014 that redesigned the sand trap in order to eliminate the need for blasting during construction.

Strategy: Place all beach compatible inlet maintenance material from channel or sand trap material on the downdrift beaches in areas of greatest need to meet an annualized bypassing objective of at least 44,000 cy; implement a physical monitoring program; update the inlet management plan using the updated sediment budget from 2014; construct a sediment impoundment basin and modifications to the north jetty and other improvements to facilitate mechanical bypassing of sand, including removal of the rock spoil located in the nearshore north of the inlet.

JOHN U. LLOYD BEACH STATE PARK – DANIA BEACH - HOLLYWOOD – HALLANDALE BEACH, BROWARD COUNTY, R86-R128

This is an 8.1 mile segment of critically eroded beach partially within the area of influence of Port Everglades Inlet. This area includes John U. Lloyd Beach State Park and the communities of Dania Beach, Hollywood, and Hallandale Beach, and the project history for this segment of shoreline is described in Table 12.

In 1971, the City of Hallandale Beach first restored the southernmost 4,000 ft of Broward County shoreline with 350,000 cy of sand from an offshore borrow site.

In 1976, beach restoration of John U. Lloyd Beach State Park (R86-R93, **Broward County Shore Protection Project – Segment III**) was constructed using sand from offshore borrow sites. The federal project is authorized until 2026. The beach berm was constructed at elevation +10 ft NGVD and extended the MHW shoreline 140 ft seaward. For the purposes of estimating costs, a five year nourishment interval was considered. In 1989, nourishment and sand tightening of the south jetty was conducted. The beach berm was constructed at elevation +10 ft NGVD and extended the MHW shoreline 100 ft seaward, which included fill material equivalent to five years of advance nourishment. The 1989, the project provided storm protection during Hurricane Andrew, but the advance nourishment did not meet the five year performance expectation.

In 1979 restoration of Hollywood - Hallandale Beach (R101-R128, **Broward County Shore Protection Project-Segment III**) was constructed using sand from offshore borrow sites. The beach berm was constructed at elevation +7 ft NGVD and extended the MHW shoreline 178 ft seaward. For the purposes of estimating costs, a five year nourishment interval was considered. In 1991, nourishment was conducted. The beach berm was constructed at elevation +7 ft NGVD and extended the MHW shoreline 51 ft seaward. Additional fill material equivalent to eight years of advance nourishment was placed seaward of the design berm. The 1991 nourishment project provided storm protection during Hurricane Andrew and the advance nourishment met the eight year performance expectation but, during the subsequent delay in nourishment, the beach berm has been eroded significantly.

Nourishment of John U. Lloyd Beach State Park (R86-R92) and Dania Beach-Hollywood-Hallandale Beach (R98 - R128) was completed in March 2006 using 1,850,000 cy of sand from offshore borrow sites. The beach fill at the state park is constructed at an elevation +9 ft NGVD and constitutes six years of advance nourishment. Also, a spur groin attached to the south jetty and two T-head groins located on

the shore south of the inlet were constructed to retain the beach fill within the park project area. The beach fill design for Dania Beach - Hollywood - Hallandale consisted of a 50 foot extension of the MHW shoreline seaward of the Erosion Control Line plus fill material equivalent to six years of advance nourishment. The project included construction of 8.9 acres of artificial reef as mitigation for impacts to 7.6 acres of nearshore hardbottom. A physical and environmental monitoring program was conducted to verify avoidance of impacts to nearshore hardbottom and the performance of the mitigation.

The Segment III project of 2005/2006 placed approximately 1.85 million cy of sandy material from an offshore borrow site along 6.82 miles of shoreline (R86-R92 and R99 – R128). This 2006 project also constructed a spur connected to the south jetty of Port Everglades Inlet, installation of two T-head groins offshore of John U. Lloyd State Park and construction of 8.9 acres of artificial reef as mitigation.

Currently the Segment III project is in the planning phase to construct a beach nourishment project along 8.2 miles of critically eroded shoreline in the winter of 2017/2018. The City of Hollywood in February 2012 completed an interim truck haul beach nourishment project (R107 to R109 and R119 to R124) to address hot spot erosion.

Table 12. J.U. Lloyd State Park - Hollywood - Hallandale Beach Nourishment (Segment III) Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1971	350,000	Offshore	R124-R128	0.8
1976-1977	1,090,000	Offshore	R86-R93	1.5
November 1979	1,980,000	Offshore	R101-R128	5.2
1989	603,000	Offshore	R86-R93	1.5
August 1991	1,108,000	Offshore	R101-R128	5.2
2001	25,000	Upland	R121-R123	0.38
2005-2006 ¹	1,850,000	Offshore	R86-R92 and R99-R128	6.8
February 2012	80,000	Upland	R107-R109; R119-R124	0.75
2013 ²	116,000	Offshore	R87-R90	0.75

¹ Includes the placement of 550,000 cy of sand along the JUL shoreline (R86-R92) and 1,300,000 cy along the Dania Beach, Hollywood, and Hallandale Beach shoreline (R99 and R128). Of the sand volume placed between R101 and R128, 188,000 cy was placed under a USACE contract as part of the 2004 FCCE (PL 84-99) Post-Storm Rehabilitation Project.

