

THE “BIGGEST,” THE “BADDEST,” AND THE “BESTEST” – COASTAL RESTORATION CAJUN STYLE

J.S. Dartez¹

ABSTRACT

The Biggest

Whiskey Island is centrally located in the Isle Dernieres chain and it is a remnant of the single, larger Isle Dernieres (Last Island), which was segmented into multiple smaller islands by a major hurricane in 1856. The Project includes restoring the beach and dune along 6.9 kilometers (km) with 7.2 million cubic meters (MCM) of sand from the borrow area. The borrow area lies within Ship Shoal Lease Block 88 located on the Outer Continental Shelf (OCS) almost 16.7 km from Whiskey Island and contains over 12.0 MCM of sand. The Project also proposes to create an approximate 305 meter (m) wide marsh platform along approximately 1,676 m using over 0.8 MCM of sand from the borrow area. This Project represents “The Biggest” in terms of volume per linear foot of shoreline with an average density of over 1,105 cubic meters per liner meter.

The Baddest

Scofield Island is located west of the active Mississippi River bird’s foot delta in Plaquemines Parish, Louisiana. A primary objective of this Project was the excavation and delivery of Mississippi Riverine sand for beach and dune restoration; a first in our nation’s history. Multiple design and construction challenges arose requiring the Coastal Protection and Restoration Authority (CPRA) of Louisiana, Consulting Team and construction contractor to adapt. This Project is “The Baddest” because construction of the beach and dune required 35.4 km of pipeline and four booster pumps along a sediment pipeline corridor that crossed two hurricane protection levees, went underneath two highways and a navigation channel, traversed the Empire Waterway, crossed Pelican Island, entered the Gulf of Mexico, and extended to Scofield Island. The Project length was 3.5 km, total volume placed was over 2.6 MCM, and the benefit hectares equaled 257. The pipeline corridor has subsequently been utilized for two other restoration projects.

The Bestest

As a first in Louisiana’s restoration history, the Caminada Headland Beach and Dune Restoration Projects utilized sand dredged from Ship Shoal, an OCS sand resource located approximately 55.6 km from the restoration area. The 20.9 km long Headland was restored with approximately 8.3 MCM. This Project is “The Bestest” for restoring and protecting the fragile ecosystem which provides critical habitat for nesting shorebirds and the Headland’s importance in serving as a defense of our national energy infrastructure. The western portion of the Headland directly protects Port Fourchon, one of the nation’s most important energy ports.

Keywords: Dredging, Louisiana, Habitat, Cutterhead, Hopper

INTRODUCTION

Louisiana Coastal Restoration Programs began in 1990 with the federally enactment of the Coastal Wetlands Planning, Protection and Restoration Act (CWWPRA). This was the first major program to fund Barrier Island Restoration. Two Louisiana Coastal Area (LCA) Studies were initiated in 2004 and 2012 to study and evaluate potential coastal restoration projects for the rebuilding of the Louisiana coastline. The Coastal Impact Assistance Program (CIAP) was established by Section 384 of Energy Policy Act of 2005 with a purpose to assist oil & gas producing States in mitigating impacts from Outer Continental Shelf oil & gas production. Following the Deepwater Horizon Oil Spill two programs were established. The first is the Natural Resources Damage Assessment (NRDA) funded from the consent decree for Deepwater Horizon Oil Spill Settlement Funds with a global settlement of \$20 Billion (\$US) over 15-year period of which Louisiana is expected to receive \$5 Billion.

¹ J. Steven Dartez, Coastal Engineering Consultants, Inc., 5745 Essen Lane, Suite 200, Baton Rouge, Louisiana 70810, USA, T: 225-769-1982, Email: sdartez@ceci-la.com.

The portion of the NRDA program called the Gulf Environmental Benefit Fund is administered by the National Fish and Wildlife Foundation (NFWF) in support of barrier island and diversion projects, approximately \$1.27 Billion of the expected \$5 Billion (CPRA 2017). The second is the RESTORE Act, was signed into law in July 2012, and is administered by the Gulf Coast Ecosystem Restoration Council. The RESTORE program addresses the long-term health of Gulf Coast region's ecosystems and economy. Louisiana is expected to receive \$787 Million over a 15-year period (CPRA 2017). The Gulf of Mexico Energy and Security Act (GOMESA) is a dedicated funding stream for coastal restoration and risk reduction to Gulf States that permit OCS exploration. Louisiana set to receive ~ 39% of total from the GOMESA funding (CPRA 2017). Numerous parishes, cities, local governments, and environmental non-profit groups also conduct small scale restoration efforts for their communities and the State in general. Table 1 below is a listing of past and present barrier island restoration efforts undertaken by the State of Louisiana.

Table 1. Louisiana Barrier Island Restoration Summary.

Project	Length (meters - m)	Volume (million cubic meters - MCM)	Density (MCM/m)	Hectares (ha)
TE-24 Trinity Island (1999)	6,757	3.01	445	124
TE-20 East Island (1999)	5,791	3.71	641	113
TE-25-30 East Timbalier (2000)	8,796	2.06	234	98
TE-27 Whiskey Island (2000)	3,734	2.18	584	149
TE-40 Timbalier Island (2006)	4,907	2.75	560	124
TE-37 New Cut (2007)	2,530	0.63	249	63
BA-38-1 Chaland Headland (2007)	4,267	1.45	340	157
BA-35 Bay Joe Wise (2009)	4,267	2.26	530	170
BA-30 East Grand Terre (2010)	4,389	2.55	581	315
BA-38-2 Pelican Island (2012)	3,862	3.45	893	237
TE-48 Raccoon Island (2013) *	1,189	0.57	479	23
TE-52 West Belle Headland (2013)	3,505	3.12	890	197
BA-40 Riverine-Scofield (2013)	3,862	2.69	697	206
BA-45/143 Caminada Headland (2016) **	20,056	6.76	337	429
BA-110/111 Shell Island (2016)	5,791	4.74	819	388
BA-76 Chenier Ronquille (Const.)	2,195	2.01	916	202
TE-100 Caillou Lake Headlands (Const.)	7,224	7.98	1,105	377

* Marsh Fill Only

** Beach/Dune Fill Only

WHISKEY ISLAND – “THE BIGGEST”

Location and Project Description

The restoration of Whiskey Island is being conducted under the project name Caillou Lake Headlands Restoration (TE-100), a NRDA project. The TE-100 project area includes the restoration area on Whiskey Island; two (2) borrow areas located in the Gulf of Mexico, the sand source located approximately 15.2 kilometers (km) to the southwest of Whiskey Island and the mixed sediment source located approximately 7.8 km to the southeast of the island; and two (2) conveyance corridors connecting the borrow areas to the restoration area (Figure 1). Whiskey Island is located within the Isles Dernieres Reach of the Terrebonne Basin barrier island chain. The Isles Dernieres Reach represents a barrier island arc approximately 35.4 km long in Terrebonne Parish and extends from Caillou Bay east to Cat Island Pass. Raccoon Island, Whiskey Island, Trinity Island, East Island, and Wine Island, the primary islands that comprise the Isles Dernieres barrier island reach, are backed by Bay Blanc, Bay Round, Caillou Bay, and Terrebonne Bay, and bordered by the Gulf of Mexico on the seaward side. The present sub-aerial Whiskey Island is approximately 5.8 km long and approximately 1.1 km at its widest. Whiskey Island has approximately 93.1 hectares (ha) of mangrove wetlands in two (2) locations, at its east end and in its middle. The project will

restore the beach and dune feature along 6,858 m of existing barrier shoreline, as measured along the proposed design alignment, and create an additional 304.8 m wide marsh along the westernmost portion of Whiskey Island.

