BARRIER ISLAND STATUS REPORT
Draft Fiscal Year 2017 Annual Plan

1.0 Introduction

The Coastal Protection and Restoration Authority (CPRA) provides this barrier island status report as part of the Annual Plan document to be submitted to each member of the Louisiana Legislature in compliance with Act 297 of the 2006 Regular Legislative Session. The Act requires that the report: 1) indicate the condition of all barrier islands; 2) provide the status of all barrier island stabilization and preservation projects under construction; and 3) outline future plans for restoration and maintenance of the barrier islands and coastal passes. Because the Annual Plan provides information about all coastal restoration projects in Louisiana (including location, status, features, acres benefited, cost, and funding source), it is appropriate to include a report on the status of the barrier islands.

2.0 Overview of Barrier Islands

The coastline of the modern Mississippi River delta plain is bordered by numerous barrier islands related to several historic major deltaic headlands. For the sake of convenience these islands and headlands can be organized into four distinct barrier systems, each tied to an abandoned Mississippi River delta complex: from west to east they are the Teche, Lafourche, Modern, and St. Bernard delta systems (Figure 1). The back-barrier bays and lagoons are connected to the Gulf of Mexico by numerous tidal inlets, which allow the exchange of diurnal

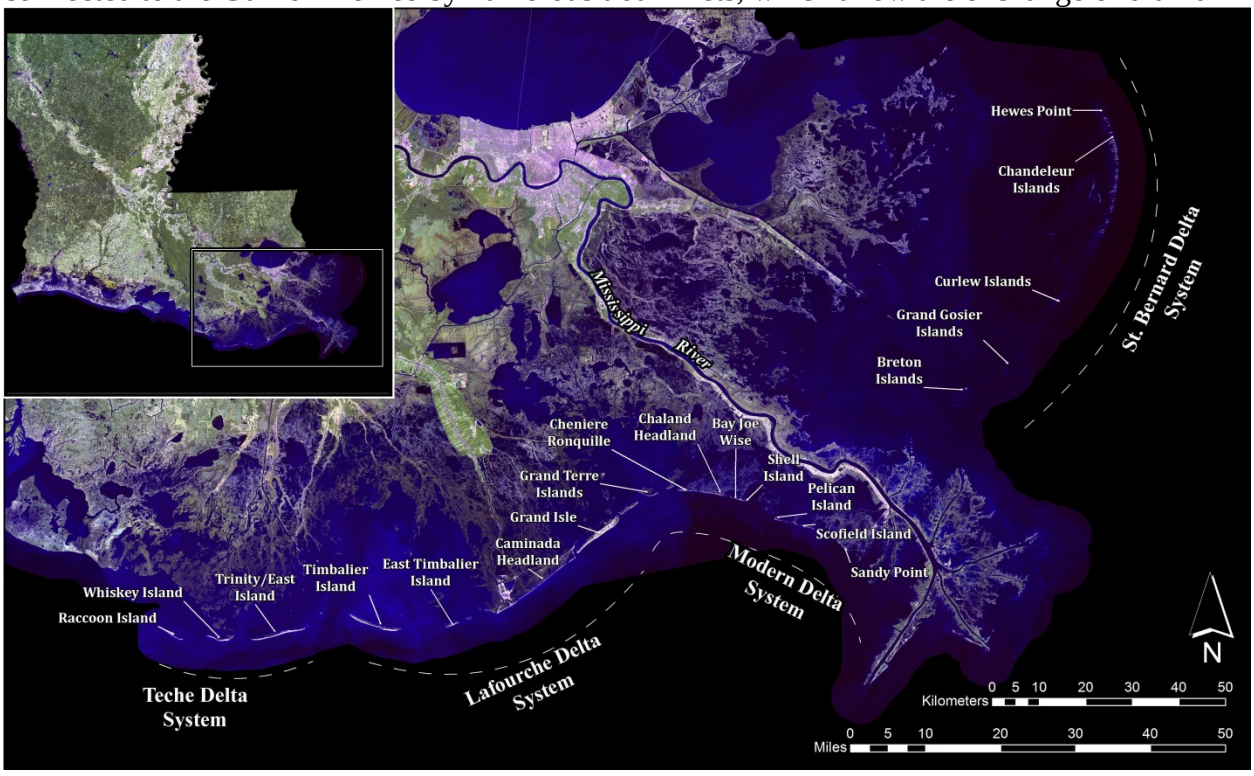

Figure 1: Location of Teche, Lafourche, Modern, and St. Bernard barrier island systems in Louisiana.

tides and separates these barrier islands from each other. The morphology of the barrier islands along the Louisiana coast is related to the sediment supply and physical processes acting in the region (Georgiou et al., 2005). Because barrier islands migrate and deteriorate over time (McBride and Byrnes, 1997), restoration of these habitats requires periodic replenishment of sediment/sand to compensate for the losses due to erosion and subsidence. Numerous hurricanes and the *Deepwater Horizon* oil spill have clearly demonstrated the advantage of robust barrier islands and a well-managed coastline in terms of shoreline resilience and hurricane damage reduction. These events have also highlighted the ecological concerns related to the massive loss of coastal wetland and barrier island systems (Ewing and Pope, 2006). Coastal landscapes created by these barriers can provide a significant and potentially sustainable buffer from wind and wave action as well as storm surges generated by tropical storms and hurricanes. In addition, barrier shorelines are unique habitats that represent the foundation for complex and productive coastal ecosystems.

The restoration of Louisiana's barrier islands has been a priority for a number of programs over the past several decades. In the 1990s, barrier island restoration was a priority for the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) program, which funded construction of a number of barrier island restoration projects. More recently, the CPRA has constructed or is planning to construct a large number of additional projects to restore barrier islands and headlands in coastal Louisiana. The constructed projects have been studied and their performance has been assessed to adaptively improve resilience and persistence of new projects. Khalil and Raynie (2015) suggest a system-wide approach for of restoring and maintaining individual barrier island. They further recommend that an integrated, system-wide approach acknowledges and embraces the interconnected nature of internal marshes, bays, tidal inlets/passes, and barrier islands as they all constitute one system.

More than 30 barrier island projects have been implemented in Louisiana over the past two and a half decades. These projects are described below geographically from west to east, and are grouped by barrier island system.

2.1 Teche Delta System (Raccoon Island to Wine Island)

2.1.1 Constructed Projects

1. Raccoon Island Repair and Restoration Project (TE-106; State; 1994) – The goal of this project was to close breaches formed by Hurricane Andrew and restore the sand beach also removed during the storm. The goal was accomplished through the closure of 5 breaches, restoration and elevation of the beach, and construction of back barrier nodes (small sand islands) to provide additional habitat. Construction placed 1.5 million cubic yards (MCY) of fine sand which was dredged from back barrier borrow sites. Vegetation was installed to hold sediments and create appropriate habitats.
2. Raccoon Island Breakwaters Demonstration (TE-29; CWPPRA; 1997) – The goal of this project was to reduce shoreline erosion and increase subaerial land area. Eight segmented breakwaters were constructed along the eastern end of the island to reduce the rate of shoreline retreat, promote sediment accretion along the beach, and protect seabird habitat. Project effectiveness was determined by monitoring changes in the shoreline, wave energy,

and elevations along the beach, and by topographic and bathymetric surveys of the Gulf between the shoreline and the breakwaters.