² 44,200 cy (2005/06) and 116,000 cy (2013) of sand were dredged from the inlet channel and placed on the JUL Beach SP shoreline.

Strategy: Maintain the project through monitoring and nourishment using sand from offshore, upland and inlet sources.

GOLDEN BEACH - SUNNY ISLES - HAULOVER BEACH PARK, MIAMI-DADE COUNTY, R1-R26.7

This is a 5.1 mile segment of critically eroded beach between the Broward-Dade county line and Bakers Haulover Inlet. Restoration and nourishment have been conducted in Sunny Isles (R7-R20) and Haulover Beach Park (R20-R26) as part of the federally-authorized **Miami-Dade County Shore Protection Project**, and the project history for this segment of shoreline is described in Table 13. The Sunny Isles segment of the project is authorized until 2038. The critically eroded beaches within Golden Beach (R1-R7) receive sand from spreading of the adjacent nourishment projects.

In 1987, restoration of the 1.3-mile long Haulover Beach Park (R20-R26) was completed using 235,000 cy of sand from an offshore borrow area. The project restored a 50 foot wide beach berm at elevation +8.2 ft NGVD. In 2002, the first nourishment of the project was deferred based upon monitoring surveys that indicate additional beach fill was not needed at that time.

In 1988, restoration of Sunny Isles (R7-R20) was constructed using sand from an offshore borrow area. The project restored a 20 foot wide beach berm at elevation +8.2 ft NGVD. Additional fill material equivalent to ten years of advance nourishment was placed seaward of the design berm. The loss of fill material spreading into Golden Beach required interim nourishment of northern Sunny Isles in 1994, but the project was delayed until 1997 following settlement of a legal challenge to the federal environmental authorization. Overall, the project has met performance expectations, except for the loss of beach fill at the north end of the project area. Nourishment was completed in December 2001 and in an effort to improve the longevity of the project, a submerged nearshore breakwater was constructed at R7 in February 2002. Truck haul nourishment was conducted in 2009 in Sunny Isles using an upland sand source.

Table 13. Sunny Isles and Haulover Beach Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1955 to 1959	418,214	Bakers Haulover Inlet	R19–R26	1.4
1960	180,000	Offshore	R19-R26	1.4
1978	300,000	Offshore	R20-R26	1.1
1980	43,163	Bakers Haulover Inlet flood shoal	R19-R26	1.4
1984	35,000	Bakers Haulover Inlet flood shoal	R19-R26	1.4
1987	235,000	Offshore	R19-R26	1.4
1988	1,320,000	Offshore	R7-R20	2.5
1990	32,000	Bakers Haulover Inlet ebb shoal	R7-R9	0.4
1994	24,560	Bakers Haulover Inlet	R20-R25	0.9
July 1997	80,000	Offshore	R7-R10	0.6
1997	9,000	Upland	R7-R8 & R10 & R16	0.3
2001-2002 ¹	737,152	Offshore	R7–R19	2.4
July 2009	10,000	Upland	R7-R10.5	0.6
March 2014	35,000	Bakers Haulover Inlet ebb shoal	R12-R16	0.8

¹ The volumes for Sunny Isles in 2001/2002 includes placement of 704,353 cy between R7-R19, with an additional amount of 2,799 cy placed northward to R6 for a 1000' taper into Golden Beach and an additional 30,000 cy placement along R7 to R8.5 following a 30 day stabilization period of the salient behind the newly constructed breakwater.

Strategy: Maintain the project through monitoring and nourishment.

BAKERS-HAULOVER INLET, MIAMI-DADE COUNTY, R26-R27

The entrance channel depth is -11 ft MLW at **Bakers-Haulover Inlet**, a man-made inlet within a federally-maintained navigation project. Extension of the south jetty was completed in 1975 during the

Bal Harbour nourishment. Sand tightening and extension of the north jetty was completed in December 1986. Maintenance dredging of the navigation channel and the flood shoal has been conducted periodically and the material placed on the adjacent beaches. FDEP adopted the Bakers Haulover Inlet Management Study Implementation Plan in September 1997, but a specific volume of sand as an average annual bypassing objective was not established.

Strategy: Place all beach compatible maintenance dredging material on adjacent beaches in areas of greatest need. Update the sediment budget and the inlet management plan.

BAL HARBOUR MIAMI-DADE COUNTY, R27-R31

This is a 0.75 mile segment of critically eroded beach from Bakers-Haulover Inlet to Surfside municipal boundary. Beach restoration was completed for the segment as part of the federally-authorized **Miami-Dade County Shore Protection Project**. The project is authorized until 2025, and the project history for this segment of shoreline is described in Table 14.