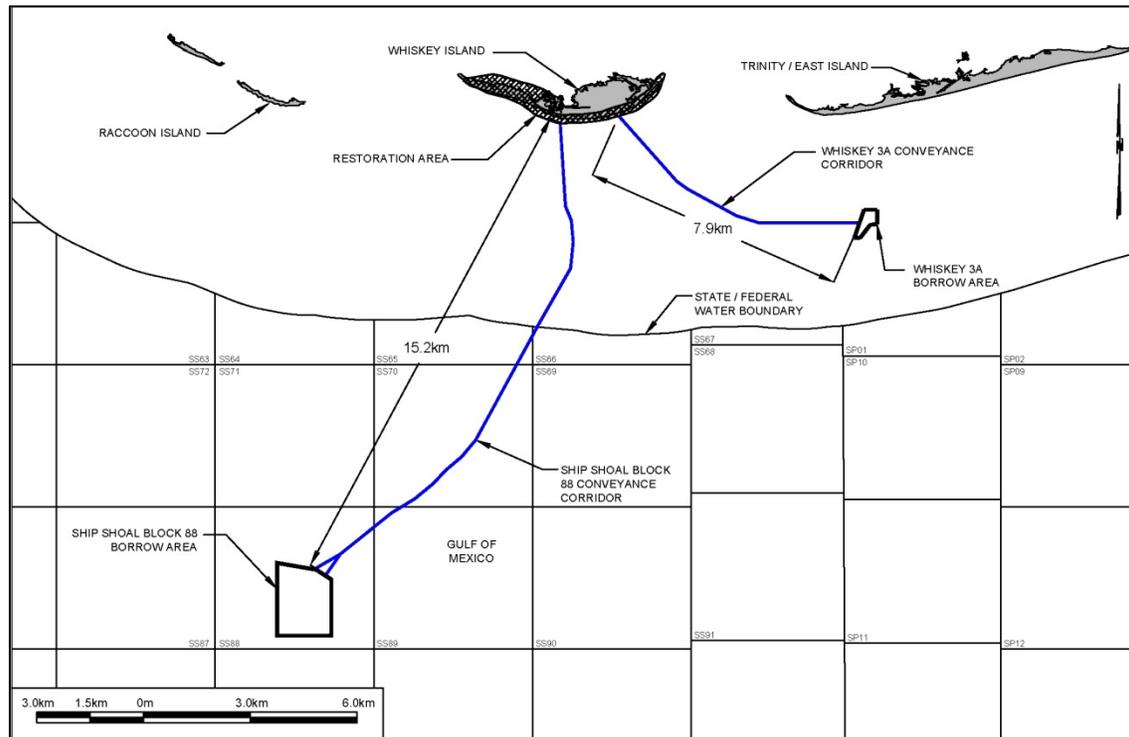


Figure 1: Project Overview

Design

Fill Template

The beach and dune feature spans the entire gulf face of Whiskey Island and would create approximately 299.5 ha of beach and dune habitat. The beach/dune fill template is tapered at each end to minimize end losses resulting from abrupt changes in shoreline alignment. The tapers are 914.4 m long and 762.0 m long at the west end and east end of the fill template, respectively. The beach and dune platform consists of placement of approximately 7.2 million cubic meters (MCM) of sand.

The marsh component is located along the western segment of Whiskey Island spanning approximately 1,676 m in length and will create approximately 65.6 ha of marsh habitat. The marsh fill template was designed to be synergistic with the existing mangrove habitats and the recent marsh restoration project on Whiskey Island. The marsh platform will consist of placement of approximately 0.8 MCM of mixed sediments. The design for Whiskey Island's restoration template (Figures 2 and 3) includes the following dimensions and elevations:

- Gulf-side beach width range = 141 m to 216 m;
- Gulf-side fore slope = 1V:25H;
- Beach elevation = +1.3 m NAVD88;
- Dune crest width = 30.5 m;
- Dune slopes = 1V:30H;
- Dune elevation = +2.0 m NAVD88;
- Bay-side beach width = 30.5 m;
- Marsh platform width (average) = 304.8 m; and
- Marsh platform target elevation = +0.7 m NAVD88.