3. Raccoon Island Shoreline Protection/ Marsh Creation (TE-48; CWPPRA; 2007, 2013) – The goal of this project was to protect the Raccoon Island rookery and seabird colonies from an receding shoreline by reducing the rate of erosion along the western end of the island and creating more land along the northern shoreline. This goal was accomplished through the construction of eight additional breakwaters west of the existing (TE-29) breakwaters and a terminal groin at the eastern of the island (Phase A). In addition, mixed sediment from an offshore borrow area in federal waters was dredged to create 60 acres of back barrier marsh platform with an average elevation of 3.5 feet (Phase B). The shoreline protection (Phase A) component of this project was constructed in 2007; construction of the back barrier marsh platform component (Phase B) was completed in April 2013.
4. Whiskey Island Restoration (TE-27; CWPPRA; 1999) – The objective of this project was to create and restore beaches and back barrier marsh platform on Whiskey Island. About 4.6 miles of the Gulfside shoreline with beach/dune component of variable width (700-800 feet) was restored using about 2.9 MCY of sand. The dune height was 4 feet with crest width varying between 300-500 feet. The project created 523 acres of back barrier marsh platform and filled-in the breach at Coupe Nouvelle. The initial vegetation planting of smooth cordgrass (*Spartina alterniflora*) on the bayside shore was completed in July 1998 and additional vegetation seeding and planting was carried out in spring 2000.
5. Whiskey Island Back Barrier Marsh Creation (TE-50; CWPPRA; 2009) – The goal of the TE-50 project was to increase the longevity of the previously restored island by increasing the island's width which helped retain sand volume and elevation. Approximately 316 acres of back barrier intertidal marsh habitat, 5,800 linear feet of tidal creeks, three 1-acre tidal ponds and 13,000 linear feet of protective sand dune were created by semi-confined disposal and placement of dredged material. About 2.76 MCY of mixed sediment was dredged from an offshore borrow area in Gulf of Mexico near the island. After removal of the mixed sediment overburden, about 0.36 MCY of underlying sand was used to create the dune fronting the marsh platform. Native marsh vegetation was planted to colonize and protect the newly-placed marsh soil was undertaken.
6. Isles Dernieres Restoration Trinity Island (TE-24; CWPPRA; 1999) – The project objectives included the restoration of the dunes and back barrier marshes of Trinity Island. Approximately 4.85 MCY of sand/sediment were dredged from a borrow area in Lake Pelto to build approximately 4.3 miles of 8-feet high dune with crest width of about 300 feet along with an elevated marsh platform at the bay side of the island. A total of about 353 acres of supratidal and intratidal habitats were created. About 22,500 feet of sand fences were installed in various orientations along with vegetative planting to stabilize the sand and minimize wind-driven transport.
7. New Cut Dune and Marsh Restoration Project (TE-37; CWPPRA; 2007) – The purpose of this project was to close the breach between Trinity and East Islands through the creation of beach, dune, and marsh habitats in order to increase the structural integrity of eastern Isles Dernieres by restoring the sand transport within the littoral zone and adding sediment into the nearshore system. New Cut was closed through the construction of about 8,000 feet of dune platform (by placing approximately 0.85 MCY of sand dredged from an offshore borrow area) matching the dune elevations on the east and west, strengthening the connection

between East and Trinity Islands. Nine species of native barrier island vegetation were planted along with over 17,000 linear feet of sand fence.

8. Isles Dernieres Restoration East Island (TE-20; CWPPRA; 1999) – The project restored the coastal dunes and wetlands of the Eastern Isles Dernieres. Approximately 3.9 MCY of sand were dredged from Lake Pelto to build about 353 acres of beach and dune with target elevations of 2 feet and 8 feet, respectively. The dune crest width ranges from 300 to 500 feet. Sand fences were installed and vegetation planted to stabilize the sand and minimize aeolian transport.
9. Enhancement of Barrier Island Vegetation Demonstration (TE-53; CWPPRA; 2010) – The goal of this project was to test several methodologies or products to enhance the establishment and growth of key barrier island and salt marsh vegetation. The project focused specifically on enhancing the establishment and growth of transplants of both dune vegetation (*Panicum amarum* and *Uniola paniculata*) and marsh vegetation (*Spartina alterniflora* and *Avicennia germinans*). Planting took place on Whiskey Island and New Cut in 2010, and monitoring of vegetation treatments was completed in 2011.

2.1.2 Projects under Construction

1. NRDA Caillou Lake Headlands Restoration Project (TE-100; NRDA): This restoration includes the project area as envisaged by previous CWPPRA project entitled "Ship Shoal: Whiskey West Flank Restoration (TE-47)". The design template of this project is the same as that suggested under the Louisiana Coastal Area (LCA)- Terrebonne Basin Barrier Shoreline (TBBS) Restoration Project, which includes the entire island footprint. This project is expected to provide a barrier to reduce wave and tidal energy, thereby protecting the mainland shoreline from continued erosion. The objective of this project is to rebuild dunes and a marsh platform on the Whiskey Island through the emplacement of about 8.9 MCY of sand transported from Ship Shoal Block 88. About 4.26 miles of shoreline will be nourished with a 6.4 feet high and 100 feet wide dune crest and 4.2 feet high and 464 feet wide beach on Gulf side and 100 feet wide on Bay side, covering around 1,063 acres. About 0.82 MCY of sediment would be used to construct 178 acres of marsh platform. *Deepwater Horizon* NRDA Early Restoration funds will be used for construction of this project.

2.1.3 Future Projects

None.

2.2 Lafourche Delta System (Timbalier Island to East Grand Terre Island)

2.2.1 Constructed Projects

1. Timbalier Island Planting Demonstration (TE-18; CWPPRA; 1996) – For this project, sand fences were installed and vegetation suited to the salinity and habitat type of Timbalier Island was planted in several areas on the island to trap sand and buffer wind and wave energy.
2. Timbalier Island Dune and Marsh Creation (TE-40; CWPPRA; 2004) – Timbalier Island is migrating rapidly to the west/northwest; therefore, the western end of Timbalier Island is undergoing lateral migration by spit-building processes at the expense of erosion along the eastern end. The objective of this project was to restore the eastern end of Timbalier Island

by restoring beach, dunes, and marsh. An 8-foot high dune with average crest width of about 400 feet was built using about 4.6 MCY of sand/sediment dredged from offshore borrow area which created a total fill area of about 273 acres, including about 196 acres of marsh platform.

3. East Timbalier Island Sediment Restoration, Phase 1 (TE-25; CWPPRA; 2000) – This project strengthened and thus increase the longevity of East Timbalier Island. The project included the placement of dredged sediment in three embayments along the landward shoreline of East Timbalier Island, along with aerial seeding of the dune platform, installation of about 13,000 linear feet of sand fencing, and dune vegetation plantings. About 2.8 MCY of sediment was dredged from an offshore borrow area to create a total of about 217 acres of supratidal and intratidal habitats which included a 5-foot high dune with crest width of about 200 feet and a 2-foot high and 500-foot wide marsh platform. This project was funded over two funding cycles, PPL 3 and 4, from 1999 and 2000, respectively.
4. East Timbalier Island Sediment Restoration, Phase 2 (TE-30; CWPPRA; 2000) – The project goals and objectives were the same as that of Phase 1. While Phase 2 of the project along the western half of the island did not reconnect the western and eastern portions of the island, it did create 99% of the targeted acreage. It has helped to protect thousands of acres of existing fringing marsh to the north. Construction funds from this phase of the project were also used for 7,000 feet of rubble mound revetment created to protect the newly created habitats.
5. West Belle Pass Barrier Headland Restoration (TE-52; CWPPRA; 2012) – This project re-established the eroded West Belle Pass headland via dune and marsh creation and prevented increased erosion along the adjacent bay shoreline, protected the interior marshes and the Port Fourchon area. The project created a continuous headland approximately 10,660 feet in length, creating about 93 acres of dune habitat using nearly 1.74 MCY of dredged sand, and about 227 acres of marsh habitat using 3.05 MCY of dredged mixed sediment. Construction began in May 2011 and completed in 2012.
6. Caminada Headland Beach and Dune Restoration (BA-45; CIAP; Surplus) – Recently constructed Caminada Headland Beach and Dune Restoration project has restored and maintained the headland through the creation of dunes and beach habitat and will protect unique coastal habitats, re-established littoral sand transport to Grand Isle, and protect Port Fourchon and the only hurricane evacuation route available to the region. This reach of the Barataria shoreline also supports the only land-based access to the barrier shoreline in the Deltaic Plain. Construction of portions of the Caminada Headland component of the LCA-BBBS Restoration Project template began in early 2013 using CIAP 2007 and Surplus 2008 funds. Approximately 3.3 MCY of sand from South Pelto Blocks 12 and 13 borrow area (eastern portion of Ship Shoal Complex) were placed to restore approximately 6 miles of shoreline by constructing a 7-foot high and about 290-foot wide dune and a 4.5-foot high and 65-foot wide beach over a surface area of about 303 acres. This restoration project is unique in that it is the first time that sand from the Ship Shoal complex was dredged for coastal restoration purposes and was transported a distance of almost 22 miles. Also for the first time compactional subsidence could be quantified by measuring elevational changes in the various subsurface strata due to emplacement of sand during restoration by installing 10 monuments at three different stations. The details are mentioned later in this report under Caminada-Moreau Subsidence Study (CMSS) in Section 3 – Monitoring and Maintenance.
7. Bayside Segmented Breakwaters at Grand Isle (BA-50; CIAP; 2012) – The purpose of this project was to reduce erosion on the bay side of Grand Isle. Twenty-four 300 foot

breakwaters (approximately 1.5 miles) were constructed on the back-bay side of Grand Isle. This project was constructed with Jefferson Parish CIAP funds in September 2012.