In 1975, restoration at Bal Harbour (R27-R31) was completed by the local government on a federal reimbursement basis. The project included restoration of a 20 foot wide dune at elevation +10.7 ft NGVD and a 50 foot wide level berm at elevation +8.2 ft NGVD. Additional fill material equivalent to ten years of advance nourishment was placed seaward of the design berm. Though nourishment of several areas of the initial project was conducted between 1987 and 1990, the overall project has exceeded performance expectations. Nourishment of discreet segments of the project was conducted between 1997 and 2001 with subsequent full nourishments in 2003 using offshore material. The 2014 nourishment event (USACE Contract G) was completed using dredge material from the Bakers-Haulover ebb shoal.

Table 14. Bal Harbour Segment, Miami-Dade County Shore Protection Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1960	86,000	Offshore	R27-R31	0.8
1961-1964	83,000	Offshore	R27-R31	0.8
1968-1969	136,000	Offshore	R27-R31	0.8
July 1975	1,625,000	Offshore	R27-R31	0.8

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1990	225,000	Offshore	R27-R31	0.8
1998	282,852	Bakers Haulover Inlet & flood shoal	R28-R31	0.6
2002	35,000	Offshore	R27-R31	0.8
2003	188,000	Bakers Haulover Inlet ebb shoal	R27-R31	0.8
2007	30,000	AIWW	R27-R31	0.8
2009	15,000	Upland	R27-R28.8	0.34
2010	33,080	AIWW	Unknown	Unknown
2014	235,733	Bakers Haulover Inlet ebb shoal	R27-R31	0.8

SURFSIDE, MIAMI-DADE COUNTY, R31-R38

This is a 1.3 mile segment of critically eroded beach from the southern boundary of Bal Harbour to Miami Beach municipal boundary. Beach restoration was completed for the segment as part of the federally-authorized **Miami-Dade County Shore Protection Project**, and the project history for this segment of shoreline is described in Table 15. The restoration of the federally-authorized Miami-Dade County Shore Protection Project at Surfside (R31-R38) was completed in January 1978 using sand from offshore borrow sites. The project included restoration of a 20 foot wide dune at elevation +10.7 ft NGVD and a 50 foot wide level berm at elevation +8.2 ft NGVD. Additional fill material equivalent to ten years of advance nourishment was placed seaward of the design berm. Though nourishment of several areas of the initial project was conducted between 1987 and 1990, the overall project has exceeded performance expectations. Nourishment of discreet segments of the project was conducted between 1997 and 2001.

Table 15. Surfside Segment, Miami-Dade County Shore Protection Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
August 1978	2,640,000	Offshore	R31-R38	1.5

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
August 1999	590,000	Offshore	R32-R36	0.8
April 2014	14,000	Upland	R32-R36	0.8

MIAMI BEACH, MIAMI-DADE COUNTY, R38-R74.4

This is a 7.35 mile segment of critically eroded beach from the southern boundary of Surfside to Government Cut, within the municipal boundary of Miami Beach. Beach restoration was completed for this segment as part of the federally-authorized **Miami-Dade County Shore Protection Project**, and the project history for this segment of shoreline is described in Table 16.

The restoration of the remaining federally-authorized Miami-Dade County Shore Protection Project at Miami Beach (R38-R74) began in 1978 and was completed in January 1982 using sand from offshore borrow sites. The project included restoration of a 20 foot wide dune at elevation +10.7 ft NGVD and a 50 ft wide level berm at elevation +8.2 ft NGVD. Additional fill material equivalent to ten years of advance nourishment was placed seaward of the design berm. Though nourishment of several areas of the initial project was conducted between 1987 and 1990, the overall project has exceeded performance expectations. Nourishment of discreet segments of the project was conducted between 1997 and 2001.

The performance of the beach fill along the segment of shore north of 32nd Street, Miami Beach has not maintained the design beach width. Erosion by storm waves and tides is exacerbated by the seaward encroachment of the upland development relative to the adjacent shore. A 1994 nourishment project, interrupted by a legal challenge to the federal environmental authorization, was completed in 1997. In order to improve the longevity of the beach fill and maintain the design beach width of the project, three shore-attached breakwaters were constructed at 32nd Street (R59-R60) during May-July 2002.

Concurrently, transfer via truck-haul from south Miami Beach (R67-R72) a total of 125,000 cy of beach sand to the breakwater site and to an adjacent erosional area (R53.5-R56) was conducted. In 2005, approximately 35,000 and in 2006, an additional 30,000 cy of sand respectively from an upland mine was placed via truck haul downdrift of the structures (R60-R61)

Additionally, the performance of the beach fill along the segment of shore located near 55th Street, Miami Beach and 44th Street, Miami Beach has not maintained the design beach width. Erosion by storm waves and tides is exacerbated by the seaward encroachment of the upland development relative to the adjacent shore. During 2006, the County truck hauled and placed approximately 30,000 cy of

sand at the 55th Street segment (R48.7-R50.7) and placed approximately 50,000 cy of sand at the 44th Street segment (R53.7-R55.5).