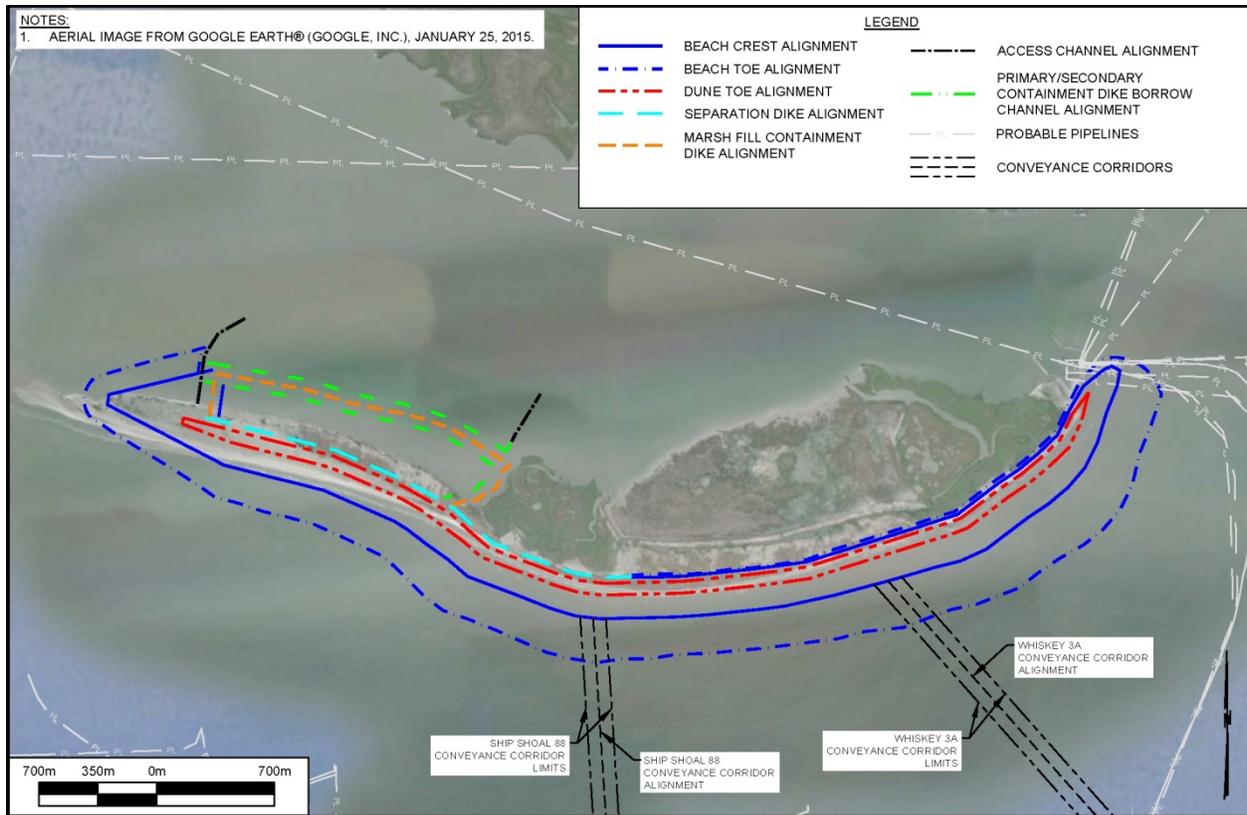


Figure 2: Fill Template Plan View

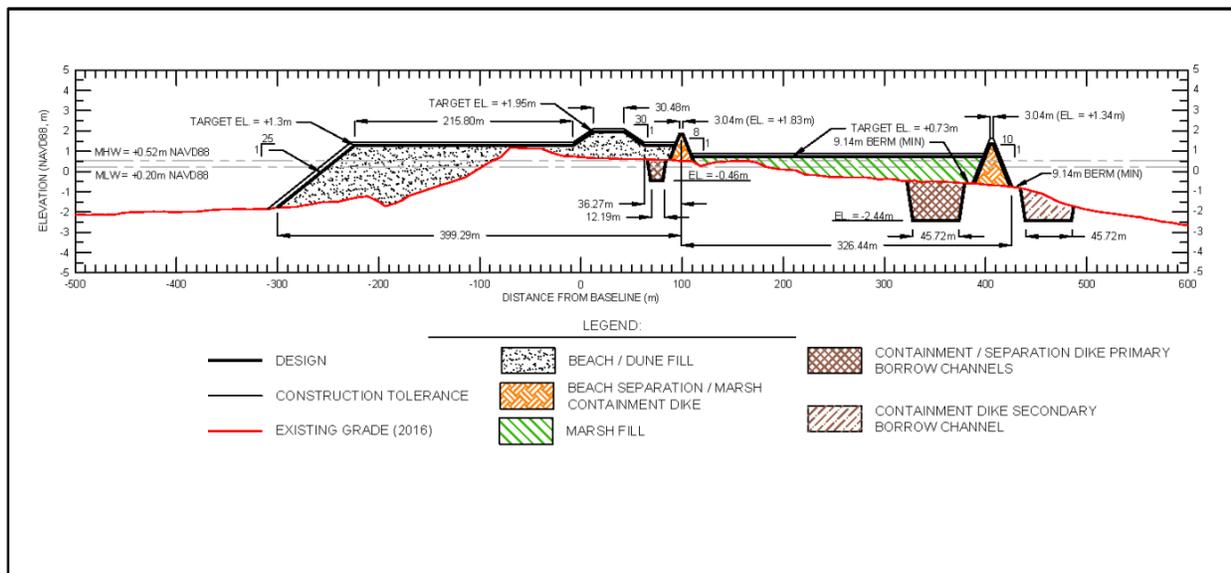


Figure 3: Fill Template Typical Section

Borrow Area

The designated borrow area for the beach and dune fill is located in Federal waters on the OCS over 15.2 km southwest of Whiskey Island and denoted as Ship Shoal Block 88 Borrow Area. Seafloor elevations within the study area range from less than -4.9 m to deeper than -11.3 m NAVD88. The borrow area dimensions vary with an average length of 1,900 m and average width of 1,310 m. The surface area is approximately 259 ha. Sediment analyses indicated good quality sand containing an average grain size of 0.19 mm classified as fine sand in the Wentworth scale and fine sand in ASTM soil size ranges, and is comprised of over 96% sand. The beach and dune borrow area has approximately 9.2 MCM of beach compatible sand to a design depth ranging from -8.2 m NAVD88 to -10.4 m NAVD88 with a 0.6 m allowable overdredge ranging from -8.8 m NAVD88 to -11.0 m NAVD88.

The designated borrow area for the marsh fill is located in State waters over 7.8 km southeast of Whiskey Island and is denoted as the Whiskey 3A Borrow Area. Within the study area seafloor elevations range from less than -4.6 m to deeper than -7.0 m NAVD88. The Whiskey 3A Borrow Area is irregular in form and its dimensions vary significantly with an average length over 609.6 m and average width over 289.6 m. The surface area is approximately 31.2 ha. The borrow area has approximately 1.7 MCM of marsh compatible sediments sand to a dredge cut depth of -11.3 m NAVD88 with a 0.6 m allowable overdredge to -11.9 m NAVD88.

Conveyance Corridors

The Ship Shoal Block 88 Conveyance Corridor is approximately 175.9 km from the Ship Shoal Block 88 Borrow Area to Whiskey Island. The Conveyance Corridor is 152.4 m in width with water depths vary from -9.8 m NAVD88 to 0 m NAVD88 at Whiskey Island and is aligned to avoid the buffered areas identified as potential cultural resources or abandoned/plugged wells.

The Whiskey 3A Conveyance Corridor connecting the Whiskey 3A Borrow Area to Whiskey Island. The alignment is approximately 8.3 km in length, 152.4 m in width, and the water depths vary from -6.1 m NAVD88 to 0 m NAVD88 at Whiskey Island.

Construction

Whiskey Island is currently under construction. Bid documents allowed for the construction contractor to elect to construct the marsh fill template from either the Ship Shoal Block 88 or the Whiskey 3A Marsh Borrow Area. The contract was awarded for the construction of the beach, dune, and marsh fill templates exclusively from the Ship Shoal Block 88 Borrow Area. The borrow area is being excavated utilizing a cutterhead dredge with sediment transported to the fill templates via a submerged sediment pipeline with assistance of three (3) booster pumps (10,742kW total). Construction completion is anticipated in early 2018.