8. Vegetative Plantings of a Dredged Material Disposal Site on Grand Terre Island (BA-28; CWPPRA; 2001) – The goal of this project was to stabilize dredged material sites on West Grand Terre Island. This was achieved through vegetation plantings and by purchasing grazing rights on the island for the 20-year life of the project.
9. East Grand Terre Island Restoration (BA-30; CIAP; 2010) –This project stabilized and benefitted 1,575 acres of barrier island habitat and extended the island's life by filling breaches and tidal inlets along the shoreline, by emplacement of sand. About 621 acres of land were created by restoring 2.8 miles of barrier shoreline through construction of a 6-foot high dune along with 165 acres of beach habitat and construction of about 456 acres of marsh platform using about 3 MCY of sand and 1.6 MCY of mixed sediment from two offshore borrow areas. Although the CPRA constructed this projects using CIAP 2007 funds, this project was engineered, designed, permitted, and received the necessary land rights for construction, through the CWPPRA program, in partnership with the NOAA Fisheries.

2.2.2 Projects under Construction

1. Caminada Headland Beach and Dune Restoration Increment II (BA-143, NFWF) – In order to achieve the goals of this project approximately 5.39 MCY of sand will be dredged from the South Pelto Block in Ship Shoal and a 7-foot high dune will be constructed with a 290 foot width along with a 4.5-foot high and 65-foot wide beach over a project length of 39,000 linear feet thereby restoring the headland on the similar design template as BA-45. Construction of this project started from the central portion of the headland, where the BA-45 project ended and will continue eastward to Caminada Pass. It is expected to create about 489 acres of land. Construction of the project initiated in mid-2015 and should be completed by the end of 2016. Between BA-45 and BA-143 projects more than 8.5 MCY of sand from Ship Shoal will be placed onto the headland to restore over 13 miles of beach and dune habitat.

2.2.3 Future Projects

1. East Timbalier Island Restoration Project (TE-118; NFWF) – East Timbalier Island is part of a barrier island chain that separates Terrebonne and Timbalier Bays from the Gulf of Mexico. The island is currently comprised of two severely degraded segments. This project is under engineering and design phase and is developing a final design package consisting of permitting, WVA assessment, and construction plans and specifications – with probable construction cost and schedule, all sufficient to re-establish the historic island footprint, reconnecting the two segments, with restoration of dune, supratidal, and intertidal habitat. Estimated Benefits (East Timbalier Plan B) include about 241 acres of beach/dune habitat and 279 acres of intertidal marsh in Target Year 1 (TY1).
2. Caminada Headlands Back Barrier Marsh Creation Project (BA-171; CWPPRA) – This project will create 300 acres of back barrier intertidal marsh and nourish 130 acres of emergent marsh behind 3.5 miles of Caminada Beach using 2.7 MCY of mixed sediment dredged/ pumped from delineated borrow area in the Gulf of Mexico. The marsh creation and nourishment cells are designed to minimize impacts on existing marsh and mangroves.

Assuming some natural vegetative recruitment, vegetative plantings are planned at a 50% density, with half planned at TY1 and half planned at TY3. This project (BA-171) will be designed to create and nourish marsh habitat behind BA-45 to further reduced the likelihood of breaches and improve the longevity of the shoreline. BA-171 is a CWPPRA project which is funded for E&D (Phase 1).

3. Barataria Basin Barrier Shoreline (BBBS) Restoration (LA-10; LCA) – Initially this project included the Caminada Headland Beach and Dune Restoration and Shell Island Restoration Projects. Portions of Caminada Headland were constructed with CIAP and Surplus funds. The eastern beach/dune portion will be constructed with NFWF funds, and a portion of the back barrier marsh platform is being designed through CWPPRA. Shell Island East was constructed with Berm to Barrier Funds, and Shell Island West will be constructed with NRDA funding. Construction of the remainder of the BBBS template features will be decided at a later date.
4. West Grand Terre Beach Nourishment and Stabilization Project (Project ID TBD: RESTORE) – Funding for E&D efforts have been approved by the RESTORE Council and should commence within fiscal year 2016.

2.3 Modern Delta System (Chenier Ronquille to Scofield Island)

2.3.1 Constructed Projects

1. Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration (BA-38; CWPPRA; 2007, 2012) –This project restored barrier island habitat, enhanced storm-related surge and wave protection, prevented overtopping during storms, and increased the volume of sand within the active barrier system. This project includes restoration of two barrier islands viz. the Chaland Headland portion of this project, which was constructed in 2007, and the Pelican Island segment, which began construction in May 2011 and was completed in 2012. Additionally in June 2010, the state began construction of a barrier berm in response to the *Deepwater Horizon* oil spill from Shell Island to Scofield Island west of the river to safeguard its coast from the effects of the oil. The construction of the berm introduced a significant amount of sand into the barrier island system.
    a. Pass La Mer to Chaland Pass Restoration (BA-38-1; CWPPRA; 2007) – A total fill area of 484 acres was created which included about 254 acres of back barrier marsh platform with an average elevation of 2.5 feet. Back barrier marsh platform was constructed using about 1.0 MCY of overburden mixed sediment from an offshore borrow area. About 2.4 MCY of sand were placed to build about 230 acres of beach-dune habitat with a dune height of 6 feet and crest width of 400 feet over a project length of 2.7 miles.
    b. Pelican Island Restoration Project (BA-38-2; CWPPRA; 2012) – Pelican Island was restored using about 6.4 MCY of mixed sediment and sand from 4 different borrow areas in state and federal waters ranging in distance from 2 to 12 miles. About 2.1 MCY (in-place volume) of sand were utilized to create 192 acres of beach-dune habitats. About 398 acres of marsh platform, with an average elevation of about 2.6 feet, were constructed using 1.6 MCY of sediment. Average dune elevation was about 7.5 feet extending to a length of 2.5 miles. It may be noted that Emergency Berm W9 was built in front of this island using about 1.24 MCY of sand.
2. BIMP 2009 Sand Fencing (LA-0246; State, FEMA; 2009) - For this project, sand fences were installed on several previous project sites to trap sand and buffer wind and wave energy

after overwash damages from Hurricanes Gustave and Ike impacted the Gulf of Mexico shoreline. A total of 37,200 linear ft of sand fencing were placed on Pass La Mer to Chaland Pass Restoration (BA-38-1), Timbalier Island Dune and Marsh Creation (TE-40), Isles Dernieres Restoration East Island (TE-20), New Cut Dune and Marsh Restoration Project (TE-37), and Isles Dernieres Restoration Trinity Island (TE-24).

3. Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration (BA-35; CWPPRA; 2009) – Also known as Bay Joe Wise, this project includes the emplacement of mixed sediment to create marsh along with tidal creeks and ponds, followed by vegetation plantings. The project's objectives were to: 1) prevent the breaching of the Bay Joe Wise shoreline by increasing barrier shoreline width; 2) increase back-barrier, emergent marsh area by approximately 220 acres to maintain the barrier shoreline; and 3) create emergent marsh suitable for tidal aquatic habitats. These features act as a buffer against wave and tidal energy, thereby protecting the mainland shoreline from breaching and continued erosion. About 350 acres of total fill area was created which included a marsh platform approximately 1,000 feet wide contiguous with the northern side of the gulf shoreline of Bay Joe Wise. The dune was built to an elevation of 6 feet with a dune crest width of about 110 feet. Approximately 3 MCY of sediment were dredged from the Pas la Mer Ebb-Tide Delta, Pass Chaland Ebb-Tide Delta, and Grand Pass Ebb-Tide Delta. The project also included the construction of approximately 10,000 feet of 4-foot wide, 2-foot deep tidal creeks or water exchange channels. In addition, immediate post-construction aerial seeding was conducted with Japanese millet (*Echinochloa frumentacea*) or brown top millet (*Panicum ramosum*) followed by smooth cordgrass (*Spartina alterniflora*) and black mangrove (*Avicennia germinans*) plantings.
4. Riverine Sand Mining/Scofield Island Restoration (BA-40; Berm Funds; 2013) – The goals of this project were to mitigate breaches and tidal inlets in the shoreline, reinforce the existing shoreline with sand, increase the width of the island with back barrier marsh to increase island longevity, and to re-establish a sandy dune along the length of the shoreline to protect the back barrier marsh platform from sea level rise and storm damage. The beach-dune habitats were constructed by the sand dredged from a borrow area in the Lower Mississippi River via a 22-mile long pipeline and the marsh platform was constructed from an offshore borrow source of mixed sediment. Although this project was designed under CWPPRA, construction began in December 2012 using Berm Funds. This created approximately 2.16 miles of beach and dune fill to close the breach areas and restore/protect the eroding beach. The dune component included a 50-foot wide crest width at +6 feet NAVD88. The beach fill template included a 100-foot wide construction berm at +4 feet NAVD88. The surface area of the beach platform was approximately 223 acres measured at +4 feet NAVD88. The required fill volume was approximately 2.03 MCY (required excavation (cut) volume was approximately 2.64 MCY). An approximately 2.23-mile long back barrier marsh platform on the bay side of Scofield Island was constructed. The surface area of the proposed marsh platform is approximately 375 acres with target marsh platform elevation of +3.0 feet NAVD88. The required fill volume was approximately 1.74 MCY (the required excavation (cut) volume is approximately 2.79 MCY). It may be noted that Emergency Berm W-10 was built in front of this island using about 0.964 MCY of sand.
5. Western Berm Reaches (West of Mississippi River along Shell, Pelican and Scofield Islands) In response to the *Deepwater Horizon* oil spill which began on April 20, 2010, the State of Louisiana constructed approximately 16 miles of sand berms along several sections of the

state's barrier islands both east and west of the Mississippi River. The objective of these projects was to provide a barrier to oil and minimize the potential impact of the oil spill to thousands of acres of fragile barrier islands and wetlands ecosystem in coastal Louisiana.

a. Berm Reach W8 (Shell Island): The initial template of berm reach W8 was located within the footprint of the Shell Island restoration project which was proposed under the Barataria Basin Barrier Shoreline LCA project. However, pre-construction surveys indicated that the island had receded, so the profile was shifted approximately 750 feet north. The construction template for the W8 berm reach was identical to the templates used on the other berm reaches: a 20-foot crest width, +5 feet, NAVD 88 crest elevation, 1V:25H side slopes above -2.0 feet, NAVD88 and 1V:50H below -2.0 feet, NAVD 88. Construction of approximately 9,000 linear feet of berm on Shell Island started on October 9, 2010 and was completed by November 23, 2010. Approximately 777,000 cubic yards of sand was placed along the island.
b. Berm Reach W9 (Pelican Island): Construction of berm reach W9 along Pelican Island started on July 18, 2010 and was completed by October 2, 2010. Sand was placed within the construction template, which was identical to the template used for the other berm reaches. The template was superimposed on the existing island and within the footprint of the proposed CWPPRA Pelican Island Restoration Project (BA-38-1). A total length of 12,700 feet of berm was constructed and approximately 1,294,000 cubic yards of sand was emplaced within the berm along Pelican Island.
c. Berm Reach W10 (Scofield Island): Construction of berm reach W10 on Scofield Island started on September 13, 2010. Approximately 935,000 cubic yards of sand was placed between September 13 and November 23, 2010 for constructing approximately 14,755 feet of berm. The construction template for berm reach W10 was identical to the other berm reaches. The berm was constructed within the footprint of the proposed CWPPRA Scofield Island Restoration Project (BA-40).

6. Shell Island Restoration – Shell Island is a critical component of the Barataria shoreline which has been breached into two islands – east and west. Restoration of these two islands was initially included in the LCA-BBBS Project. The Shell Island Restoration project would restore this barrier island through the creation of dune and marsh habitat. The overall goals of this project are to prevent intrusion of the Gulf of Mexico into interior bays and marshes, restore natural sand transport along this reach of the coast, and protect oil and gas facilities. This segment of the shoreline has been nearly lost. It may be noted that Emergency Berm Reach W8 was built using about 0.777 MCY of sand on the eastern portion of the Shell East island. This project has been split into two projects: Shell Island East-Berm (BA-110) and Shell Island West NRDA (BA-111). Shell Island East (Berm) has been constructed, whereas Shell Island West NRDA is funded through the Louisiana Outer Coast Restoration project using NRDA Early Restoration Funds.
   a. Shell Island East Berm (BA-110) was constructed between April 2013 and August 2013. About 2.29 MCY of sand from a Lower Mississippi River Borrow Area (the same borrow area used for the Scofield Restoration Project [BA-40]) were utilized to construct an 8-foot NAVD 88 dune with a crest width of 340 feet between station 76+79 and station 144+00 creating a dune area of about 87 acres as well as a beach area of approximately 54 acres. About 136 acres of marsh platform were constructed using about 0.286 MCY from the same borrow area as the dune sediment.

2.3.2 Projects under Construction

1. Cheniere Ronquille Barrier Island Restoration (BA-76; NRDA) – This objective of this project is to expand the Cheniere Ronquille's gulf shoreline structural integrity by tying into two recently constructed projects to the east and address one of the remaining reaches of the Barataria/ Plaquemines shoreline. The design includes fill for a beach and dune plus 20 years of advanced maintenance fill, as well as fill for marsh creation/nourishment. Approximately 127 acres of beach/dune fill will be constructed and approximately 259 acres of back barrier marsh platform will be constructed using the sand/sediment from the borrow areas identified for earlier projects. Once restored, this island will provide critical habitat, and help reconnect the barrier island chain that provides defense to inland communities. Dune plantings will be conducted by seeding and installing approved nursery stock. About half of the marsh platform will be planted with cordgrass and portions of the dune, swale, and marsh will be planted with appropriate woody species. This project will be built by the National Marine Fisheries Services and is funded through the Louisiana Outer Coast Restoration project using NRDA Early Restoration Funds.
2. Shell Island West (BA-111: NRDA): The template of this project includes 16,100 feet of shoreline with an 8-foot high and 340-foot wide dune on the western portion of the east island, and a 380-foot wide dune on the western island, creating an area of about 231 acres with 4.8 MCY of sand. The project involves the construction of approximately 285 acres of barrier marsh platform with about 1.1 MCY of mixed sediment from an offshore borrow area. This project is funded through the Louisiana Outer Coast Restoration project using NRDA Early Restoration Funds.

2.3.3 Future Projects

None

2.4 St. Bernard Delta System

2.4.1 Constructed Projects

1. Chandeleur Islands Marsh Restoration (PO-27; CWPPRA; 2001) – This project was intended to accelerate the recovery period of barrier island areas overwashed by Hurricane Georges in 1998 through vegetation plantings. The overwash areas, which encompass 364 acres, are located at 22 sites along the Chandeleur Sound side of the island chain and were planted with smooth cordgrass (*Spartina alterniflora*).
2. Eastern Berm Reach E4 (East of Mississippi River along Chandeleur Islands): In response to the *Deepwater Horizon* oil spill which began on April 20, 2010, the State of Louisiana constructed approximately 16 miles of sand berms along several sections of the state's barrier islands both east and west of the Mississippi River. The objective of this project was to provide a barrier to oil and minimize the potential impact of the oil spill to thousands of acres of fragile barrier islands and wetlands in coastal Louisiana. A total of 47,000 feet (8.9 miles) of berm were constructed along the Chandeleur Islands by about 5.85 MCY of sand dredged from Hewes Point in the north.

2.4.2 Projects under Construction

None.

2.4.3 Future Projects

1. Louisiana Outer Coast Restoration Project: North Breton Island (NRDA) – Funded as an Early NRDA Restoration Project, the Louisiana Outer Coast Restoration project comprises four island segments including Breton Island. The goals of this project are to restore beach, dune, and back-barrier marsh habitats, as well as habitat for brown pelicans, terns, skimmers, and gulls to help compensate the public for spill-related injuries and losses to these resources. The restoration involves emplacement of compatible sediments to restore beach, dune, and back-barrier marshes; installation of sand fencing to trap and retain windblown sediments and foster dune development; and revegetation of appropriate native species in dune and back-barrier marsh habitat.