In 2007, a backpassing project was completed to excavate sand from the accretional beach at Lummus Park (R67-R72) and pump it north for placement between R53.5-R56. The backpassing event was followed by a truck haul event in 2009 as an interim measure preceding the federal nourishment. Sand from an upland mine was placed in recurrent hotspots at 55th and 44th Streets and a new hotspot at 67th Street (R43-R44.5). A total of 23,000 cy of sand was placed.

In March of 2011, DEP issued a joint coastal permit for the construction of the federal Contract E project. The permit authorized placement of sand from an offshore source onto the Miami Beach segment from R37.75-R46.25. The permit also authorized backpassing of sand from the dry sandy beach at Lummus Beach Park to hotspot locations at R53.7-R55.5 and R60-R61.1. Placement of the offshore material was completed in April of 2012 with 206,042 cy of material placed. Placement of backpassed material was completed in September of 2012 with a total of 141,159 cy of material placed.

In June 2003, the Army Corps of Engineers selected a conceptual design through its innovative erosion control technology program (Section 227) for a Submerged Artificial Reef Structure to be located at 63rd Street, Miami Beach (R46). DEP issued a Notice of Intent to issue a Joint Coastal Permit for the construction of the **Reefball Breakwater Structures**, known as Contract H, in November 2011 and federal funding has been secured for initial construction of the reef modules. Installation of the modules is pending future federal appropriations, but is anticipated for 2015.

Table 16. Miami Beach Segment - Miami-Dade County Erosion Control Project history.

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
August 1979	1,530,000	Offshore	R38-R46	1.5
October 1980	3,177,100	Offshore	R46-R59	2.4
December 1981	2,200,000	Offshore	R59-R66	1.4
January 1982	2,400,000	Offshore	R66-R74	1.9

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
1985	110,000	Offshore	R42-R46	0.8
1985	50,000	Offshore	R57-R60	0.6
September 1994	122,096	Offshore	R54-R57	0.2
1994	30,000	Upland	R54-R59	0.4
1996	8,000	Backpassing from R59-R60	R54-R60	0.8
July 1997	479,069	Offshore	R53-R58	1.0
1997	35,000	Upland	R54-R56	0.4
1997	50,000	Upland	R57-R59	0.4
1998	18,000	Upland	R44-R45	0.2
August 1999	132,000	Offshore	R73-R74	0.3
2001-2002	167,662	Offshore	R44-R46.5A	0.4
2002	125,000	Backpassing from R59-R60	R53.5-R56 and R60-R61	0.7
2005	35,000	Upland	R60-R61	0.2
2006	30,000	Upland	R48.7-R50.7	0.4
2006	50,000	Upland	R53.7-R55.5	0.4
2006	30,000	Upland	R60-R61	0.2
2007	70,000	Backpassing from R67-R72	R43-R45	0.4

Date Completed	Volume (CY)	Source	Location	Length (Mi.)
2009	10,000	Upland	R43-R44.5	0.29
2009	10,000	Upland	R48.7-R50.7	0.38
2009	3,000	Upland	R53.7-R55.5	0.34
2012	206,042	Offshore	R37.75-R46.25	1.6
2012	141,159	Backpassing from Lummus Park (R64-R71).	R53.7-R55.5 R60-R61.1	0.55

Strategy: Maintain the project through monitoring and nourishment; transfer sand from accreted beaches in areas of greatest need.

GOVERNMENT CUT, MIAMI-DADE COUNTY, R-74

Government Cut, a man-made inlet that is part of the federally authorized **Miami Harbor Navigation Project**, is the entrance to the Port of Miami. The navigation channel depth in Government Cut is -44 ft MLW. In 1983, the sand tightening of 1,200 ft of the seaward end of the north jetty was completed. In 1999, the remainder of the north jetty was sand tightened. The inlet channel and jetties act as a barrier to littoral sand transport to the downdrift beaches south of the inlet by trapping sand in the channel or deflecting it offshore. Net southerly littoral drift arriving at Government Cut has been estimated to range from 24,000 cy per year to 49,000 cy per year. The low longshore transport rate and long jetties have prevented significant shoaling of the navigation channel. Maintenance dredging is not frequent, and then has coincided with channel deepening projects. The dredged material from deepening of the exterior and interior navigation channels and expansion of the turning basin has been used to create spoil islands that now contain residential or port facilities.

Strategy: Place all beach-compatible dredged material from maintenance of the navigation channel on the adjacent beaches.

REGIONAL STRATEGIES FOR BEACH AND INLET MANAGEMENT

SPONSORS AND FUNDING

The Broward County Shore Protection Project was authorized in 1965 for federal participation in beach erosion control for the entire county in three designated segments. The local sponsor is [Broward County](#). The project provides for a navigation feature at [Hillsboro Inlet](#), which is inactive due to the non-federal improvements to the inlet. Segment I (R1-R24, north county line to Hillsboro Inlet) has not been constructed under the federal authorization. In 1996, extension of federal participation in Segment II (R25-R85) and Segment III (R86-R128) was approved for fifty years following the date of initial beach restoration to 2020 and 2026, respectively. The local-state sponsors are authorized to design, permit and construct the project, then seek reimbursement of the federal cost-share.