Title - Cajun Style

The Caillou Lake Headlands Restoration (TE-100) was given the distinction of “The Biggest” due to the sheer volume of sediment used for restoration. It currently is the largest, by volume, single restoration project undertaken by Louisiana.

SCOFIELD ISLAND – “THE BADDEST”**Location and Project Description**

Scofield Island is a 3.8 km long barrier island located between Scofield Bayou and the merger of Bay Coquette and the Gulf of Mexico along the Plaquemines Barrier System.

A major and unique feature of the Riverine Sand Mining / Scofield Island Restoration (BA-40) project was the Conveyance Corridor for installation of the sediment pipeline from the Mississippi River to Scofield Island (Figure 4). The Conveyance Corridor design included crossing over the Mississippi River Levee, routing beneath Louisiana Highway 11 through an installed permanent casing, crossing the Empire Landfill, subaqueous crossing beneath the Empire Boat Harbor navigation canal, routing beneath Louisiana Highway 23 through an installed permanent casing, crossing over the Hurricane Protection Levee, crossing a small area of saltwater marsh, and crossing over the rock breakwater at the Empire Locks (Figure 5). The sediment pipeline then paralleled the Empire Waterway to the

Empire Jetties at the Gulf of Mexico, and then progressed eastward to Scofield Island. The total pumping distance was approximately 35.4 km facilitated with the use of four (4) booster pumps (19,175kW total).

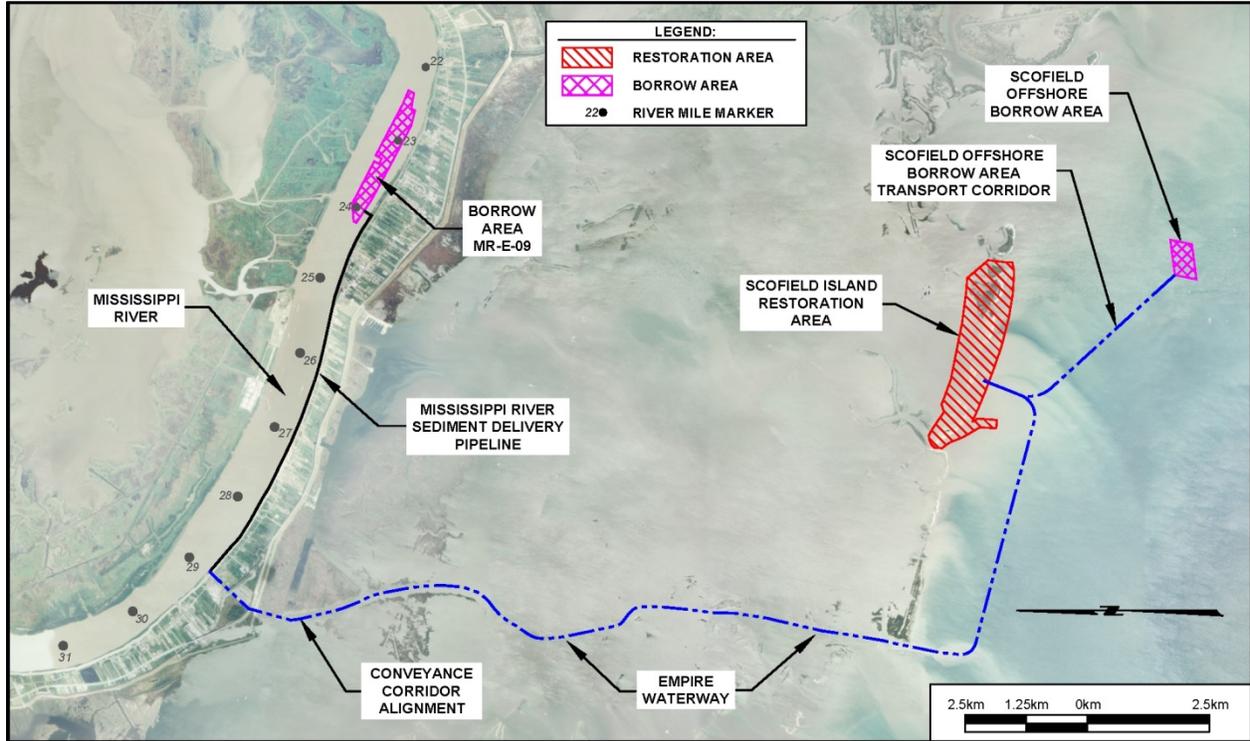


Figure 4: Project Overview



Figure 5: Equipment and Conveyance Corridor Crossings

As-Built Features

General

The project features included creation of a marsh platform using 1.15 MCM of mixed sediment contained with containment dikes. The seaward beach / dune platform was expanded and the breaches filled to address the severity of erosion using 1.45 MCM of sand placed along the gulf shoreline. Also included were access channels and signage, sand fencing, and vegetative plantings. The project benefits include approximately 60.7 created beach/dune hectares (ha) above mean high water and approximately 160 ha of created marsh.

Mississippi River Borrow Area (MR-E-09)

The MR-E-09 Borrow Area design was approximately 2,896 m long, 335 m wide, and 7.6 m thick. The volume ranged from 2.95 to 4.48 MCM (high water to low water periods, respectively). The borrow area sediments consisted primarily of fine grained sands with a mean grain size of 0.19mm. Figure 6 presents a colored contour map of elevation changes between the pre- and post-construction surveys.

Scofield Offshore Borrow Area (SOBA)

The SOBA lies approximately 4.8 km south of Scofield Island, at depths ranging from -5.5 to -6.1 feet NAVD88. The SOBA was delineated to include the interdigitated strata of sandy, silty, and clayey sediment with a mean grain size of 0.10mm. The design plan was approximately 853 m long by 579 m wide with a thickness up to 6.7 m, corresponding to a volume of approximately 2.52 MCM. Figure 7 presents a colored contour map of elevation changes between the pre- and post-construction surveys.

