

**FLORIDA DEPARTMENT OF  
ENVIRONMENTAL PROTECTION  
BUREAU OF BEACHES AND COASTAL SYSTEMS**

**STRATEGIC BEACH MANAGEMENT PLAN**

**for the**

**SOUTHEAST ATLANTIC COAST REGION**

**SUBREGIONS**

**Northern Palm Beaches**

**Palm Beaches**

**Southern Palm Beaches**

**Broward/Dade Beaches**

**Southern Barriers**

## **NORTHERN PALM BEACHES**

There are 13.3 miles of beaches in the **Northern Palm Beaches** subregion, which extends from the Martin-Palm Beach county line to Riviera Beach (R70) on Singer Island in Palm Beach County, as shown on Figure SE.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 in recent years were Hurricane David (1979), the Thanksgiving Day Northeaster of 1984, Hurricane Irene (1999), Hurricanes Frances and Jeanne (2004), Hurricane Wilma (2005), and Subtropical Storm Andrea, October northeasters and Tropical Storm Noel (2007).

### **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 in Martin County, where private development is threatened. The area is subject to dynamic erosion and accretion cycles on the downdrift side of the rock headland at the Preserve. In response to the 2004 hurricanes, a dune restoration project was constructed in 2008.

**Strategy:** Maintain the dune project; conduct physical monitoring of the area in conjunction with countywide monitoring or the statewide regional monitoring program.

#### **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 conducted along private development in Tequesta. This area was severely impacted by Hurricanes Frances and Jeanne (2004). Following the effects of the 2004 hurricane season, emergency protective berms were constructed in 2005 using funds from FEMA.

**Strategy:** Maintain the dune restoration project.

#### **JUPITER INLET, PALM BEACH COUNTY, R12-R13.5**

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. 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 Department adopted an Inlet Management Study Implementation Plan in October 1997 that established an annualized bypassing objective of 75,000 cubic yards. 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 cubic yards; coordinate maintenance dredging of Jupiter Inlet and the Intracoastal Waterway with the beach nourishment cycle of the Jupiter-Carlin Park project; continue a physical monitoring program and, based on the results, formally validate or revise the sediment budget.

**JUPITER -CARLIN, PALM BEACH COUNTY, R12-R19**

This is a 1.1-mile segment of critically eroded beach that is partially in the area of influence of Jupiter Inlet. In April 1995, construction of the federally authorized **Jupiter-Carlin Park Beach Restoration Project** (R13.5-R19) was completed using sand from the ebb tidal shoal of Jupiter Inlet. The local sponsor is Palm Beach County. The project design consists of a beach berm at elevation +9 ft NGVD 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 the Jupiter Inlet Park beach, 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. In March 2002, beach nourishment was conducted using sand from an offshore borrow site. A physical and environmental monitoring program is being conducted. A study to evaluate alternatives to address erosional hotspots at Jupiter Inlet Park began in 2007. Dune restoration was completed in December of 2007 between R13-R17 as a result of damage from Subtropical Storm Andrea.

**Jupiter-Carlin Park Beach Restoration Project**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
April 1995	604,000 cubic yards	R13-R19	1.05 miles
March 2002	625,000 cubic yards	R13-R19	1.05 miles

**Strategy:** Maintain the project through monitoring and nourishment; complete the study to evaluate alternatives to address erosional hotspot at Jupiter Inlet Park.

**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.

**Strategy:** Conduct physical monitoring.

**JUNO BEACH, PALM BEACH COUNTY, R26-R38**

This is a 2.4-mile segment of critically eroded beach. In March 2001, construction of the non-federal **Juno Beach Restoration Project** (R26-R38) was completed along 2.4 miles of shore using 1,000,000 cubic yards of sand obtained from an offshore borrow area. The local sponsor is Palm Beach County. The project restored the beach berm at +9 ft NGVD and provided additional fill material equivalent to six years advance nourishment. The project required construction of 4.47 acres of artificial reef to mitigate for adverse impacts to 3.77 acres of nearshore hardbottom. A physical and environmental monitoring program was also conducted. Nourishment for this area is planned for 2008.

**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. 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. Palm Beach County performed dune restoration projects throughout much of this area in 2001, 2004, 2005, and 2006. In March 2001, the Department and Palm Beach County initiated the first phase of a feasibility study of coastal erosion control structures. Preliminary findings were inconclusive. An additional feasibility study of coastal erosion

control structures was concluded in 2005. This feasibility study recommended the placement of beach erosion control structures. In 2006, Palm Beach County began permitting activities to construct 14 offshore breakwaters between R61-R68. The project proposes to stabilize the beach without the placement of sand to avoid impacts to hardbottom from an initial placement of sand. Potential adverse impacts to the nearshore hardbottom are possible and may require mitigation. A dune restoration project was completed between 850 feet north of R61 and 850 feet south of R65 in June, 2007 due to the impacts of Subtropical Storm Andrea, and was essentially repeated in January, 2008 due to the impacts from Tropical Storm Noel.

**Strategy:** Construct appropriate erosion control structures where environmentally suited; maintain dune project.

## **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 the state and federal government, but decided not to seek federal participation in the Juno Beach project in order to shorten the time between the planning phase and project construction. The Department also participates with Jupiter Inlet District on inlet management activities at Jupiter Inlet and with the Town of Jupiter Island on dune construction projects. Project cost estimates and schedules may be found in the Florida Beach Management 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. Artificial reefs have been constructed as mitigation to offset adverse impacts to nearshore hardbottom caused by the Jupiter-Carlin project and are being monitored. Artificial reefs will be constructed as mitigation for the Juno Beach project. An environmental assessment or impact statement may be required during the design and permitting phase of the proposed Singer Island beach erosion control project.