The Miami-Dade County Beach Erosion Control and Hurricane Protection Project was authorized in 1968 for federal participation in shore protection projects from Haulover Beach Park (R20) through Miami Beach to Government Cut (R74). In 1985-1986, Sunny Isles was included in the authorized project and is federally authorized until 2038 while the Miami-Dade portion of the project is federally authorized until 2025. The local sponsor is [Miami-Dade County](#). Design, permitting and construction are conducted by the [USACE](#) with reimbursement or advance payment by the local and state sponsors. Project cost estimates may be found in [FDEP's Beach Management Funding Assistance Program](#) - Long Range Budget Plan.

PROJECT COORDINATION

Regionalization is the funding and coordination of multiple nourishment and inlet management activities to take advantage of identifiable cost savings through economies of scale, reduced equipment mobilization and demobilization costs, and elimination of duplicative administrative tasks.

Opportunities in this subregion include:

1. Broward County is attempting to implement this concept through contracting the construction of the next nourishment activities at three different segments of beach.
2. In Miami-Dade County, nourishment has been routinely conducted for different segments of beach under a single construction contract. Previous maintenance dredging material from

Bakers-Haulover Inlet has been placed on the beach. In the future, the schedule of maintenance dredging should be coordinated with the need for nourishment.

3. Coordination with the Corps and Port of Miami and Port Everglades to minimize beach impacts of proposed Port improvements.

ENVIRONMENTAL PROTECTION

The protection of marine turtles, hardbottom and coral reef habitat, and seagrass beds are primary environmental concerns within this subregion. The timing of construction is restricted during the marine turtle nesting season of March 1 through October 31 in Broward County north of Port Everglades. In south Broward and Miami-Dade County, projects have been approved for construction during the nesting season. Project design and method of construction are restricted in order to avoid or minimize adverse impacts to marine turtles and hardbottom and reef habitat. Mitigation is required to offset permitted impacts to nearshore hardbottom caused by the restoration projects in Broward County and a county-wide physical and environmental monitoring program is conducted to identify potential impacts to hardbottom and reef communities. Miami-Dade County conducts a county-wide marine turtle monitoring and protection program. Bakers Haulover Inlet and Government Cut are located within the limits of the [*Biscayne Bay Aquatic Preserve*](#). Projects located within and near the aquatic preserve boundaries require additional protection, including more stringent water quality standards than in non-aquatic preserve waters, during permitting and construction to ensure preservation of the existing conditions.

SAND SOURCES

Due to the fact that there are limited sand resources existing in State waters in Southeast Florida, FDEP and the USACE completed the [*Sediment Assessment and Needs Determination \(SAND\) study*](#). This study was conducted in a collaborative manner and was reviewed by and vetted through all the participating stakeholders. The SAND study determined that the regional offshore supply of sand in state and federal waters is more than adequate to meet the needs of all the beach nourishment projects in the five southeastern coastal counties, St. Lucie, Martin, Palm Beach, Broward, and Miami-Dade, for the next 50 years (year 2062), according to Ousley et al. (2014). Subsequently, FDEP analyzed the need for sand over the next 10 to 20 years for the five southeastern counties and determined that approximately 20 to 30 million cy will be needed for beach nourishment projects. Due to the narrow continental shelf adjacent to Florida's southeastern shoreline, it is expected that some counties may need to look for sand

resources in upland sand mines and/or offshore borrow sites in neighboring counties; Miami-Dade County has already initiated this process.

It is recommended that continued coordination between FDEP, the USACE, [BOEM](#) and Local Governments to use best management practices with these offshore resources. For additional information on sand sources, FDEP manages a database named the [Regional Offshore Sand Source Inventory \(ROSSI\)](#).

ADDITIONAL INFORMATION

The introduction at the beginning of the state's Strategic Beach Management Plan provides additional information including overviews of:

- The principals followed to help guide the state's management strategies
- The miles of critically eroded beaches under active management
- Statewide sand source studies
- Statewide monitoring programs
- Innovative technologies examined
- Basic suggestions for emergency response plans