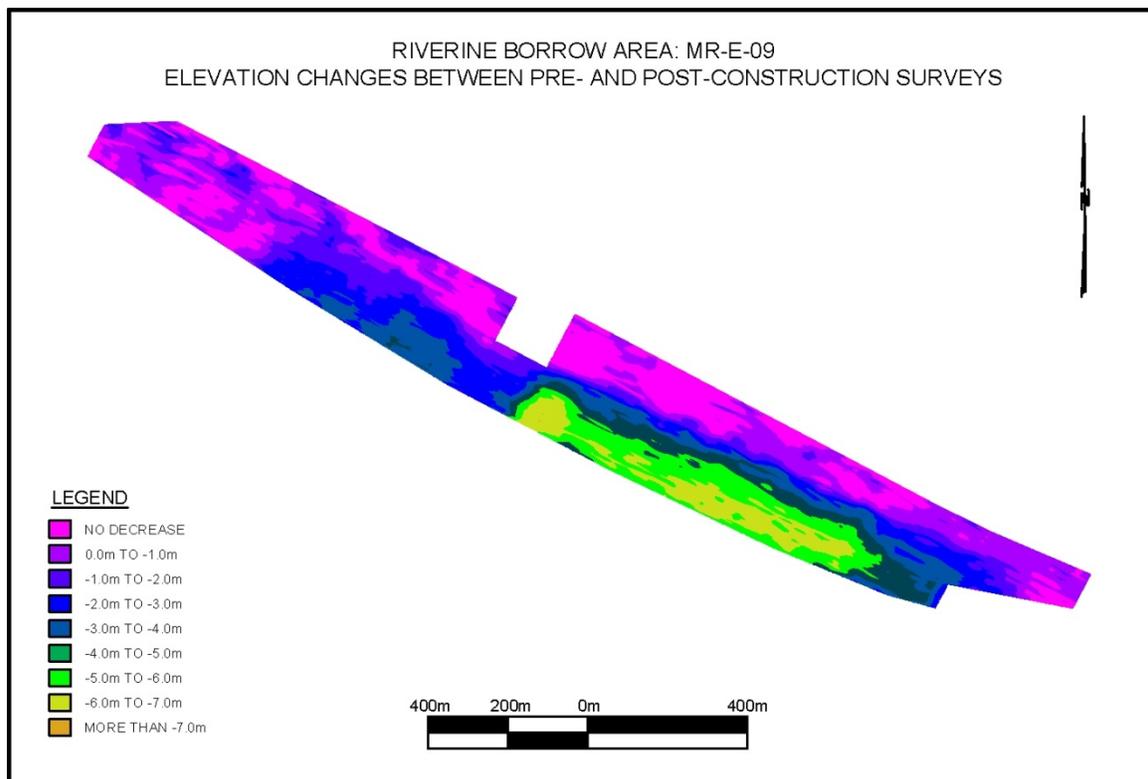


Figure 6: Elevation Changes Between Pre- and Post-Construction Surveys

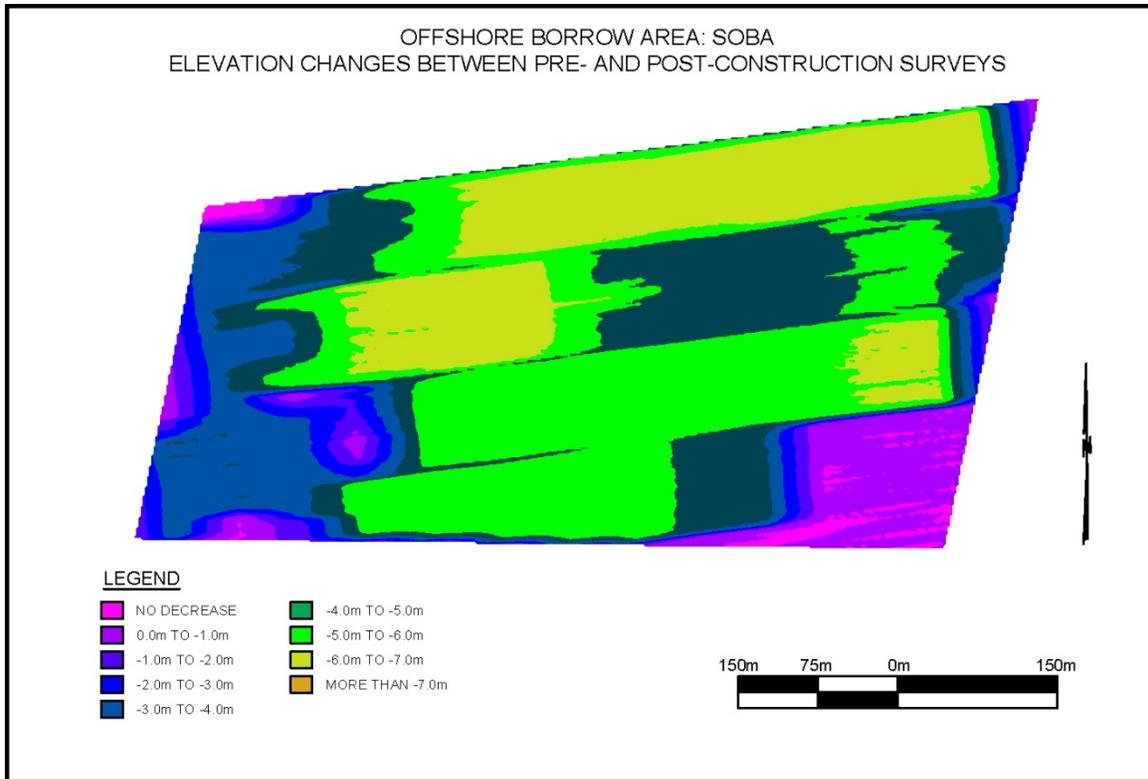


Figure 7: Elevation Changes Between Pre- and Post-Construction Surveys

Beach and Dune

The beach and dune elements were constructed to elevations of +1.2 m and +1.8 m NAVD88, respectively along 3,870 m of shoreline (Figure 8). The combined beach and dune component maintained a width of a minimum of 195 m. A single row of sand fencing was installed along the entire length of the dune with overlapping gaps for passage. The Project constructed approximately 607 ha of supratidal habitat.

Marsh

The marsh cells were constructed to the target marsh elevation of +0.9 m NAVD88 with an average width of over 3050 m creating approximately 146 ha of future intertidal habitat. The original marsh platform was designed to form two areas or cells due to the necessity to maintain an access channel from the north to a petroleum pipeline transfer facility. Settlement plates were installed within the marsh fill areas to provide long term settlement measurements of the project.



Figure 8: Completed Scofield Island Project

Title - Cajun Style

The Riverine Sand Mining / Scofield Island Restoration (BA-40) was given the distinction of “The Baddest” due to the first use of Mississippi River sediments for barrier island restoration and at the time the longest sediment delivery pipeline for coastal restoration in Louisiana.