### **SAND SOURCES**

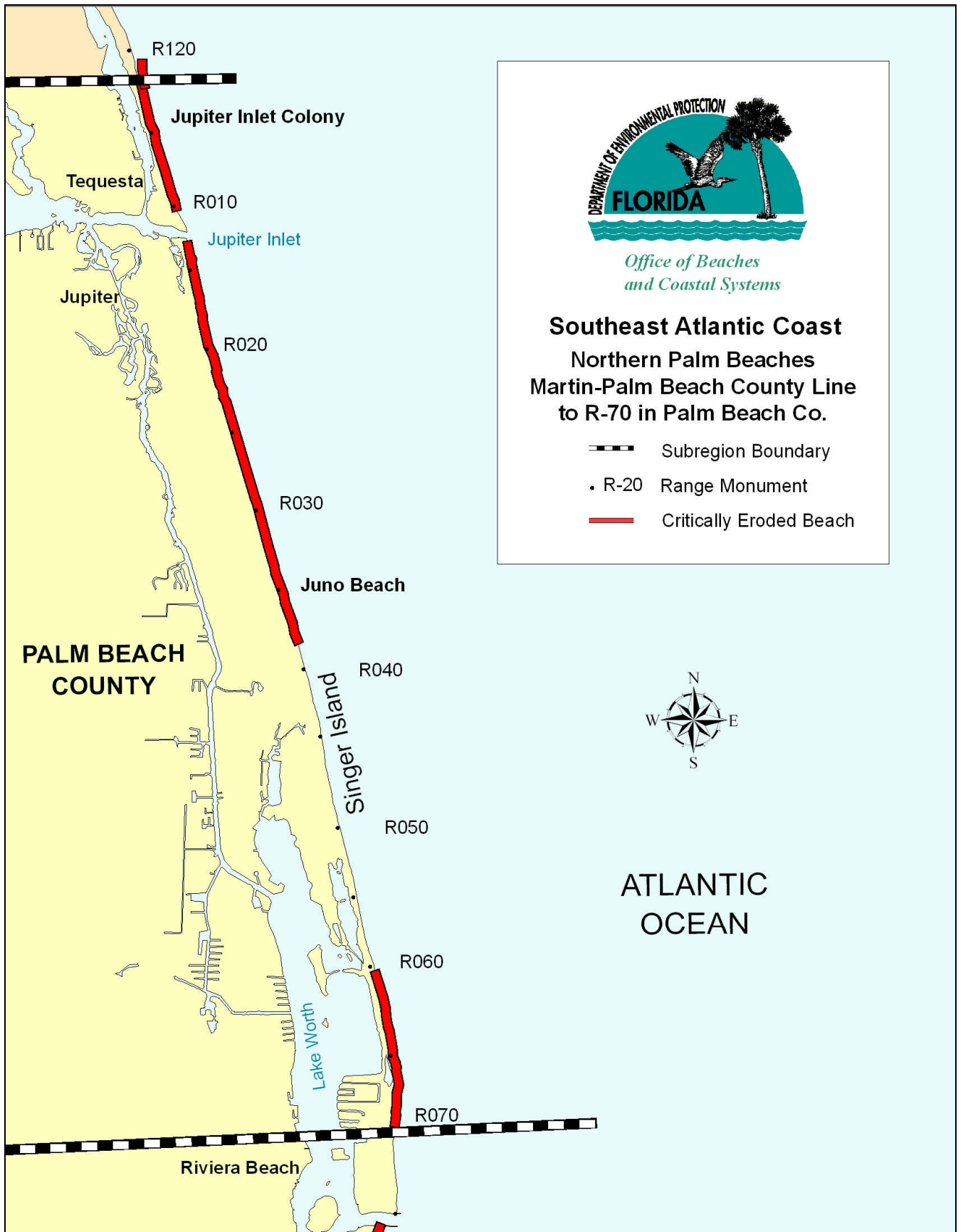
The Department and the U.S. Army Corps of Engineers, under the Coast of Florida Study, conducted an extensive offshore geotechnical investigation of the region. This study supported an investigation of sand

sources offshore of northern Palm Beach County in conjunction with the Jupiter-Carlin Park and Juno Beach projects that identified sufficient material for initial beach restoration, but not long-term periodic nourishment. The reconnaissance phase of a sand search for offshore sources of beach compatible sand began in 2003 for three areas: Singer Island, Briny Breezes, and Highland Beach. Borrow areas have been identified within these reconnaissance areas.

#### **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 SE.1: Northern Palm Beaches**

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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 SE.2. There are 14.9 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 and South Lake Worth Inlets. The most erosive storms in recent years were Hurricane David (1979), the Thanksgiving Day Northeaster of 1984, Hurricane Irene (1999), Hurricanes Frances and Jeanne (2004), Hurricane Wilma (2005), and Subtropical Storm Andrea, October northeasters and Tropical Storm Noel (2007).

### **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 feet MLLW. The channel is dredged frequently and the sand is placed on the downdrift beach within 3,000 feet of the south jetty. A sand transfer plant, operated by Palm Beach County, was constructed on the north jetty in 1958, but was not in operation between May 1990 and May 1996. The transfer plant bypasses sand to the downdrift beach immediately south of the jetty. In November 1996, the Department adopted the Lake Worth Inlet Management Study Implementation Plan that did not establish a bypassing objective. In December 2000, a sediment budget study recommended bypassing an average annual volume of 202,000 cubic yards 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.

**Palm Beach Harbor Entrance  
Channel Dredging**

<b>Date Completed</b>	<b>Volume</b>
1993	40,000 cubic yards
January 1994	14,400 cubic yards
March 1994	155,000 cubic yards
April 1995	180,000 cubic yards
June 1996	88,000 cubic yards
March 1997	100,000 cubic yards
February 1998	33,000 cubic yards
1999	35,000 cubic yards
2000	95,000 cubic yards
2001	100,000 cubic yards
2002	138,000 cubic yards
2003	100,000 cubic yards
2004	100,000 cubic yards

**Lake Worth Inlet Bypassing**

<b>Date Completed</b>	<b>Volume</b>
1996	193,300 cubic yards
1997	144,800 cubic yards
1998	58,400 cubic yards
1999	65,000 cubic yards
2000	220,000 cubic yards
2001	220,000 cubic yards
2002	232,000 cubic yards
2003	157,000 cubic yards
2004	188,000 cubic yards

In May 2001, the U.S. Army Corps of Engineers completed a navigation study 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 suggests Palm Beach County design and construct the 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. 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.

**Strategy:** Bypass an average annual volume of 202,000 cubic yards of sand to the downdrift beaches; place all beach compatible material dredged during channel maintenance on downdrift beaches in areas of greatest need; extension of the discharge pipeline to increase bypassing efficiency with discharge points located at the south jetty, and approximately 1,000 feet and 2,500 feet south of the south jetty.

**PALM BEACH ISLAND, PALM BEACH COUNTY, R76-R128**

This is a 10.9 mile segment of critically eroded beach where erosion is attributed to the effects of Lake Worth Inlet as far south as R121, approximately 45,000 feet. 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.

North of Midtown (R78-R90) is a 2.6 mile segment of critically eroded shoreline. This area is also referred to as Reach 2 and includes the beach between Onondaga Avenue and 1,080 feet north of Wells Road. Design and permitting are in process for a project that will serve as a feeder beach for periodic placement of maintenance material dredged from Lake Worth Inlet. The 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. Engineering is underway for a feeder beach project that will account for the presence of nearshore hardbottom.