3.0 Monitoring and Maintenance

Louisiana's barrier islands are part of a complex system controlled by many overlapping and interrelated processes. The four primary barrier island systems have been monitored and evaluated by recent efforts, such as the Barrier Island Comprehensive Monitoring (BICM) program (Section 3.1) and the monitoring of the Emergency Berms (Section 3.2). In addition to this monitoring, a very specific monitoring (with regional ramifications) for quantification of compactional subsidence caused by the emplacement of sand during restoration was undertaken under Caminada-Moreau Subsidence Study (CMSS; Section 3.3). Besides monitoring, the Barrier Island Maintenance Program (BIMP; Section 3.4) provides a framework for prioritizing planning, design, and construction of barrier island maintenance projects when needs are identified. These programs have provided information to the CPRA regarding the current condition and stability of Louisiana's barrier islands. To reduce the acceleration of island disintegration that commonly occurs after islands breach, a barrier island Breach Management Program is currently being developed to address both breach prevention and response to breaches when they occur (Section 3.5). This program will drastically improve the state's ability to repair storm-induced damages and extend the project-life and integrity of Louisiana's barrier shorelines. Finally, to ensure optimum, efficient and effective use of limited sediment resources within the borrow areas, a Borrow Area Monitoring and Maintenance (BAMM) project was undertaken to understand the evolution of the borrow pits (inland, riverine, and offshore) over time, especially the infilling characteristics (rate and types of sediment) and gradient of the pit-slopes (Section 3.6). BAMM is an integral component of Louisiana Sediment Management Plan (LASMP) which embraces a regional sediment management strategy upon which restoration projects are planned within a regional purview as opposed to merely a project-specific approach.

3.1 Barrier Island Comprehensive Monitoring (BICM) program

As detailed in earlier status reports (CPRA, 2016) BICM was developed and implemented to establish baseline conditions for the state's barrier shoreline after hurricanes Katrina and Rita, as

well as to refine the methods and products for use in programs such as LCA, CWPPRA, CIAP, and BIMP.

The advantage of BICM over CWPPRA project-specific monitoring alone, is the ability to provide integrated long-term data on all of Louisiana's barrier shorelines, instead of only those areas with constructed projects. As a result, a greater amount of long-term data are now available to evaluate constructed projects, facilitate planning and design of future barrier island projects, assist operations and maintenance activities, and determine storm impacts. Because data were collected for the entire barrier island system concurrently, BICM datasets are more consistent and regionally encompassing than previous barrier island data collection efforts.

BICM datasets collected include 1) post-storm damage assessment photography and videography, 2) shoreline position, 3) land/water analysis, 4) topography, 5) bathymetry, 6) habitat composition, and 7) surficial sediment characteristics. Additionally, these datasets have been compared to historic datasets (where available) that have been standardized, thereby providing digital datasets to user groups for their use in multiple restoration efforts. Data collection for all seven BICM components initiated in 2005 was completed in 2008. Final datasets and reports are currently available through the CPRA web site. A final report entitled "Louisiana Barrier Island Comprehensive Monitoring (BICM) Program Summary Report: Data and Analyses 2006 through 2010: U.S. Geological Survey Open-File Report 2013–1083" was published as a USGS open file and can be accessed online via the CPRA website or at http://pubs.usgs.gov/of/2013/1083/ (Kindinger et al., 2013).

Currently, the next BICM data collection cycle (2015-2019) has been initiated with the revisions and development of shoreline position data and the addition of shorelines for the 1950s, 2008, and 2012. These data will be available in early 2016 and provide updated shoreline erosion data, including added time periods, to better evaluate changes in shoreline position, particularly in regards to various restoration efforts since 2006. BICM is currently (2015) collecting bathymetry and sediment data in the Teche, Lafourche, Modern Deltas, and Chandeleurs, and will then initiate data collection efforts in 2016 in the Chenier Plain, with data synthesis and delivery by 2019. Habitat mapping on the basis of the 2015 coast-wide color infrared photography will commence in 2016.

Data collection activities for the other BICM datasets are being planned with USGS and other contractors to reoccupy the original BICM data locations for comparisons, as well as provide some added coverage areas based on stakeholder needs (Eastern Chenier Plain). Efforts are continuing to contract USGS for topographic LiDAR surveys. Additionally, LiDAR was flown by USGS for the Teche and Lafourche Deltaic Regions in early 2008 and plans are underway to bring these data into the BICM program for use. LiDAR data were acquired from the Caminada Headland to Sandy Point in March, 2013 as part of a lower Barataria basin LiDAR update through a partnership with USGS and the processed data were delivered from USGS in early 2015. The Teche Delta region was surveyed in early 2015. LiDAR efforts for the Chenier Plain are being developed for data collection in early 2017 to complete the BICM area coverage. Currently, additional historic datasets are being considered for those areas not already covered under the initial BICM effort, and coverages will be updated as funding allows.

Additional data collections such as subsidence, overwash incidents, annual shoreline survey profiles, and vegetation sampling are being developed and budgeted based on user input and needs identified for the 2017 Master Plan update, as well as storm damage assessments and other programs (Figure 2).

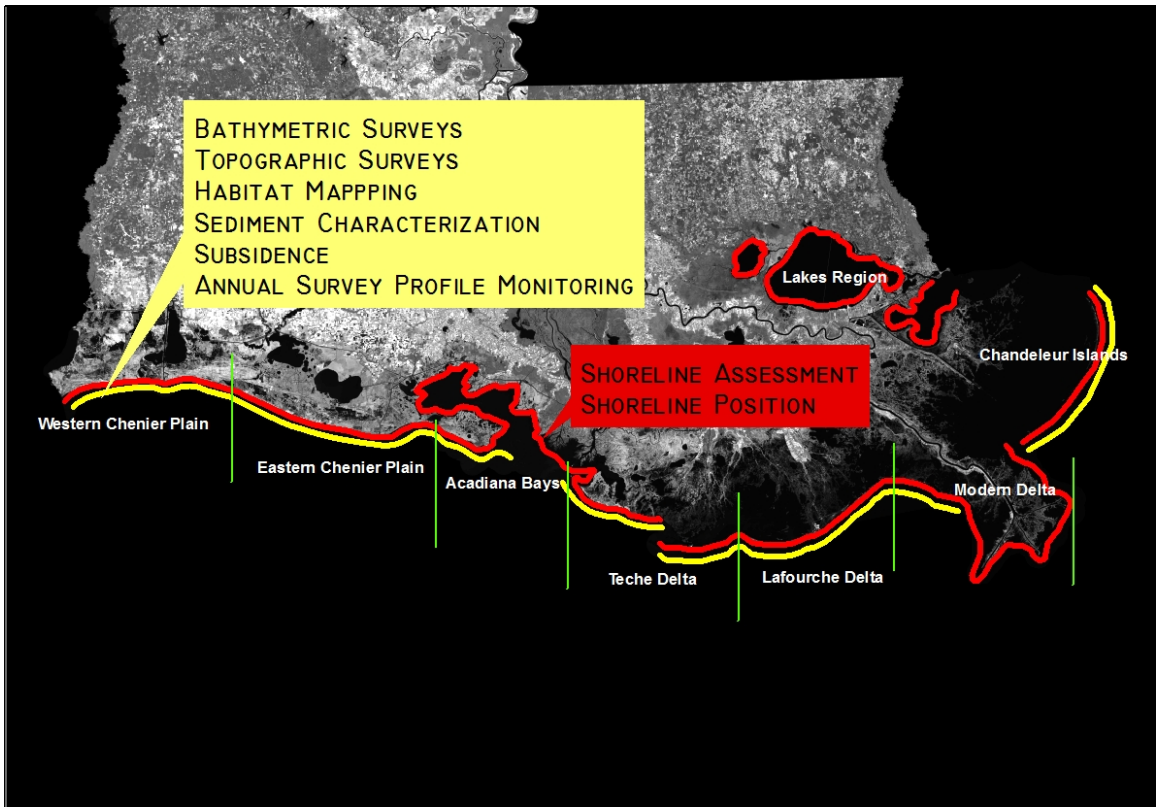

Figure 2: Proposed BICM data collection 2015 through 2019.