CAMINADA HEADLAND – “THE BESTEST”

Location and Project Description

The Caminada Headland is a Gulf of Mexico shoreline that spans from Belle Pass on the west to Caminada Pass on the east, a distance of approximately 21.4 km (Figure 9). The restoration of the Caminada Headland was comprised of two increments, Increment I (BA-45) and Increment II (BA-143). The BA-45 project originated at Belle Pass and continued eastward for approximately 9.4 km to just east of Bayou Moreau in Lafourche Parish. The BA-143 project continued the construction of the BA-45 project eastward for an additional 11.9 km to Caminada Pass. The borrow area for both projects was located in the South Pelto Outer Continental Shelf (OCS) Lease Blocks 13 and 14, at the far eastern end of Ship Shoal. Ship Shoal is an east-west elongate sand body approximately 64.3 km in length and varies from 3.2 to 9.7 km in width. The BA-45 project was funded through a combination of CIAP and State surplus funds and the BA-143 project was funded through NFWF.

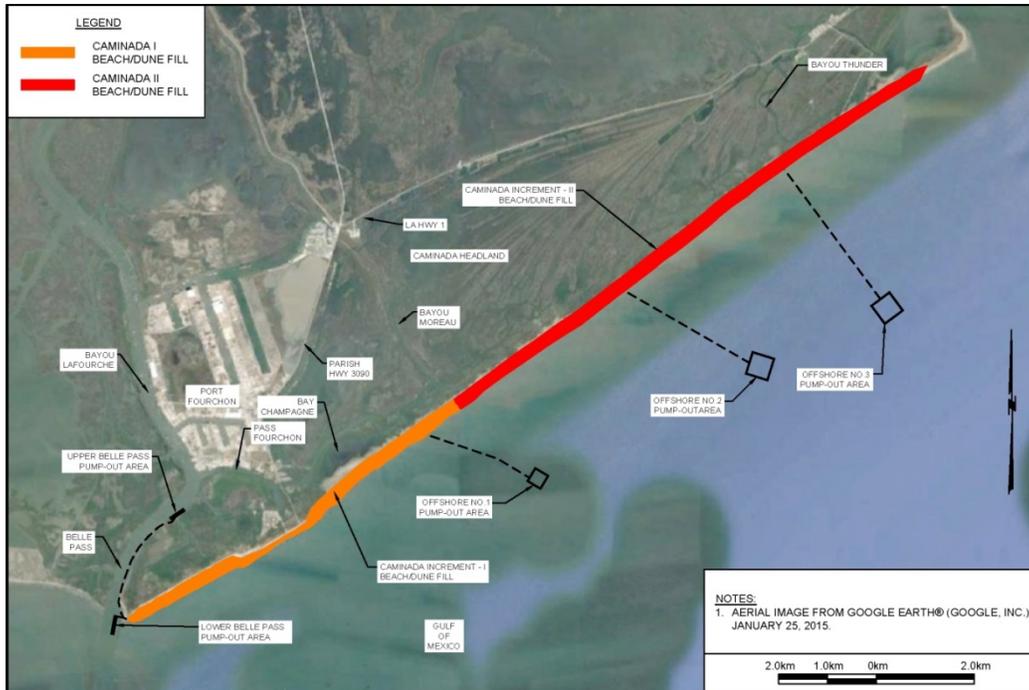


Figure 9: Project Overview

Construction Methods

Sediment for the projects was excavated and transported by two methods (Figure 10). The first excavation/transport method utilized a cutterhead dredge and spider barge to load scow barges. The scow barges were towed to the one of three offshore pump-out areas offshore of the fill template. At the pump-out area the scows were offloaded utilizing a hydraulic unloader and the sand slurry was pumped and deposited within the fill template via a sediment pipeline with the assistance of a booster pump when necessary. The second excavation/transport method utilized a hopper dredge to excavate the sediment from the borrow area, retain the sediment within the hopper, and transport the sediment to the offshore pump-out areas. Once at the pump-out area, the hopper dredge would connect to a submerged sediment pipeline, re-slurry the sediment within the hopper, and pump the slurry to the fill template. Transport distance for both the scow barges and hopper dredges averaged approximately 55.6 km.

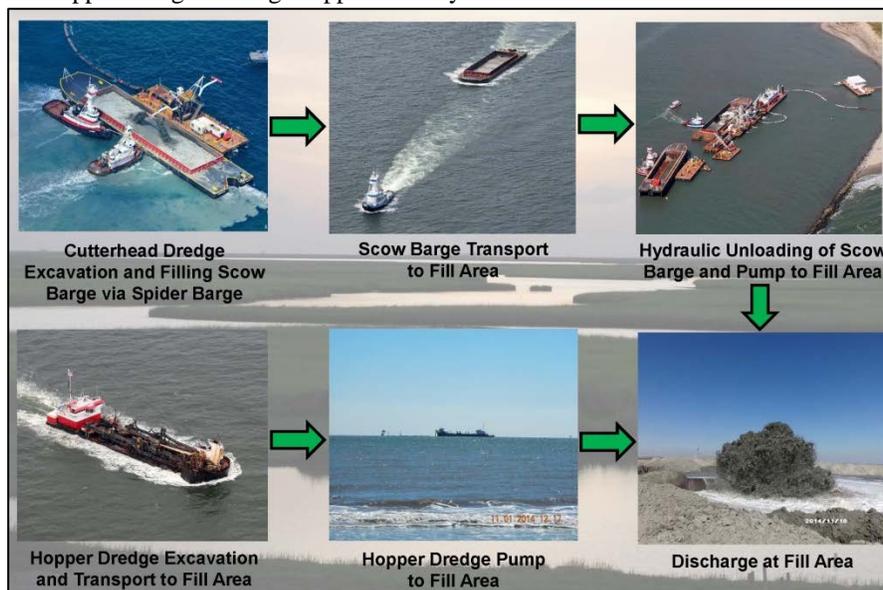


Figure 10: Construction Methods

As-Built Features

Beach and Dune

The design elevations of the beach and dune components were +1.4 m and +2.1 m NAVD88, respectively along approximately 21.3 km of shoreline. There was a +0.3 m construction tolerance above the design elevation which the construction contractor elected to utilize. Generally, along the entire fill template the beach and dune were constructed to elevations of +1.7 m and +2.4 m NAVD88, respectively. The BA-45 design beach slope extending seaward was 1V:20H with a construction tolerance slope of 1V:40H extending seaward from Mean Low Water (MLW). Using the lessons learned from the BA-45 project, the BA-143 project had a design beach slope extending seaward of 1V:20H with a construction tolerance slope of 1V:25H extending seaward from MLW (Figure 11). The combined beach and dune component maintained a minimum width 123.4 m. The total volume of sand placed and retained on the Caminada Headland during construction of both projects was approximately 6.8 MCM. The completion of the projects resulted in approximately 429 ha of gulf subtidal, gulf intertidal, supratidal, and dune habitats being created (Figures 12 and 13).