In December 1995, construction of the non-federal **Mid-Town Beach Restoration Project** (R95-R100; also referred to as Reach 4) was completed using 880,000 cubic yards 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 project did not impact nearshore hardbottom areas located seaward of the equilibrated toe of the beach fill. The project maintained a beach berm along most of the project length through the nourishment interval, but experienced significant erosion at the north and south limits of the beach fill. In February 2003, beach nourishment and restoration of an expanded project area, spanning from R90.4-R101.4 (the northern extension is also referred to as Reach 3) was completed after settlement of a petition for an administrative hearing challenging issuance of the permit. In the settlement for the hearing, a 400-foot segment of the beach fill was eliminated around the Breakers' Rock Pile, which is composed of old concrete pier debris, to minimize impacts to wormrock and other benthic species that have encrusted the concrete. A physical and environmental monitoring program is being conducted to verify avoidance of impacts to nearshore hardbottom. During the 2004 hurricane season, the Mid-Town Beach Restoration Project was impacted. In 2005, FEMA provided emergency funding to replace the sand lost to the 2004 storms. Nourishment of the Mid-Town Beach Restoration Project was performed in 2006 which restored the beach to the design template.

**Mid-Town Beach Restoration Project**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
December 1995	880,000 cubic yards	R95 - R100	1.0 miles
February 2003	1,400,000 cubic yards	R90.4 - R101.4	2.5 miles
February 2006	893,000 cubic yards	R90.4 - 101.4	2.5 miles

Design and planning for the **South of Midtown Beach Restoration Project** (R101.4-R110) is ongoing. This area is also referred to as Reach 5 and includes the beach between Banyan Road and Widener's Curve.

In 2002, the design of the non-federal **Phipps Ocean Park Beach Restoration Project** (R119-R126; also referred to as Reach 7) was completed. 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. Construction was completed in 2006. The project restored 1.4 miles of beach at elevation +9 ft NGVD using 1.1 million cubic yards of sand from two borrow sites located approximately 3,500 feet offshore and approximately 1.5 and 2.6 miles south of the fill area. 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. A physical and environmental monitoring program is being conducted in accordance with the permits. This area experienced erosion during the 2004 hurricane season. In conjunction with the construction of the Phipps Ocean Park Beach Restoration Project in the spring of 2006, the Town of Palm Beach constructed a dune restoration project from 450 feet south of R116 to 100 feet south of R133.5.

Reach 8 (R126-R134) includes the beach between the Ambassador Hotel and La Bonne' Vie. This area experienced erosion during the 2004 hurricane season. To assist recovery, dune reconstruction was conducted in the spring of 2006. This included replacing material lost to storm events and adding vegetation at appropriate locations. A notice of intent to issue a permit has been issued to restore the beach between DEP monument T125 to 597 feet north of R127 and 954 feet north of R128 to R132 to a berm height of +9 feet NGVD, and a dune between R132 and 350 feet north of R134 using approximately 724,200 cubic yards of sand from offshore sources. The beach in the vicinity of R128 at the City of Lake Worth Municipal Beach is not included in the proposed Reach 8 project. Eight acres of artificial reef is proposed for mitigation of impacts to hardbottom. A third party petition has been received, and must be resolved if construction is to proceed.

**Strategy:** Maintain the projects through monitoring and nourishment using sand from offshore 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.

#### **SOUTH PALM BEACH, PALM BEACH COUNTY, R133.5-R136.7**

This is a 0.7 mile segment of critically eroded beach in South Palm Beach that is armored. The County has initiated a feasibility study to assess beach management alternatives. A dune restoration project was completed in March, 2007 between R136 and R137 due to the effects of Subtropical Storm Andrea. Additional sand was placed along the same shoreline in February, 2008, for Tropical Storm Noel.

**Strategy:** Conduct dune restoration where feasible; complete feasibility study to determine environmentally acceptable designs for beach restoration.

#### **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 is located along the south side of the interior entrance channel, but is dredged infrequently. The Department adopted the South Lake Worth Inlet Management Study Implementation Plan in March 1999, which established an annualized bypassing objective of 88,000 cubic yards of sand, including a minimum of 60,000 cubic yards 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 refurbish the plant. Reconstruction of the plant is necessary to upgrade the engine from diesel to electric, increase the size of the discharge pipe, and improve the efficiency of the bypassing system at the inlet as recommended in the adopted inlet management plan; this work is scheduled for 2008. In August 2002, construction was completed on expansion of the sediment impoundment basin as recommended in the adopted inlet management plan; maintenance dredging of the

basin is expected to occur once every eight years. During the 2004 hurricane season, the sand transfer plant was damaged and became inoperable.

**Strategy:** Continue to bypass suitable sediment to the downdrift beaches to meet an annualized bypassing objective of 88,000 cubic yards, including a minimum of 60,000 cubic yards mechanically bypassed by the sand transfer plant; reconstruct the sand transfer plant and extend the discharge pipeline along the beach south of the inlet and provide multiple discharge points to optimize placement of fill and improve the performance of the Ocean Ridge beach restoration project.

### **OCEAN RIDGE, PALM BEACH COUNTY, R152-R168**

This is a 3.3 mile segment of critically eroded beach that is partially within the area of influence of South Lake Worth Inlet. The area includes the communities of Ocean Ridge, Briny Breezes, Boynton Beach, and Gulf Stream.

In April 1998, construction of the federally authorized **Ocean Ridge Beach Restoration Project** (R152-R159) was completed along 1.6 miles of beach using 784,000 cubic yards of sand from a borrow site located 2,100 feet offshore of the project area. The project included construction of eight groins. The local sponsor is Palm Beach County. The project restored a beach berm at elevation +9 ft NGVD, and provided six years of advance nourishment (assuming a minimum of 60,000 cubic yards 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 was eroded during the 2004 hurricane season. The U.S. Army Corps of Engineers 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 550,000 cubic yards of sand from the previously used 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 and constructed mitigation. Palm Beach County will construct 2.25 acres of artificial reef to compensate for these impacts.

**Strategy:** Maintain the project through inlet bypassing, monitoring and nourishment using sand from offshore sources; conduct a feasibility study of beach erosion control alternatives for the remaining critically eroded beaches and evaluate impacts of the groin at Briny Breezes.

## **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, and 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. Project cost estimates and schedules may be found in the Florida 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 U.S. Army Corps of Engineers. 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.