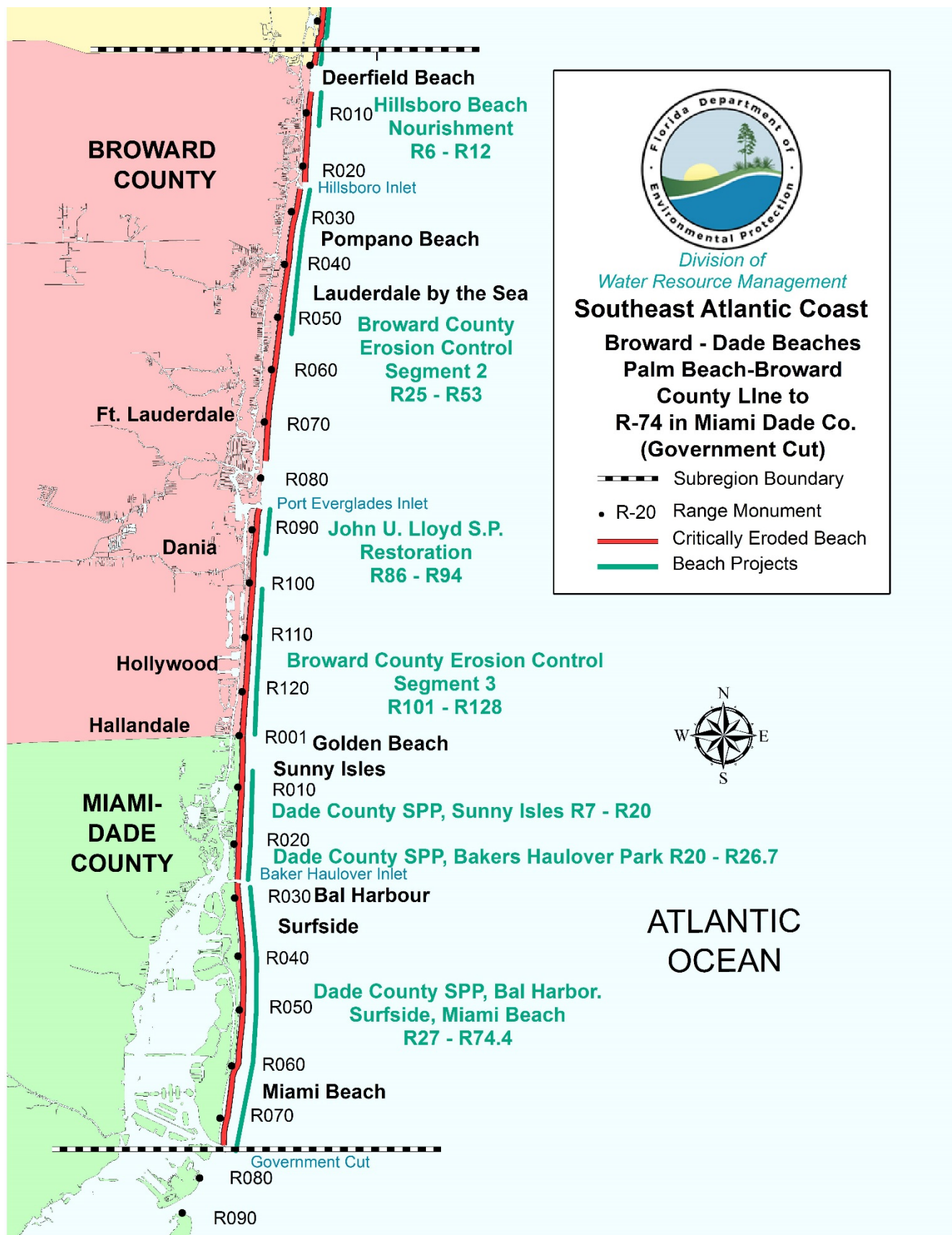


Figure 4. The Broward and Miami-Dade Beaches subregion of the Southeast region of Florida

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SOUTHERN BARRIERS

There are 6.4 miles of beaches in the **Southern Barriers** subregion, which extends from Fisher Island (R75) to Cape Florida (R113), as shown on Figure 5. The area includes Fisher Island, Virginia Key, and Key Biscayne, which are separated by Norris Cut and Bear Cut and from the mainland by Biscayne Bay. There are 2.5 miles of critically eroded beaches in this subregion on Key Biscayne, all of which are restored.

Erosion is attributed to occasional tropical storms and hurricanes, the downdrift influence of shore protection structures, and the effects of the inlets. The most erosive storms in recent years were Hurricane Andrew (1992) and Hurricane Rita and Wilma (2005) and Subtropical Storm Andrea, October northeasters (2007), Tropical Storm Noel (2007).

STRATEGIES FOR INLETS AND CRITICALLY ERODED BEACHES

NORRIS CUT (R78-R79) AND BEAR CUT (R88-R89), DADE COUNTY

Norris Cut and Bear Cut are stable, natural coastal inlets. Navigational dredging has not been conducted at Norris Cut and Bear Cut, although terminal groins have been constructed on Norris Cut to stabilize beaches on Fisher Island and Virginia Key, and two separate groin fields have been installed along the Bear Cut shoreline of Virginia Key.

In 1969, the federally-authorized **Virginia Key Beach Erosion Control Project** (R79-R88) restored a 50 foot wide beach berm at elevation +6 ft MLW along 1.3 miles of the beach using 176,800 cy of sand obtained from an offshore borrow area. In April 1974, groins were constructed (R79-R84) and 110,000 cy of beach compatible dredged material from Government Cut placed there. Timber groins (R84-R87) were constructed along the Bear Cut inlet shore of Virginia Key, some in 1948 and the remainder in 1956. In 1965, Dade County installed concrete piling, wood panel groins on the inlet shore of southern Virginia Key fronting Bear Cut. In 2003, the rehabilitation of the existing groins, construction of three additional groins, and placement of a small amount of beach fill placed by truck from an existing stockpile was completed. This project is not located within the bounds of a critically eroded beach but is described here as a previous beach management project near the critically eroded beaches.