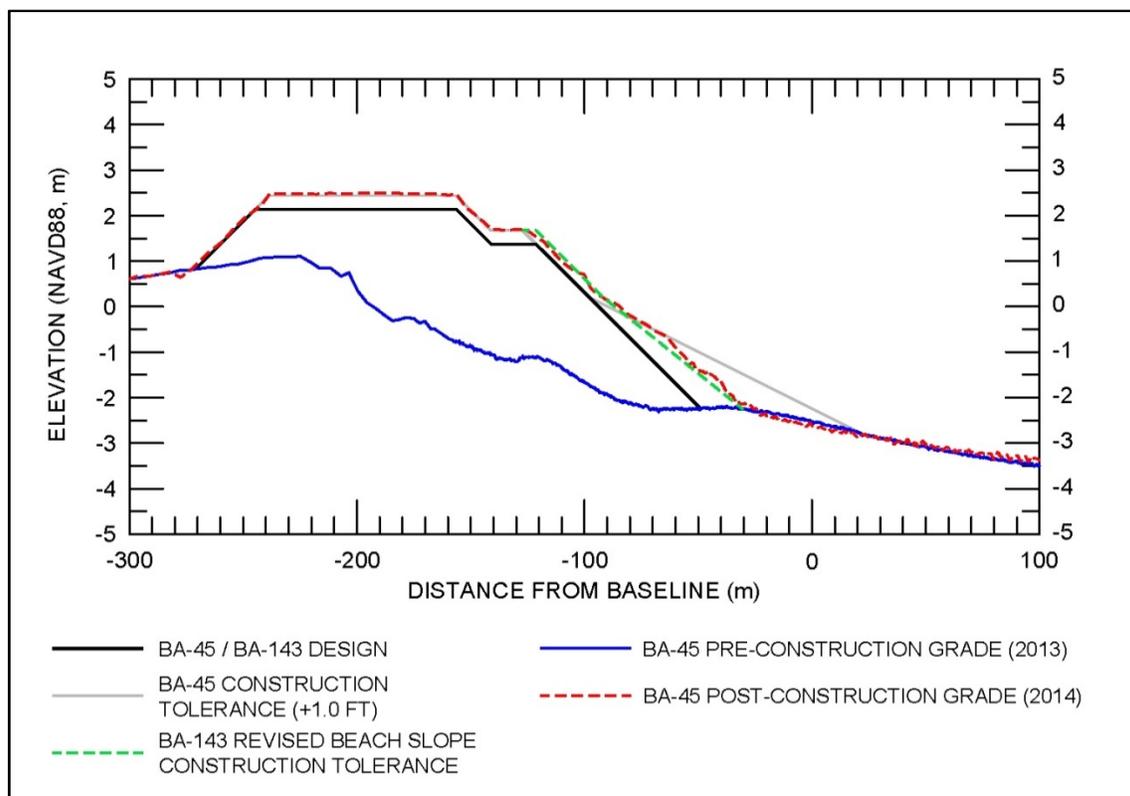


Figure 11: BA-45/143 Fill Template Typical Section



Figure 12: Completed BA-45 Beach and Dune (Looking from East End)



Figure 13: Completed BA-143 Beach and Dune (Looking from East End)

BA-45 Borrow Area

The BA-45 borrow area was a geometrical design and trapezoidal in form. Dimensions were approximately 928.1 m in length and ranged from 635.2 m to 1,371.6 m in width. The design dredge cut was -13.1 m NAVD88 with a 0.6 m allowable overdredge (-13.7 m NAVD88) and a 0.33 m allowable disturbance (-14.0 m NAVD88). The surface area was approximately 89.0 ha with a design volume estimated to be over 3.8 MCM. Vibracore samples from the borrow area collected for design had a composite sample mean grain size of 0.19 mm. Figure 14 presents the borrow area excavation alignment utilized for construction of the BA-45 project and colored contours of elevation changes between the pre- and post-construction surveys. The construction contractor excavated 2.8 MCM of sand from the borrow area during construction of the BA-45 project.

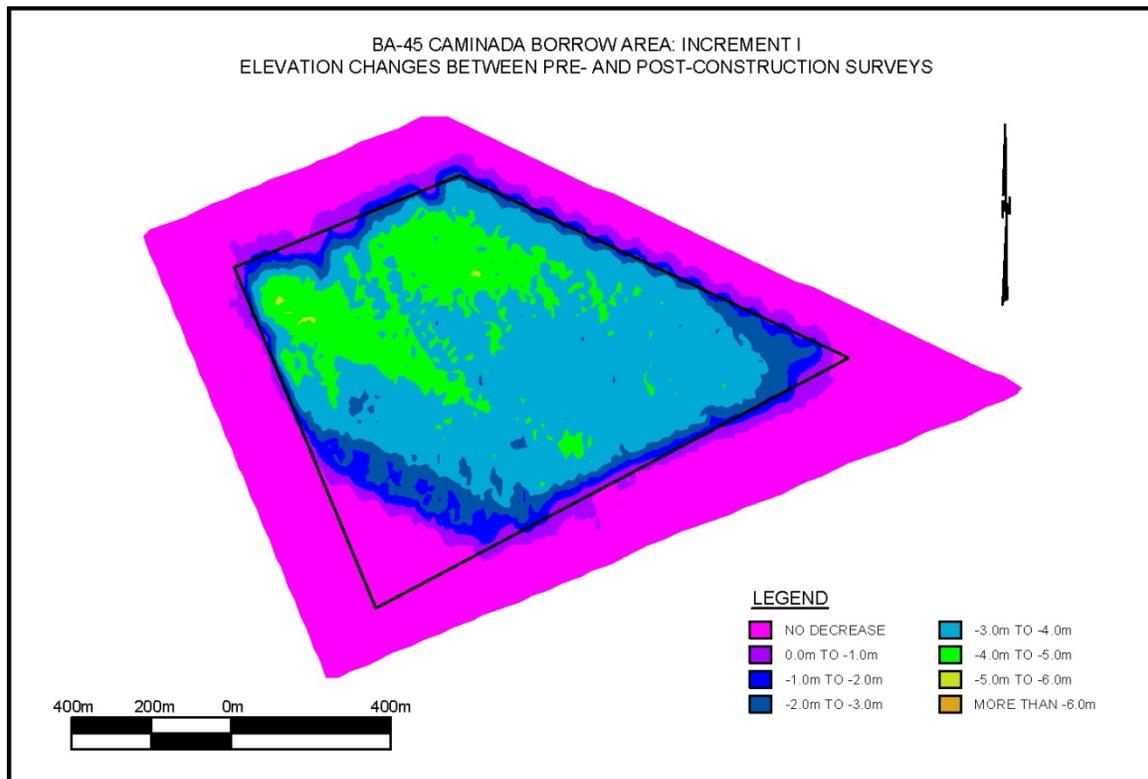


Figure 14: BA-45 Borrow Area Elevation Changes Between Pre- and Post-Construction Surveys