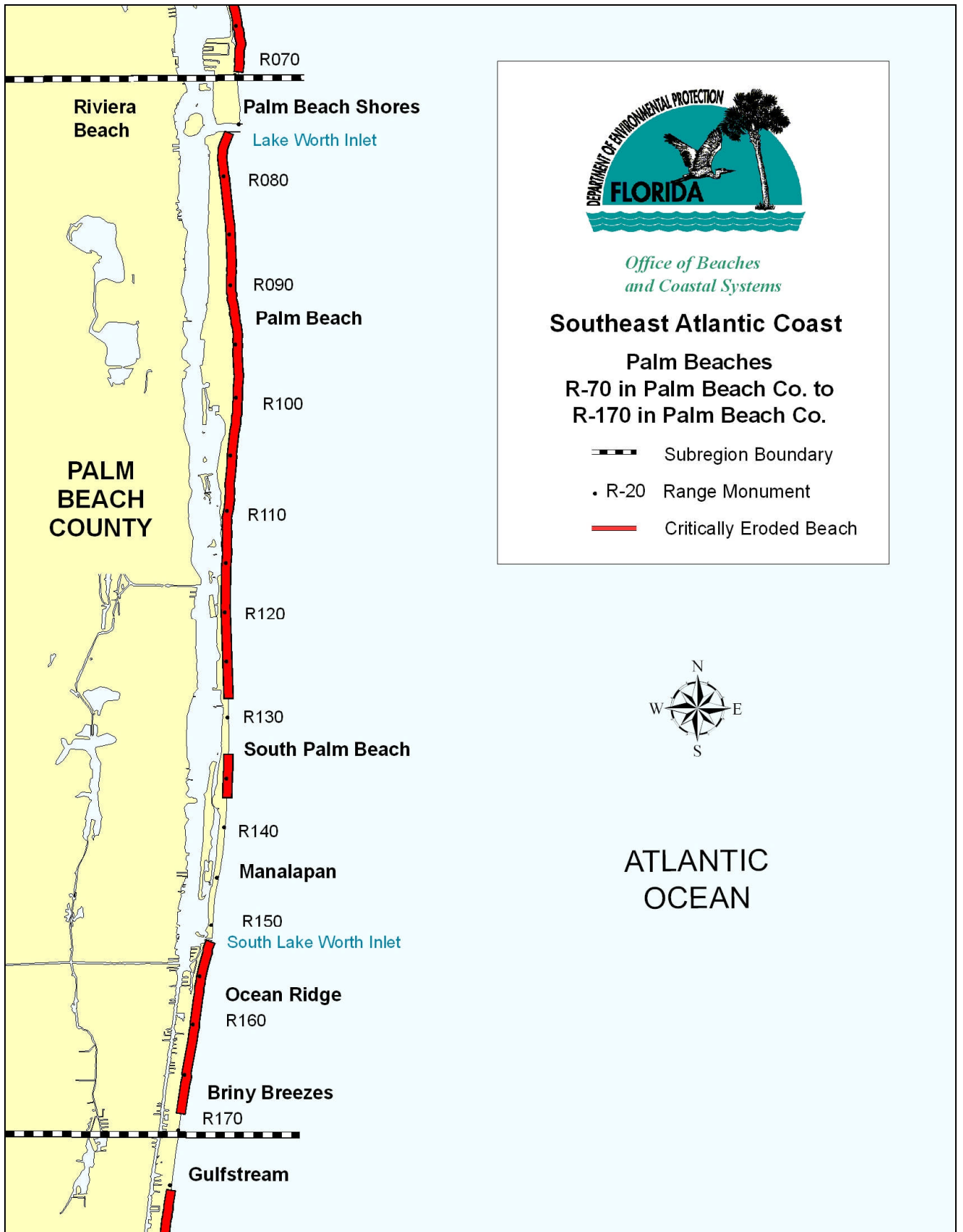
### **SAND SOURCES**

The Department and the U.S. Army Corps of Engineers, under the Coast of Florida Study, conducted an extensive reconnaissance level sand search investigation of the offshore region. This study supported an investigation of sand sources offshore of Palm Beach Island that identified borrow sites for beach restoration, but not long-term nourishment. The reconnaissance phase of a sand search for offshore sources of beach compatible sand began in 2003 for three areas: Singer Island, Briny Breezes, and Highland Beach. Borrow areas have been identified within these reconnaissance areas.

### **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 SE.2: Palm Beaches**

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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 SE.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 in recent years were Hurricane Irene (1999), Hurricanes Frances and Jeanne in (2004), Hurricane Wilma (2005), and Subtropical Storm Andrea, October northeasters and Tropical Storm Noel (2007).

### **STRATEGIES FOR INLETS AND CRITICALLY ERODED BEACHES**

#### **DELRAY BEACH, PALM BEACH COUNTY, R176-R190**

This is a 2.9 mile segment of critically eroded beach in the City of Delray Beach. Beach restoration and nourishment have been conducted.

In July 1973, construction of the federally-authorized **Delray Beach Restoration Project** (R175-R188) was completed using sand from an offshore borrow area. The local sponsor is the City of Delray Beach. The project restored a beach berm at elevation +9 ft NGVD and provided six years of advance nourishment. Beginning with the beach nourishment conducted in 1992, the design interval between beach nourishment events was 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 U.S. Army Corps of Engineers provided emergency funding to replace the material lost to storms. Construction of the nourishment project was completed in 2005.

**Delray Beach Restoration Project**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
July 1973	1,635,000 cubic yards	R175.5-R188.5	2.7 miles
May 1978	701,000 cubic yards	R177.2-R182.7 and R185.5-R188.5	1.8 miles
October 1984	1,300,000 cubic yards	R175.5-R188.5	2.7 miles
December 1992	1,198,000 cubic yards	R180-R188.5	1.7 miles
April 2002	1,150,000 cubic yards	R180-R188.5	1.7 miles
April 2005	412,000 cubic yards	R175.5-R188.5	2.7 miles

**Strategy:** Maintain the project through monitoring and nourishment using sand from offshore sources; conduct a feasibility study to examine the excavation of beach quality sand previously placed in the Delray Beach template that is located seaward of the depth of closure.

#### **BOCA RATON, PALM BEACH COUNTY, R204-R223**

This is a 4 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. In August 1988, construction of the federally-authorized **Boca Raton (North) Beach Restoration Project** (R205-R212) was completed using sand from an offshore borrow site. The local sponsor is the City of Boca Raton. The project restored the beach berm at elevation +9 ft NGVD and provided eight 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 predicted; however, a



physical and environmental monitoring program is being conducted to verify the effect of the project. The project is meeting its performance goal of preserving a beach berm through the eight 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 is anticipated for 2008.

**Boca Raton (North) Beach Restoration Project**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
August 1988	1,100,000 cubic yards	R205-R212	1.5 miles
April 1998	680,000 cubic yards	R205-R212	1.5 miles

In April 2004, construction of the federally-authorized **Boca Raton (Central) Beach Restoration 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. The project restored the beach berm at an elevation of +9 ft NGVD and provided seven years of advance nourishment along 1.5 miles of shore using 500,000 cubic yards of sand. The project included construction of a groin 1,500 ft north of the Boca Raton Inlet north jetty and modifications to the north jetty which denotes the south end of the beach fill. 0.65 acres of artificial reef was constructed to mitigate for hardbottom impacts. The north jetty was rehabilitated and the weir was relocated 50 feet 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.

**Boca Raton (Central) Beach Restoration Project**

<b>Date Completed</b>	<b>Volume (cubic yards)</b>	<b>Location</b>	<b>Length</b>
March 2004	480,000	R-216 to R-222	1.5 miles
March 2006	340,000	R-216 to R-222	1.5 miles

**Strategy:** Maintain the project through monitoring and nourishment using sand from offshore sources; restoration of the remaining critically eroded beach along the central portion 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 -10 ft NGVD. The Department adopted the Boca Raton Inlet Management Study Implementation Plan in 1997 that established an annualized bypassing objective of 71,300 cubic yards, which has been achieved. In October 2002, the Department and local sponsor initiated a study 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 cubic yards per year. 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 feet seaward. Planning work is currently underway to repair the seaward end of the jetty, which was damaged in the 2004 hurricane season.