In 1991, a privately funded beach erosion control project on **Fisher Island** (R75-R78) was constructed. The project consisted of the placement of 25,000 cy of imported oolitic aragonite sand and construction

of eight rock T-head groins. This project is not located within the bounds of a critically eroded beach but is described here as a previous beach management project near the critically eroded beaches.

KEY BISCAYNE, DADE COUNTY R101-R113

This is a 2.5 mile segment of critically eroded beach that includes the Village of Key Biscayne and Bill Baggs-Cape Florida State Park. Beach restoration has been conducted, and the project history for this segment of shoreline is described in Table 17.

In 1969, the federally authorized **Biscayne Beach Erosion Control Project** was constructed at Crandon Park on northern Key Biscayne in conjunction with the Virginia Key project. The project restored a 50 foot wide berm at elevation +7 ft NGVD along two segments of shore (R92.5-R96, R99-R101) using 196,300 cy of sand from a borrow area located immediately offshore.

In 1985, under the provisions of the 1965 Rivers and Harbors Act, the **Key Biscayne Shore Protection Project** was federally authorized. In 1987, the federal Key Biscayne Shore Protection Project (R101-R113.7) restored 2.4 miles of beaches (excluding a gap at R111-R112.3) using 420,000 cy of sand from an offshore borrow area located one mile southeast of Cape Florida. The project restored a 25 foot wide berm at the Village of Key Biscayne and a 20 foot wide berm at Cape Florida State Park, both at an elevation of +7 ft MLW, and provided additional beach fill equivalent to seven years of advance nourishment. A terminal groin was also constructed at the south end of Bill Baggs-Cape Florida State Recreation Area (R113.7). The project met its performance expectations by preserving a beach through the seven year nourishment interval. In 1994, damage caused by Hurricane Andrew to the terminal groin and adjacent revetment protecting the Cape Florida Lighthouse was repaired. The federal project was de-authorized in 1990.

In August 2002, a non-federal beach nourishment project at **Village of Key Biscayne** (R101-R108) was completed along 1.3 miles of beaches using 121,000 cy of sand from an offshore borrow site approximately 4,000 ft offshore from the southern tip of Key Biscayne. The beach fill has a construction berm width of 35 ft at elevation +7 ft NGVD. A physical and environmental monitoring program was conducted to verify avoidance of impacts to nearshore seagrass beds.

During 2005, significant erosion was sustained along Key Biscayne from Hurricanes Rita and Wilma. In addition, the seawall and revetment protecting the Cape Florida Lighthouse was damaged by Wilma. The Village nourished portions of the dune in 2008 using an upland sand source. The next nourishment

of the project shoreline between R101+300 and R107+600 was completed in 2012 using 37,500 cy of sand from an upland sand source.

Table 17. Key Biscayne Beach Nourishment Project history.

Date Completed	Volume (CY)	Borrow Source	Location	Length (Mi.)
1969	196,300	Offshore	R92.5-R96 and R99-R101	1.0
1987	420,000	Offshore	R101-R113.7	2.4
2002	121,000	Offshore	R101-R108	1.3
2008	2,400	Upland	R103-R107	0.75
2012	37,500	Upland	R101.3-R107.6	1.2

Strategy: Maintain the project through monitoring and nourishment.

REGIONAL STRATEGIES FOR BEACH AND INLET MANAGEMENT

SPONSORS AND FUNDING

In 1962, a federally authorized shore protection project by the [USACE](#) was approved for 1.8 miles of beaches on Virginia Key and 1.9 miles of beaches on northern Key Biscayne. The project was authorized for ten years from completion of initial construction, which occurred in 1969. In 1985, under the provisions of the 1965 Rivers and Harbors Act, nourishment of 2.3 miles of beaches on southern Key Biscayne and construction of a terminal groin was federally authorized. The project was deauthorized in 1990. The local sponsor was [Miami-Dade County](#). Subsequent activities on Virginia Key have been sponsored by the [City of Miami](#), owner of the island. The [Village of Key Biscayne](#) was the local sponsor since the 2002 nourishment. Project cost estimates may be found in [FDEP's Beach Management Funding Assistance Program](#) - Long Range Budget Plan.

PROJECT COORDINATION

Regionalization is the funding and coordination of multiple nourishment and inlet management activities to take advantage of identifiable cost savings through economies of scale, reduced equipment mobilization and demobilization costs, and elimination of duplicative administrative tasks. Coordination of nourishment at Key Biscayne with other projects in the area may not be practical

because a pipeline dredge is used for this project and a hopper dredge is used for other projects in the area. When future maintenance dredging of Government Cut is required, then placement of beach compatible sand on the beach of Key Biscayne should be considered.