3.2 Monitoring of the Emergency Berms

In response to the *Deepwater Horizon* oil spill which began on April 20, 2010, the State of Louisiana constructed approximately 16 miles of sand berms along several sections of the State's barrier islands both east and west of the Mississippi River. The objective was to provide a barrier to oil and minimize the potential impact of the oil spill to thousands of acres of fragile barrier islands and wetlands ecosystem in coastal Louisiana. It should be noted and appreciated that these berms are man-made features, were constructed for a specific purpose, and are different geomorphologically than native barrier islands. However, significant insights into coastal processes which affect barrier islands were gained by monitoring their changes over time. Details of these monitoring could be found in the following reports submitted to CPRA.

(1) Chandeleur Island Emergency Berm: 360-Day Monitoring Report
(2) Pelican Island Emergency Berm: 360-Day Monitoring Report
(3) Scofield Island Emergency Berm: 360-Day Monitoring Report
(4) Shell Island Emergency Berm: 360-Day Monitoring Report

Further the monitoring of the Emergency Berms has also been summarized in previous status reports (CPRA, 2016). BICM data collection initiated during the summer of 2015 may provide

an opportunity to continue to evaluate the fate of sediment additions and the sediment pathways caused by the sand berms to the barrier shoreline in future reports.

3.3 The Caminada – Moreau Subsidence Study (CMSS)

Marsh and barrier island restoration rely on placement of large quantities of sediment on existing substrate that are often compressible. At the same time, the emplaced sediment also compacts over a period of time. Engineering design of restoration projects requires knowledge of background subsidence rates, the relationship between surface loading and subsurface compaction, and settlement of the fill after placement. The Caminada – Moreau Subsidence Study (CMSS) was conceptualized, planned, developed and undertaken to evaluate the existing geological profile of deltaic deposits at foreshore, dune, and backshore locations along the Caminada Moreau, evaluate subsidence in these areas, and monitor subsidence before (for baseline measurement) and after loading sediment for the restoration of Caminada Headland. This attempt to quantify compactional subsidence is a first-of-its-kind study as no direct measurement of subsidence and its partitioning has been previously attempted (Byrnes et al., 2015). Several challenges arose during the study, requiring changes to the scope and approach.

This study was funded by CIAP and formed a part of the Performance Evaluation and Science Monitoring Project. The study was conducted under three sequential major phases (Phase 1, 2, and 3) which included the evaluation of the existing geological profile, an evaluation of subsidence, and the installation of 10 subsurface monuments at three different stations. Anchors were placed at various depths in three locations along the Caminada headland to monitor variability in compactional subsidence associated with loading from the fill, including settlement plates. In addition, a primary benchmark was established outside the influence of the fill to record background subsidence for this region. These monuments are being monitored via 10 different surveys spread over next two years during Phase 4 to document subsidence trends throughout the period. High-accuracy leveling surveys were conducted for each anchor location relative to the control benchmark to an accuracy of ±0.03 feet. Preliminary results for the first 14 months of surveys document subsidence at all depths in the sediment column for sites where fill placement is complete. Although the first anchor below the surface recorded the greatest amount of subsidence (0.25 to 0.3 feet at about 20 feet deep), anchors at 60 to 80 feet deep recorded 0.09 feet of compactional subsidence as well (Byrnes et al., 2015). This quantity of settlement at depth is more than expected, and requires further evaluation of deeper sediment layers to identify the depth at which compactional subsidence due to loading from beach restoration is within measurement uncertainty. Background subsidence calculations from control benchmark measurements indicate a subsidence rate of about 0.03 ft/yr (9.2 mm/yr), very consistent with National Geodetic Survey relative sea level rise measurements at Grand Isle of 9.1 mm/yr (Byrnes et al., 2015) . The final survey is scheduled to be completed by early 2016 and the final deliverables are expected to be submitted by mid-2016. Further the final data in the spreadsheets will be invaluable for calibrating/validating compaction-subsidence model developed by Dr. Julie Rosati (Rosati, 2009) for use with future beach restoration projects along the barrier island shorelines of south Louisiana.

A copy of the report entitled “Caminada-Moreau Subsidence Study (Phases 1-3)” can be found in the CPRA Document Database at the following link:

http://sonris-www.dnr.state.la.us/dnrservices/redirectUrl.jsp?dID=4715311

3.4 Barrier Island Maintenance Program (BIMP)

Several legislative programs have been established on both the state and federal levels that call for the implementation of a program to stabilize and preserve Louisiana's barrier islands and shorelines. House Bill No. 429, Act No. 407, authored by Representative Gordon Dove during the 2004 Regular Session, outlined the process by which the CPRA would annually develop a list of priority projects to be submitted to the House and Senate Committees on Natural Resources. These projects would be funded by the Barrier Island Stabilization and Preservation Fund, which was established by House Bill No. 1034, Act No. 786 of the 2004 Session to provide appropriations, donations, grants and other monies for the program. The legislation requires this fund to be used exclusively by the CPRA to support the Barrier Island Stabilization and Preservation Program, with all interest earnings and unencumbered monies remaining in the fund at the end of the fiscal year.

In accordance with this legislation, and with the understanding that maintenance is an integral part of stabilization, preservation, and restoration of any barrier island or shoreline, BIMP was conceptualized by the CPRA. BIMP potentially provides the framework for categorizing, prioritizing, selecting, and funding state barrier island maintenance projects, while coordinating with CWPPRA and other existing restoration mechanisms.

3.4.1 Rationale

Continued development of a BIMP program is necessary to quickly coordinate and fund the maintenance of previously constructed barrier shoreline restoration projects in Louisiana. This program can act as a comprehensive management approach to prioritizing rehabilitation efforts in coordination with other restoration initiatives (e.g., CWPPRA, LCA).

During the past decade, numerous barrier islands and headlands in Louisiana have been or are currently being restored by the state and its federal partners through CWPPRA and other sources. CWPPRA projects have a design life of 20 years; however, scheduled maintenance of these projects has not been incorporated into their funding or design. Design of these projects relies heavily on numerical models for predicting their longevity and ultimate success. Inherent in these models are certain assumptions and the realization that there are significant uncertainties about the physical processes that affect the stability of these land masses. If the project is impacted by more events than assumed in the model, the condition of the barrier island or headland deteriorates considerably, thereby reducing the life of the project. The project then requires maintenance to sustain the predicted design template. Maintenance costs can increase exponentially when not performed in a timely manner. Therefore, BIMP is a tool that can be used to formulate a much needed component of maintenance planning for existing projects without maintenance funds. This strategy will address the need for timely and cost-effective maintenance of barrier shoreline projects to ensure their long-term success and through continued integration with efforts such as development of operational sediment budgets, regional sediment management, and breach management, and Structured Decision Models, CPRA can

formulate a comprehensive approach to prioritization and implementation of Master Plan barrier island restoration and maintenance.

3.4.2 Program Area

BIMP encompasses all barrier islands, headlands, and sandy shorelines, restored or otherwise (Figure 3). Based on the geographic and geologic setting, the domain of the BIMP program includes the eight coastal segments identified below (Campbell et al., 2005).

1. Chandeleur Islands – Northern Chandeleur Islands (Freemason Islands, North Islands, and New Harbor Islands) and Southern Chandeleur Islands (Breton Island, Grand Gosier Island, and Curlew Islands).
2. Plaquemines – Sandy Point, Pelican Island, Shell Island, Chaland Headland (Pass La Mer area), Cheniere Ronquille, and East and West Grand Terre Islands.
3. Lafourche – Grand Isle and Caminada- Moreau Headland.
4. Timbalier Islands – Timbalier and East Timbalier Islands.
5. Isle Dernieres – Raccoon, Whiskey, Trinity, East, and Wine Islands.
6. Freshwater Bayou to Point Au Fer – Point Au Fer, Marsh Island, and Chenier au Tigre.
7. Eastern Chenier Plain – Freshwater Bayou to Calcasieu Pass.
8. Western Chenier Plain – Calcasieu Pass to Sabine Pass.

Grouping these apparently disparate and disjointed units of barrier islands, headlands, and sandy shorelines into coastal segments will facilitate the development of a regional long-term strategy for shoreline maintenance, including project prioritization and development. It should be noted that any alteration to an area within a segment will affect the remainder of the segment due to coastal processes and morphodynamics, and consequently, the sediment budget.