**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 cubic yards.

**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. In July 1985, the construction of the non-federal **Boca Raton (South) Beach Restoration 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 +10 ft NGVD 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 included construction of 2.4 acres of artificial reef to mitigate for adverse impacts to 2.4 acres of nearshore hardbottom. 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 six year nourishment interval and inlet sand bypassing to the downdrift shore. This area was eroded during the 2004 hurricane season and in 2005, after three years of post-project monitoring, approximately 38 percent of the sand placed in 2002 remained on the beach. Nourishment is planned for winter of 2008.

**Boca Raton (South) Beach Restoration Project**

<b>Date Completed</b>	<b>Volume (cubic yards)</b>	<b>Location</b>	<b>Length</b>
July 1985	220,000	R223-R225.6	0.6 miles
December 1996	220,000	R223-R225.6	0.6 miles
April 2002	300,000	R223-R227.9	1.0 miles

**Strategy:** Maintain the project through monitoring and nourishment using inlet sand bypassing.

**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, 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 and Central Project with reimbursement funding provided by the State and Federal government, but has not sought federal funds for the South Project. Palm Beach County has participated with the municipalities in the collection and processing of monitoring data in this subregion. Project cost estimates may be found in the Florida 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.

**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 Boca Raton (North) Project, the Boca Raton (Central) and for the Boca Raton (South) Project. A physical and environmental monitoring program is being conducted to verify the expected effects of the projects.

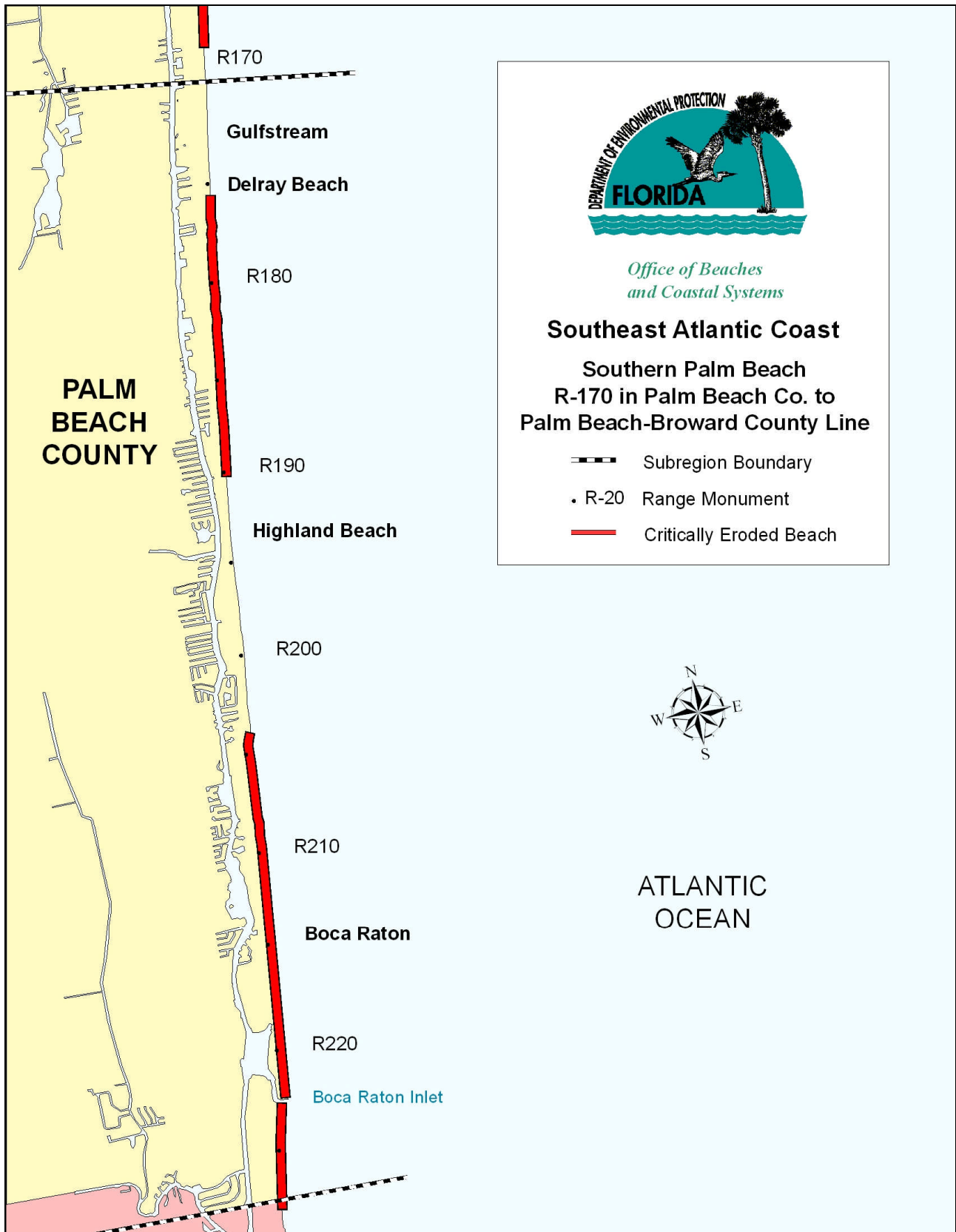
#### **SAND SOURCES**

Potential borrow areas have been identified during design of nourishment activities at Delray Beach, North Boca Raton and Central Boca Raton; however, additional investigation is needed to determine if these borrow areas contain adequate sand to meet long-term project needs. Transferring sand from the ebb tidal shoal of Boca Raton Inlet may continue to be sufficient for future nourishment of the South Boca Raton Project.

#### **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 SE.3: Southern Palm Beaches**

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## **BROWARD – DADE BEACHES**

There are 38.9 miles of beaches in the **Broward – Dade Beaches** subregion, which extends from the Palm Beach-Broward County line (R1) to Government Cut, in Dade County (R74.4), as shown on Figure SE.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 Hillsboro Inlet, Port Everglades Entrance, and Bakers Haulover Cut. The most erosive storms in recent years were Hurricane Andrew (1992), Hurricane Wilma (2005), and Subtropical Storm Andrea, October northeasters and Tropical Storm Noel (2007).

### **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. Some armoring exists in Hillsboro Beach and a boulder mound groin project 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 is 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.

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 Restoration 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 feet 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.

**Hillsboro Beach Restoration Project**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
1972	360,000 cubic yards	R7 - R12	1.0 miles
March 1998	555,000 cubic yards	R6 - R12	1.2 miles

**Strategy:** Maintain the project through monitoring and nourishment using sand from offshore sources and in coordination with sand bypassing activities.