ENVIRONMENTAL PROTECTION

The protection of marine turtles, shorebirds and seagrass beds are primary environmental concerns within this subregion. Project design and method of construction are restricted to avoid or minimize adverse impacts to marine turtles and seagrass beds; however, construction of the Key Biscayne project during the marine turtle nesting season has been approved. Norris Cut and Bear Cut are located within the limits of the [Biscayne Bay Aquatic Preserve](#). Projects located within and near the aquatic preserve boundaries require additional protection, including more stringent water quality standards than in non-aquatic preserve waters, during permitting and construction to ensure preservation of the existing conditions.

SAND SOURCES

Upland sand has been identified and permitted as an alternative to offshore sand for the Key Biscayne Project. For additional information on sand sources, FDEP manages a database named the [Regional Offshore Sand Source Inventory \(ROSSI\)](#).

ADDITIONAL INFORMATION

The introduction at the beginning of the state's Strategic Beach Management Plan provides additional information including overviews of:

- The principles followed to help guide the state's management strategies
- The miles of critically eroded beaches under active management
- Statewide sand source studies
- Statewide monitoring programs
- Innovative technologies examined
- Basic suggestions for emergency response plans

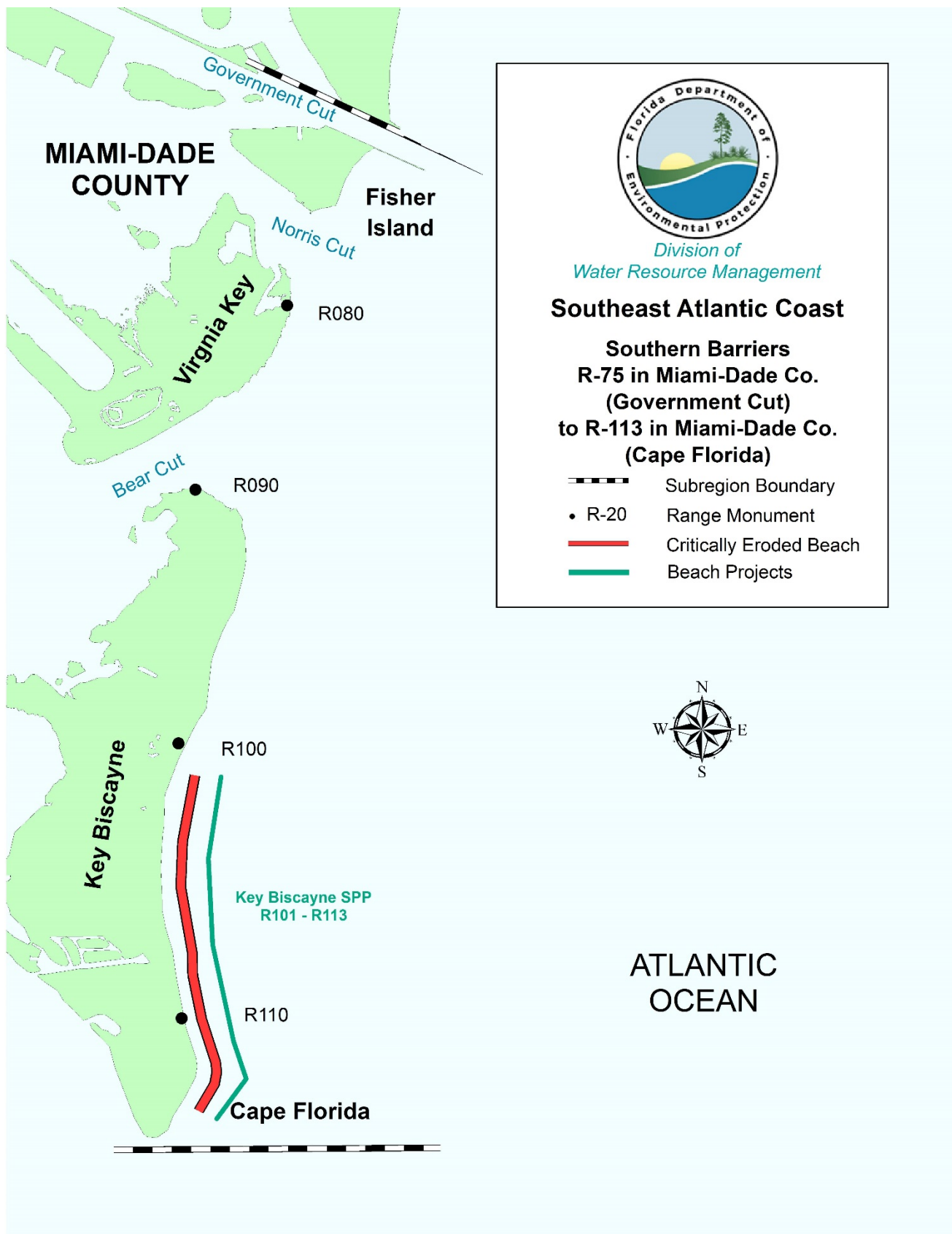


Figure 5. Southern Barriers subregion of the Southeast region of Florida.

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