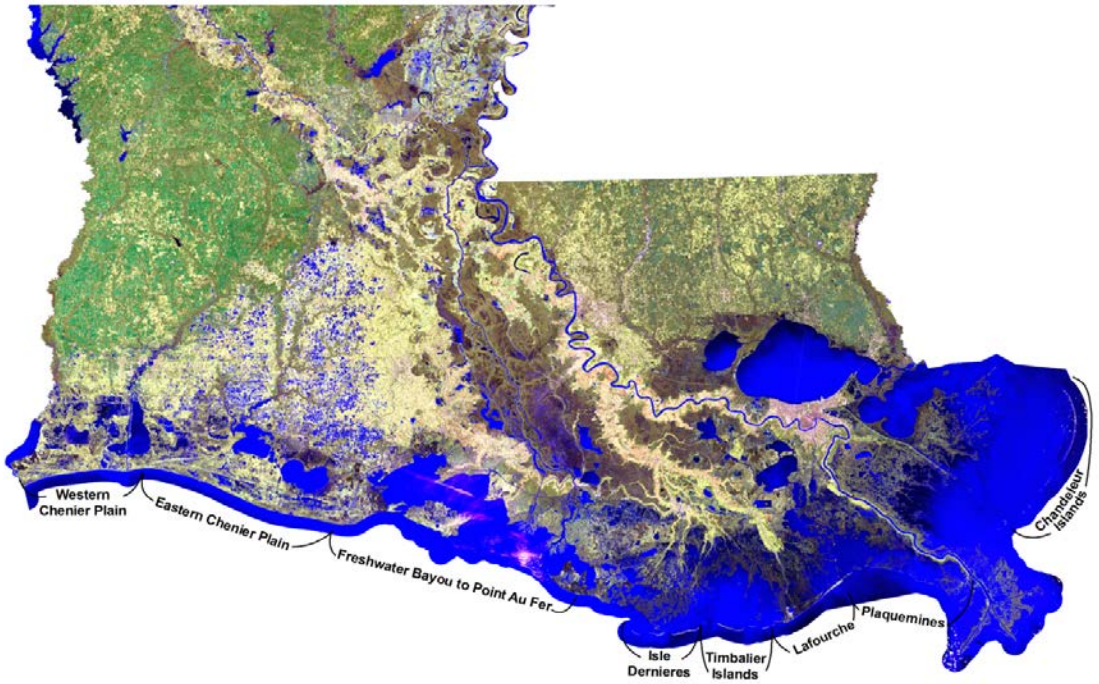

Figure 3: Various coastal segments including sandy shorelines, headlands, and barrier islands.

3.4.3 Funding and Timeline

As part of BIMP, the CPRA will formulate an annual list of potential projects based on inspections of previously constructed projects, post-storm assessments, BICM data, and existing project maintenance schedules. Data from these sources will be used to identify existing projects with an immediate need for repairs. All projects will be compiled and ranked by December 1 of each year. This list, along with recommended funding levels, will be provided to both the House and Senate Committees on Natural Resources for approval and funding. Funding will come from the Barrier Island Stabilization and Preservation Fund as set forth in House Bill No. 1034, Act No. 786 of the 2004 Session.

3.4.4 BIMP Projects

Previous efforts are described in past status reports and no new projects have been initiated under this program.

3.5 Breach Management Program

A Breach Management Program is in development to identify, classify, and prioritize methodologies and recommendations for breach prevention (proactive) and response (reactive) measures. A detailed analysis of coastal restoration projects completed in 2014 quantified the effects of breaching on barrier islands and headland beaches, specifically computing the significant increases in shoreline erosion rates. The Breach Management Program has developed a methodology to classify breach potential along the Louisiana coastline between Raccoon Island to the west and Scofield Island to the east. Barrier islands classified as having the potential to breach within four years are classified as severe and breach prevention measures are being developed for those areas. Opportunities are being explored to strategically partner breach prevention measures with other barrier island projects scheduled in the near-term within the Coastal Master Plan or as Beneficial Use Projects for disposal of maintenance dredged sediments from federal navigation channels. Additionally, breach management provides a component of BIMP, and CPRA as noted previously, will continue to integrate breach management into comprehensive shoreline adaptive management.

3.6 Borrow Area Monitoring and Maintenance (BAMM)

To ensure the efficient and effective use of limited sediment resources in Louisiana, a Borrow Area Monitoring and Maintenance (BAMM) project was initiated and funded through CIAP as a part of the Performance Evaluation and Science Monitoring Project. The BAMM project provides information to understand the evolution of the borrow pits (inland, riverine, and offshore) over time, especially the infilling characteristics (rate and types of sediment), gradient and depth of the pit-slopes, and the potential development of hypoxic conditions. Also a numerical modeling effort was undertaken to analyze and evaluate potential adverse impacts to wave climate and hydrodynamics if large inland borrow areas are dredged to mine approximately

50 MCY of sediment since borrow areas of this size are being considered for Master Plan project implementation.

The goals of BAMM are to develop general guidelines for developing criteria for location, delineation, and design of potential borrow areas in inland, riverine and offshore environments for coastal restoration and protection projects in Louisiana. These guidelines will help ensure that borrow areas are designed in a cost effective manner with minimal adverse impact on the adjoining coastal system. This included review of potential dredge impacts, existing wave analysis work and other related studies. Geophysical, geotechnical, and water quality data were collected from several borrow areas in coastal Louisiana. The combined information gathered during these efforts was analyzed and used to provide recommendations on borrow area location, depth of dredging, and design. It may be added that BAMM is an integral component of Louisiana Sediment Management Plan (LASMP) and as such will aid in reinforcing a regional sediment management strategy upon which restoration projects are recommended to be planned within a regional purview as opposed to merely a project-specific approach.

Additionally many of the current marsh creation and restoration projects in Louisiana specify that fill material be obtained from borrow areas designed within interior lakes and bays. The use of "inland" borrow areas is governed by numerous restrictions and/or regulations. Most of these regulations focus on vertical and horizontal dredging limits. The impacts of these aspects of borrow area design on wave heights and energies and the surrounding marsh environment, as well as the potential for development of hypoxic conditions are not clearly understood. Therefore, the scientific basis of these restrictions and/or regulations needs to be investigated to determine whether these borrow area design constraints are justified.

The BAMM project is divided into four tasks and a cumulative final report. As of November 2015, the second draft Project Inventory and Literature Search (Task 1) has been submitted along with a Draft Final Report. Task 2, the Bathymetric and Geophysical Collection and Analysis, was completed in May of 2013. The maps created from this data collection were analyzed/processed to assist in the calculation of infilling rates of the borrow areas and general bathymetric changes in elevation. The Hypoxia Monitoring (Task 3) involved the deployment of gauges that measure dissolved oxygen, salinity and temperature in six borrow area locations. One gauge was placed within each selected borrow area and another was placed approximately 0.5 miles outside of the borrow area and acted as a control. The gauges were deployed for approximately four consecutive months (June-October) with data collection occurring once a month. The gauges were collected for a final time in the last week of October 2013. Task 4's calibration report on Model Development was authored in October 2013. The Task 4 interim final report summarizing the entire modeling effort was submitted and reviewed. The comprehensive final BAMM report, currently being reviewed, includes recommendations on borrow area location, depth of dredging and design developed through analysis of the four subsequent tasks.

4.0 Barrier Island Performance Assessment

4.1 Overall Barrier Shoreline Condition

Louisiana's barrier shoreline is one of the fastest eroding shorelines in the world. Due to the geologic setting and the predicted changes in sea level during coming decades, these shoreline

habitats and the services they provide are some of the most vulnerable features of our coastal landscape. The CPRA's BICM Program has been established to assess and report on the changes of the coastal shoreline to help develop programmatic approaches to restoration and maintenance. As previously reported, the CPRA funded an interim study (CEC, 2012) to look at barrier island performance in the five years since BICM data were collected. The result of this study was summarized in earlier status report (CPRA 2016).

A number of barrier island projects have been constructed in the Teche, Lafourche, and Modern delta reaches since 1994. With the adoption of the 2012 *Louisiana's Comprehensive Master Plan for a Sustainable Coast* (CPRA, 2012), and a revision in 2017, it is timely to consider the status of the already-accomplished restoration projects. In order to improve the understanding of barrier system evolution and enhance the science behind barrier system restoration design, it is both essential and prudent to evaluate performance of the constructed projects as completed in the recently-commissioned barrier island performance study (CEC, 2012).