#### **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. The Department adopted the Hillsboro Inlet Management Study Implementation Plan in September 1997. The plan established an annualized bypassing objective of 120,000 cubic yards, 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. However, damage to hardbottom by cables towing the barges of excavated rock in transit to the offshore artificial reef site resulted in additional mitigation and monitoring.

**Strategy:** Continue to bypass sediment to downdrift beaches to meet an annualized bypassing objective of 120,000 cubic yards; implement a physical monitoring program and validate or redefine the sediment budget contained in 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. Numerous bulkheads and retaining walls also exist along this stretch of coast. Minimizing or avoiding impacts to nearshore hardbottom may determine the feasibility of beach restoration along remaining portions of the shoreline.

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

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 feet. 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 hurricane season; nourishment is planned for 2008.

**Pompano Beach - Lauderdale-By-The-Sea - Ft. Lauderdale Beach Restoration**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
1970	1,076,000 cubic yards	R32- R49	3.2 miles
1983	1,900,000 cubic yards	R25 - R53	5.4 miles

In 2004, design and permitting were completed for nourishment of Pompano Beach (R36-R43) and restoration of Lauderdale-By-The-Sea and northern Fort Lauderdale (R51-R72) (also collectively known as Segment II of the federal **Broward County Beach Erosion Control Project**) using 935,000 cubic yards of sand from offshore borrow sites. The Pompano Beach design specifies a berm at elevation +9 ft NGVD that extends the MHW shoreline 100 feet seaward of the Erosion Control Line plus additional fill material equivalent to six years of advance nourishment. The beach fill design of Fort Lauderdale consists of a 20 foot extension seaward of the 1998 MHW shoreline plus fill material equivalent to six years of advance nourishment. The project includes construction of 3.0 acres of artificial reef as mitigation for impacts to 2.5 acres of nearshore hardbottom. A physical and environmental monitoring program will be conducted to verify avoidance of impacts to nearshore hardbottom. Prior to construction of Segment II, Broward County must submit eighteen months of biological monitoring results from the Segment III Broward County Beach Erosion Control Project (R86-R93). After review of the impacts monitored from the Segment III project, the Department will make a recommendation to the Board of Trustees as to whether or not the Segment II project should or should not be constructed or modified to further reduce potential impacts.

**Strategy:** Maintain the project through monitoring and nourishment; monitor remaining critically eroded beaches and implement an environmentally acceptable design for beach restoration.

### **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 excavation of the inlet entrance channel was placed in the nearshore north of the inlet and acts as a littoral barrier to shoaling of the navigation channel. Maintenance dredging is conducted infrequently. The Department adopted the Port Everglades Inlet Management Study Implementation Plan in May 1999. The plan established an annualized bypassing objective of 44,000 cubic yards, which has been achieved through the construction of Segment II of the Broward County Beach Erosion Control Project. 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 2006 Segment III nourishment project described below.

In 2004, the Department and Broward County completed a feasibility study 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. In July of 2006, preliminary engineering was initiated to refine the recommendations of the feasibility study.

**Strategy:** Place all beach compatible maintenance or offshore dredged material on the downdrift beaches in areas of greatest need to meet an annualized bypassing objective of at least 44,000 cubic yards; implement a physical monitoring program to validate or redefine the sediment budget developed in the inlet management plan; construct modifications to the north jetty or other alternatives to facilitate mechanical bypassing of sand, including removal of the rock spoil located in the nearshore north of the inlet.

### **JOHN U. LLOYD STATE PARK - HOLLYWOOD - HALLANDALE, 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 State Park and the communities of Dania, Hollywood, and Hallandale. Restoration and nourishment have been conducted.

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

In 1976, beach restoration of John U. Lloyd State Park (R86-R93, **Segment III Broward County Beach Erosion Control Project**) was constructed using sand from offshore borrow sites. The beach berm was constructed at elevation +10 ft NGVD and extended the MHW shoreline 140 feet 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 feet 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 (R101-R128, **Segment III Broward County Beach Erosion Control Project**) was constructed using sand from offshore borrow sites. The beach berm was constructed at elevation +7 ft NGVD and extended the MHW shoreline 178 feet 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 feet 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 significantly eroded.

Nourishment of John U. Lloyd State Park (R86-R92) and Hollywood -Hallandale (R98 - R128) was completed in March 2006 using 1,540,000 cubic yards 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 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 is being conducted to verify avoidance of impacts to nearshore hardbottom and the performance of the mitigation.

**J.U. Lloyd State Park - Hollywood - Hallandale Beach Restoration**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length (miles)</b>
1971	350,000 cubic yards	R124-R128	0.76 miles
1976	1,090,000 cubic yards	R86-R94	1.6 miles
November 1979	1,980,000 cubic yards	R101-R128	5.3 miles
1989	603,400 cubic yards	R86-R94	1.6 miles
August 1991	1,108,000 cubic yards	R101-R128	5.3 miles
May 2006	1,540,000 cubic yards	R86-R92: R98-R128	6.9 miles

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

**GOLDEN BEACH - SUNNY ISLES - HAULOVER BEACH PARK, DADE COUNTY, R1-R27**

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 **Dade County Shore Protection Project**. 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 220,000 cubic yards 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. In an effort to improve the longevity of the project, a submerged nearshore breakwater was constructed at this location (R7) in February 2002, following nourishment completed in December 2001. A survey program is being conducted to monitor the performance of the project and verify the predicted effects of the breakwater.

**Sunny Isles and Haulover Beach Projects**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
1955 to 1984	976,000 cubic yards*	R19–R26	1.6 miles
1960	180,000 cubic yards	R19-R26	1.6 miles
1978	300,000 cubic yards	R19-R26	1.6 miles
1987	240,000 cubic yards	R19-R26	1.6 miles
1988	1,320,000 cubic yards	R7-R20	2.6 miles
1990	60,000 cubic yards	R7-R20	2.6 miles
July 1997	80,000 cubic yards	R7-R10	0.6 miles
December 2001	922,000 cubic yards	R6–R20	2.4 miles

\* Sand dredged from Bakers Haulover Inlet

**Strategy:** Maintain the project through monitoring and nourishment.

**BAKERS-HAUOVER INLET, 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. The Department 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.

**BAL HARBOUR - SURFSIDE - MIAMI BEACH, DADE COUNTY, R27-R74.4**

This is a 9.4 mile segment of critically eroded beach from Bakers-Haulover Inlet to Government Cut. It includes the communities of Bal Harbour, Surfside, and Miami Beach. Beach restoration was completed for the entire segment as part of the federally-authorized **Dade County Shore Protection Project**.

In 1975, restoration at Bal Harbour (R27-R31) was completed by the local government on a federal reimbursement basis. The restoration of the remaining federally-authorized Dade County Shore Protection Project at Surfside (R31-R38) and 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 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.