BA-143 Borrow Area

The BA-143 borrow area is an irregular polygon in form. It surrounds and includes the BA-45 borrow area in an attempt to utilize as much of the area covered by geophysical and archeological surveys as possible while maintaining the required buffers. The dimensions of the BA-143 borrow area vary significantly with an average length over 762.0 m and average width over 1,066.8 m. The surface area is approximately 111.3 ha exclusive of the BA-45 borrow area. The design dredge cut was -13.4 m NAVD88 with a 0.6 m allowable overdepth (-14.0 m NAVD88) and a 0.3 m allowable limit of disturbance (-14.3 m NAVD88). Subsequently, the limit of disturbance was expanded to 0.9 m (-14.9 m NAVD88) to more effectively and efficiently remove the sand resources within the permitted limits of excavation utilizing the construction contractor's plant and equipment. Figure 15 presents the BA-143 borrow area utilized for construction of the BA-143 project and colored contours of elevation changes between the pre- and post-construction surveys. The construction contractor excavated 4.2 MCM of sand from the borrow area during construction of the BA-143 project.

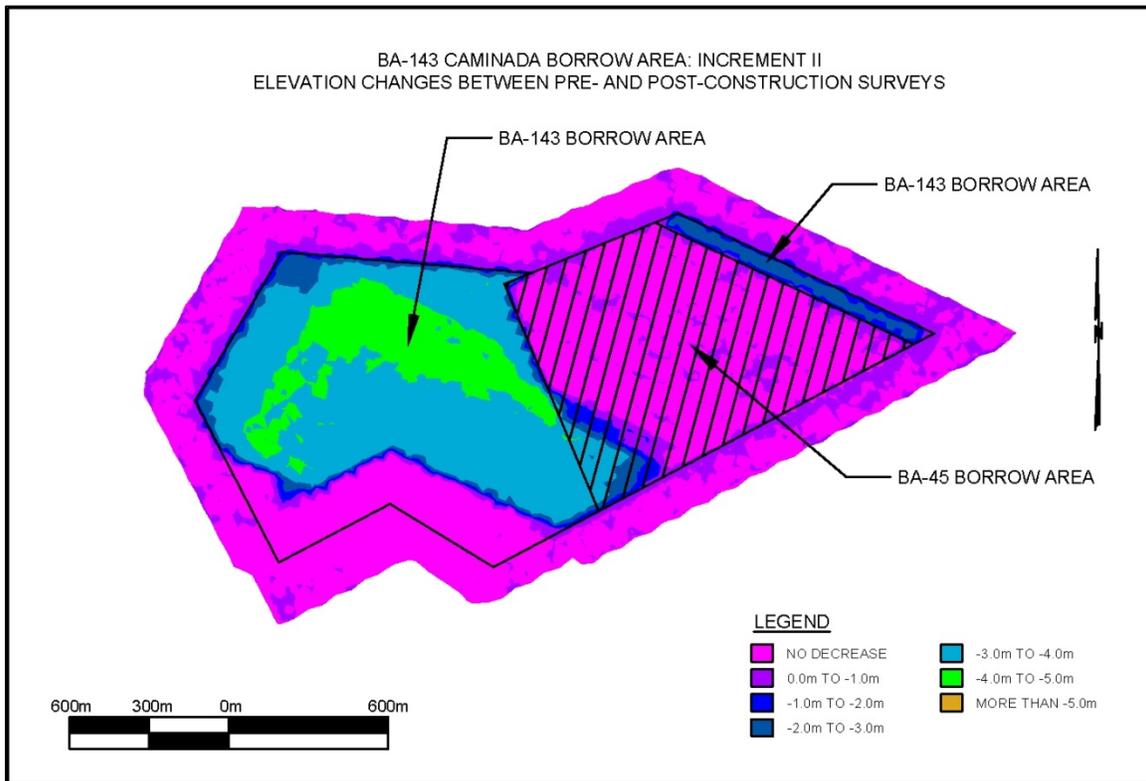


Figure 15. BA-143 Borrow Area Elevation Changes Between Pre- and Post-Construction Surveys

Title - Cajun Style

The Caminada Headland Beach and Dune Restoration Projects (BA-40 & BA-143) was given the distinction of “The Bestest” due to the first use of sand resources from the Ship Shoal area on the OCS for barrier island restoration, largest monetary investment in restoration, and the longest beach and dune restoration project in Louisiana to date.

SUMMARY

Barrier island restoration efforts began with the construction of the Trinity and East Islands in the late 1990’s. Since that time there have been 17 barrier island restoration projects constructed in coastal Louisiana. From the first restoration project until the Deepwater Horizon Oil Spill in 2010 the size of restoration efforts was constrained by available funding from programs operating at the time. After the oil spill the available funding increased dramatically with the establishment of the NRDA and NFWF programs and allowed the State of Louisiana to dedicate resources to the construction large scale barrier island restorations. Prior to 2010 the sediment volumes averaged approximately 2.5 MCM. From 2010 to present the volumes of sediment utilized for restoration average over 4.0 MCM with the largest approaching 8.0 MCM. Additional funding streams for restoration projects will come from the newly enacted RESTORE Act and the GOMESA programs.

With the construction of barrier island restoration projects in Louisiana since the early 1990’s, many of the nearshore sand sources have been exhausted and the availability of beach compatible sediment has become increasingly scarce. At present, Ship Shoal and the Mississippi River are the closest available significant and sustainable volumes of quality sediment for beach and dune restoration. All three of the projects described herein have or are currently utilizing these new sediment resources.

The Riverine Sand Mining / Scofield Island Restoration Project was the first barrier island restoration project to utilize the Mississippi River as a sediment source for beach and dune restoration and at the time the longest sediment pipeline from a borrow source to a restoration template. Since the Scofield conveyance corridor was established

there have been two additional barrier island restoration projects to utilize it. There have also been several interior marsh projects to utilize sediment from the Mississippi River with the borrow areas showing signs of infilling and thus allowing them to be utilized repeatedly. The Caminada Headland Beach and Dune Restoration – Increment I Project was the first to utilize the sand resources from Ship Shoal. Subsequently the Increment II phase for Caminada Headland and the Caillou Lake Headland Restoration (Whiskey Island) have ventured into the Outer Continental Shelf for sediment resources. All of these projects not only restored beach, dune, and marsh habitat on individual barrier island but, also added sediment to the barrier island littoral system.

REFERENCES

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CITATION

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