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 at 63<sup>rd</sup> Street, Miami Beach (R46). Permitting and construction are pending future federal appropriations.

The performance of the beach fill along the segment of shore north of 32<sup>nd</sup> 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 32<sup>nd</sup> Street (R59-R60) during May-July 2002. Concurrently, transfer via truck-haul from south Miami Beach (R67-R72) of 110,000 cubic yards of beach

sand to the breakwater site and 50,000 cubic yards of beach sand to an adjacent erosional area (R53.5-R56) was conducted. A survey program is being conducted to monitor the performance of the project and verify the predicted effects of the breakwaters. In 2005 and 2006, approximately 40,000 and 30,000 cubic yards of sand via truck haul, respectively, was placed downdrift of the structures (R60-R61) in order to mitigate for downdrift impacts as specified in the approved monitoring and mitigation plan.

Additionally, the performance of the beach fill along the segment of shore located near 55<sup>th</sup> Street, Miami Beach and 44<sup>th</sup> 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 cubic yards of sand at the 55<sup>th</sup> Street segment (R48.7-R50.7) and placed approximately 50,000 cubic yards of sand at the 44<sup>th</sup> Street segment (R53.7-R55.5).

**Bal Harbour - Surfside - Miami Beach Restoration Project**

<b>Date Completed</b>	<b>Volume</b>	<b>Location</b>	<b>Length</b>
1960 to 1969	305,000 cubic yards	R27-R31	0.8 miles
July 1975	1,625,000 cubic yards	R27-R31	0.8 miles
August 1978	2,940,000 cubic yards	R31-R38	1.4 miles
August 1979	1,530,000 cubic yards	R38-R46	1.6 miles
October 1980	3,177,100 cubic yards	R46-R59	2.6 miles
December 1981	2,200,000 cubic yards	R59-R66	1.3 miles
January 1982	2,400,000 cubic yards	R66-R74	1.7 miles
1985	110,000 cubic yards	R41-R46	1.0 miles
1985	50,000 cubic yards	R57-R60	0.6 miles
1990	225,000 cubic yards	R27-R31	0.8 miles
September 1994	120,000 cubic yards	R55-R56	0.2 miles
July 1997	432,000 cubic yards	R53-R58	1.0 miles
1997	85,000 cubic yards	R54-R56 and R57-R59	0.6 miles
1998	142,000 cubic yards	R27-R31	0.8 miles
1998	18,000 cubic yards	R44-R45	0.2 miles
August 1999	627,700 cubic yards	R31-R36	1.0 miles
August 1999	211,500 cubic yards	R73-R74	0.3 miles
June 2001	200,000 cubic yards	R44-R46A	0.4 miles
2002	35,000 cubic yards	R27-R31	0.8 miles
2002	50,000 cubic yards	R53.5-R56	0.5 miles
2002	110,000 cubic yards	R67-R72	1.0 miles
2003	230,000 cubic yards	R27-R31	0.8 miles
2005	35,000 cubic yards	R60-R61	0.2 miles
2006	30,000 cubic yards	R60-R61	0.2 miles
2006	30,000 cubic yards	R48.7-R50.7	0.4 miles
2006	50,000 cubic yards	R53.7-R55.5	0.4 miles

**Strategy:** Maintain the project through monitoring and nourishment; conduct a feasibility study for the construction of erosion control structures at areas experiencing localized erosion; conduct nourishment test projects using alternative sand sources and innovative technology; transfer sand from accreted beaches in south Miami Beach to beaches in north Miami Beach.

**GOVERNMENT CUT, 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 feet 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 cubic yards per year to 49,000 cubic yards 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, estimated at 15,000 cubic yards per year, on the adjacent beaches in areas of greatest need.

## **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 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 federal participation in the entire project was approved for the 50-year life of the project to 2025. The local sponsor is Miami-Dade County. Design, permitting and construction are conducted by the U.S. Army Corps of Engineers with reimbursement or advance payment by the local and state sponsors. Project cost estimates may be found in the Florida 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 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. 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.

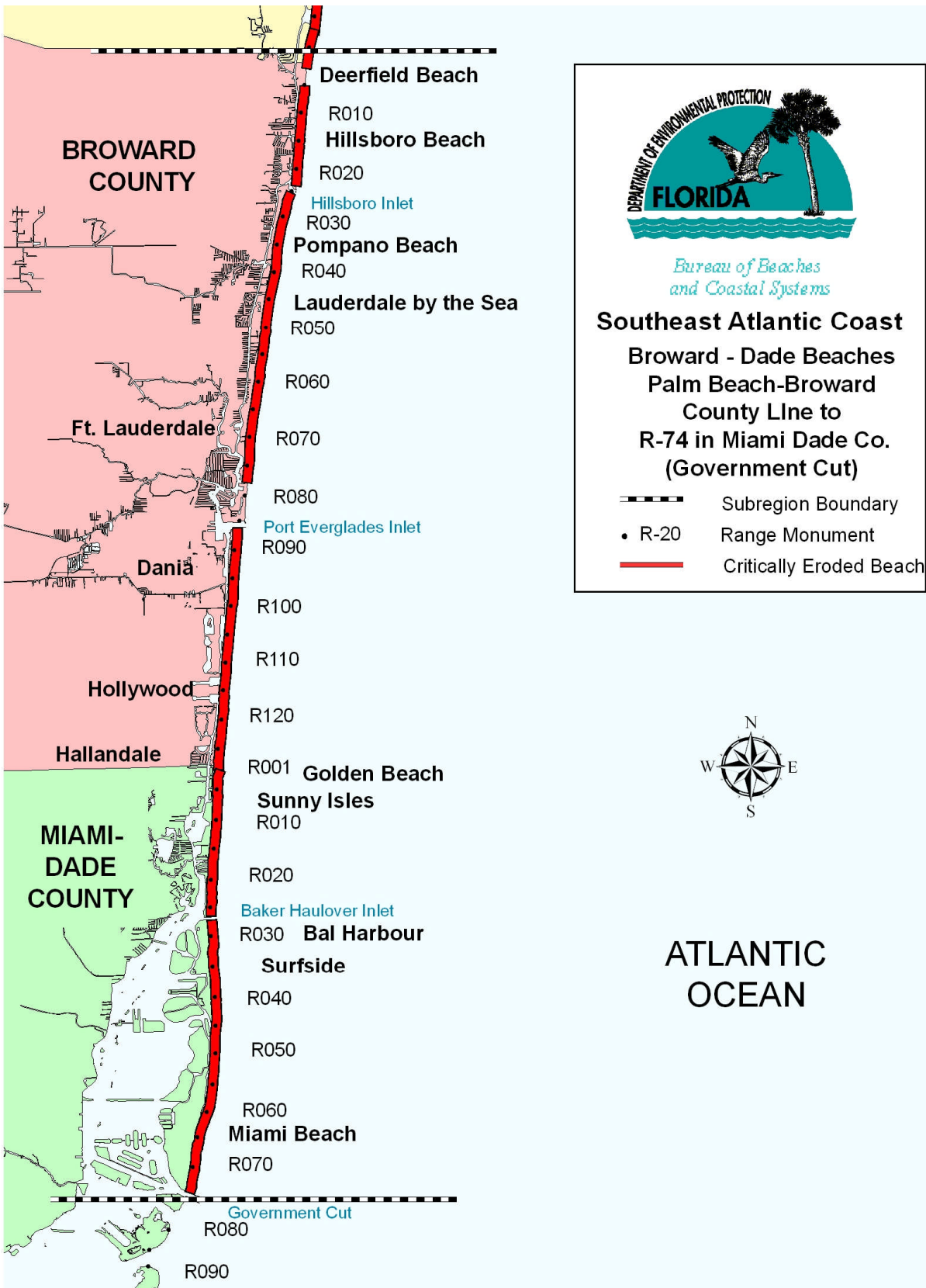
#### **SAND SOURCES**

Past studies have identified readily available sand sources remaining in the area. Comparison with projected demand has determined that these sand sources are not adequate to meet the needs of projects for the next 15 years. A regional investigation of alternative sand sources and methods to transport large quantities of material to multiple projects to reduce the overall cost of supplying sand is underway. Further exploration should be conducted in Broward County of the sand beneath surface rubble layers and in offshore areas not fully explored. Alternative upland and offshore sand sources are being sought by the Corps for nourishment in Miami-Dade County. The Department and Miami-Dade County have conducted a reconnaissance-level investigation of deep-water sand sources that should be continued.

#### **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 SE.4: Broward/Dade Beaches**

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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 SE.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 and 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.

**Strategy:** Maintenance of the existing shore protection structures is acceptable, but alteration of the inlets by dredging or navigation improvement structures is not recommended.

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 177,000 cubic yards of sand obtained from an offshore borrow area. In April 1974, groins were constructed (R79-R84) and 110,000 cubic yards of beach compatible dredged material from Government Cut were 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 cubic yards 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.

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 196,000 cubic yards of sand from a borrow area located immediately offshore.

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 cubic yards 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.

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 cubic yards of sand from an offshore borrow site approximately 4,000 feet offshore from the southern tip of Key Biscayne. The beach fill has a construction berm width of 35 feet at elevation +7 ft NGVD. Subsequent nourishment events are expected to occur every eight to ten years, using the same offshore borrow source. 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.

**Strategy:** Maintain the projects through monitoring and nourishment.

## **REGIONAL STRATEGIES FOR BEACH AND INLET MANAGEMENT**

### **SPONSORS AND FUNDING**

In 1962, a federally authorized shore protection project 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 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 of the 2002 nourishment.

### **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 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.

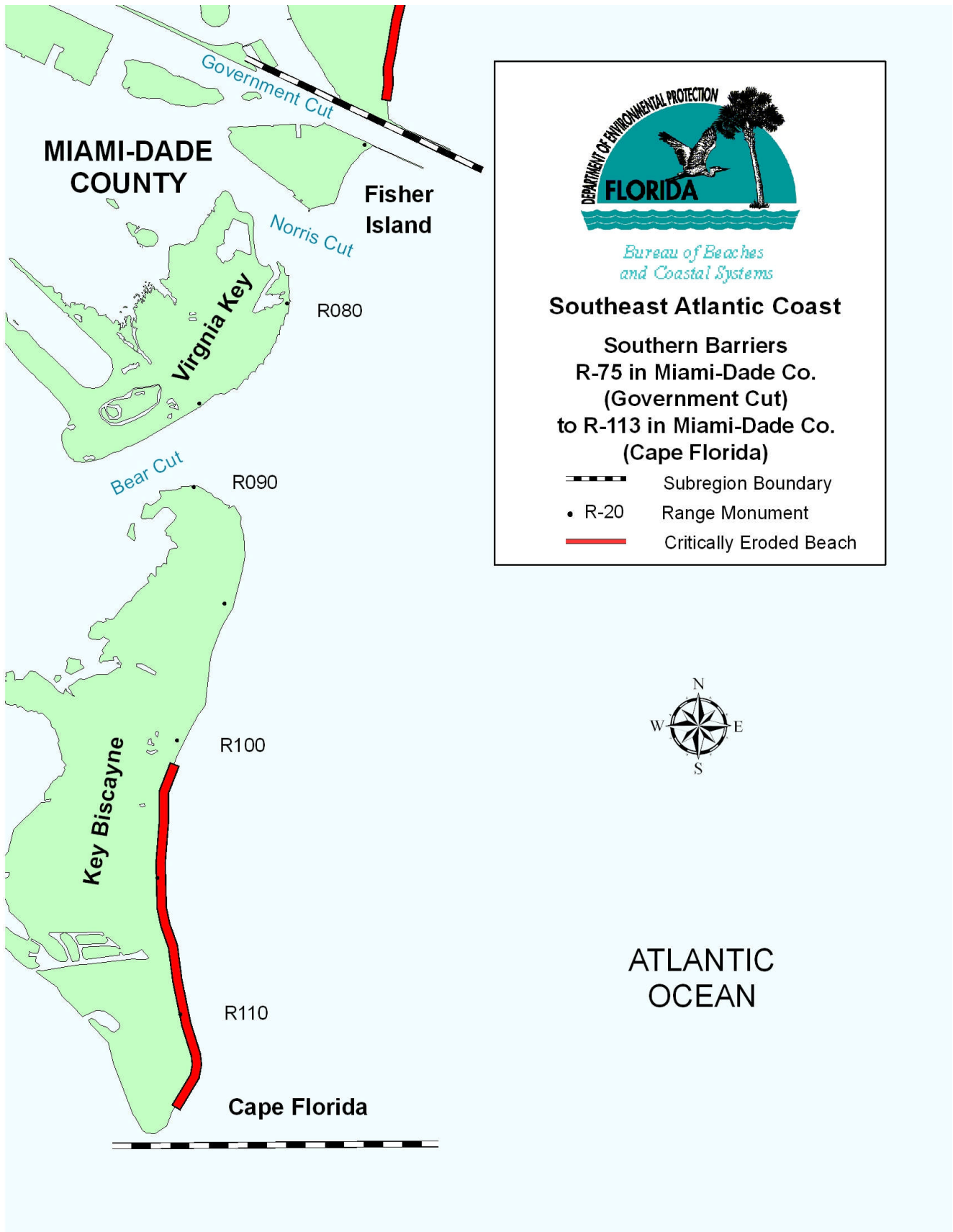
#### **SAND SOURCES**

Potential borrow areas have been identified during design of the nourishment project which contain adequate sand to meet the needs of the Key Biscayne project for the next 15 years.

#### **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 SE.5: Southern Barriers**

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