The Barrier Island Status Report is a compilation of four "Technical Memos" along with "Implementation Strategies", evaluates the performance of restored barrier islands, and can be found in the CPRA document library at http://cims.coastal.la.gov, with the individual accessible via the following links

11050_CEC-Executive Summary-12-14-2012.pdf
11050 Tech Memo 1 Data Gap Analysis-12-13-2012-final.pdf
11050 Tech Memo 2 Future Monitoring-12-13-2012-final.pdf
11050 Tech Memo 3 BVA-12-13-2012-final.pdf
11050 Tech Memo 4 Performance Analysis-12-14-2012-final.pdf
11050- Tech Memo 4 Appendix A-Modern Delta.pdf
11050_Tech Memo 4 Appendix B_Plaquemines.pdf
11050_CEC-Implementation Strategy-12-14-2012.pdf

It is anticipated that BICM data collection initiated during summer 2015 will allow updates to previous status report assessments.

4.2 Benefits of BI Restoration on Longevity of System(s)

With several major restoration projects in place, the post-restoration estimated Year of Disappearance (YOD) for several barrier island systems in Louisiana have been extended by years to decades. This increase in island longevity throughout the system is a direct benefit of the restoration projects. Further, with the increase in both frequency and intensity of major hurricanes over the past 12 years (and similar projections into the future), in the absence of the restoration and protection program, it is expected many of these islands would have disappeared much sooner than original projections. Additional BICM data collection efforts will allow revisions of YOD rates and allow CPRA to prioritize future restoration efforts based on the status and trends of shoreline and project evolution.

5.0 Minimized Design Template

Recently a "Minimized Design Template" was developed for utilization in modeling and analyzing future barrier island projects as component of the 2017 Coastal Master Plan (CEC, 2015). The minimized design template is defined as a design template with minimal barrier island dimensions that restores the barrier shoreline's geomorphic form and ecologic function and retains this form and function after being subjected to the design storm events. There are several components needed to construct the minimized design template for a barrier system including bathymetric/topographic data, sediment transport pathways, design storm criteria, subsidence and compaction, existing restoration project footprints, and site constraints (e.g., unique environmental habitats).

A minimized design template was developed for the Terrebonne Basin barrier shorelines extending from East Timbalier Island to Raccoon Island as part of the Louisiana Coastal Area program for the Terrebonne Basin Barrier Shoreline Restoration Project (TBBSR) (USACE, 2010). The design storms selected included a hypothetical 50-year design storm and historic storms, Hurricanes Katrina and Rita, which occurred in 2005, and Hurricanes Gustav and Ike, which occurred in 2008. Table 1 presents dimensions of the minimized restoration template developed for the Terrebonne Basin islands.

Table 1. Summary of Minimized Restoration Templates for TBBSR

Island	Raccoon	Whiskey	Trinity	East	Timbalier	East Timbalier
Gulf-side Beach Width (ft)	250	250	250	250	250	250
Dune Crest Width (ft)	100	100	100	100	100	100
Bay-side Beach Width (ft)	100	100	100	100	100	100
Marsh Width (ft)	1,000	1,000	1,000	1,000	1,000	1,000
Beach Elev. (ft, NAVD88)	4.2	4.0	4.0	4.0	4.0	4.0
Dune Elev. (ft, NAVD88)	6.4	6.2	6.2	6.2	6.2	6.2
Marsh Elev. (ft, NAVD88)	2.5	2.1	2.3	2.3	2.2	2.3

During 2015, system-wide barrier island and barrier headland restoration design templates were developed for Coastal Master Plan 2017. These templates achieve the goals of restoring the geomorphic and ecological form and function of the barrier shorelines through simulation of historical conditions by enlarging the existing barriers in width, elevation, and by reducing/eliminating the occurrence of breaching. Based upon the templates developed for previous projects (in Terrebonne and Barataria) along with the results of the sustainability analyses, an optimization process was undertaken to yield a system-wide restoration design template that could achieve the Study goal of providing habitat sustainability throughout the 50-

year period of analysis while meeting the breach prevention criteria at TY50. The primary differences between the 2012 Master Plan template and the recommended templates developed for this Study include the addition of a constructed dune feature, increased widths of the beach berms, increased elevations for the marsh platforms, and include a terraced feature for the marsh (see Figure 4). All of these features have been added to reduce the potential for breaching and to accommodate island overwash with the objective of maximizing the retention of sediment in the back-barrier.

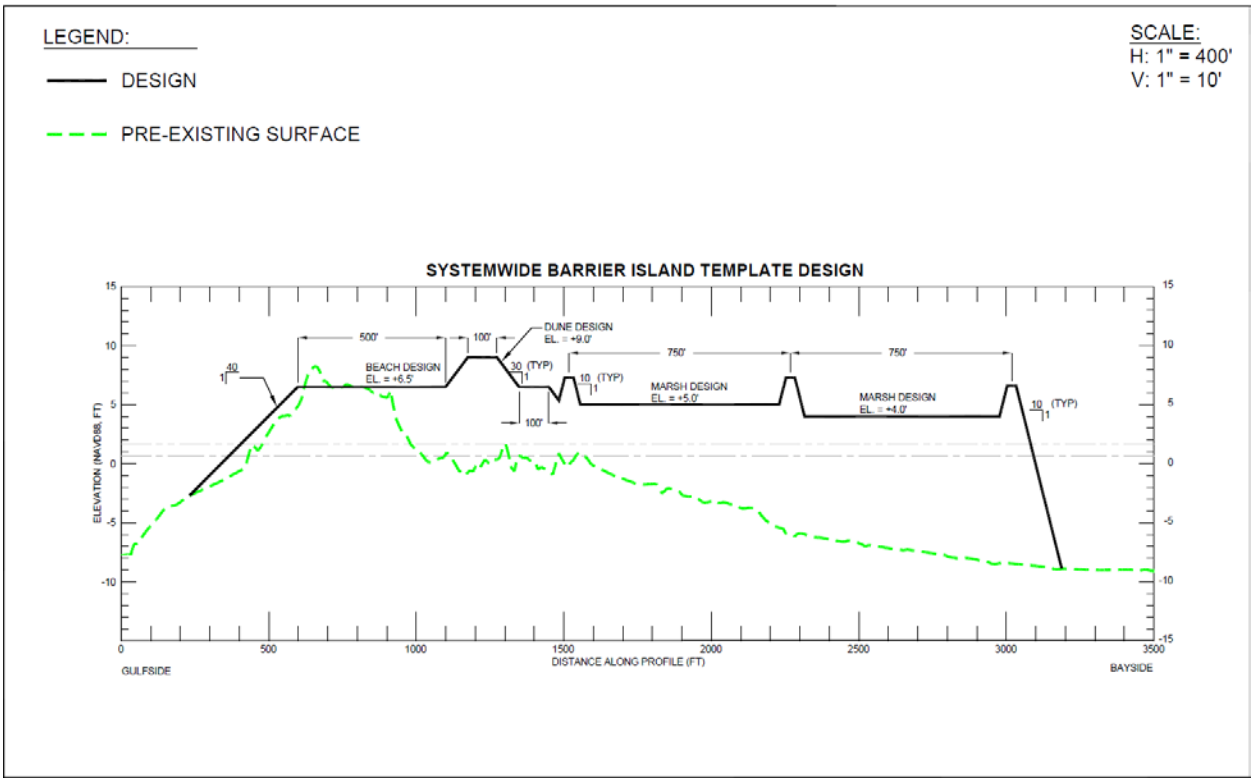

Figure 4: System-wide Barrier Island Design Template

In conjunction with the development of the barrier island design template, a barrier headland design template was developed. Based upon the barrier island template designs and results of the sustainability analyses, an optimization process was undertaken to yield a system-wide barrier headland design template that achieved the objective of providing habitat sustainability throughout the 50-year period of analysis while meeting the breaching criteria at TY50 for a headland feature (Figure 5).

The final report along with the drawings of templates can be found in the CPRA document library at http://cims.coastal.louisiana.gov/DocLibrary/FileDownload.aspx?Root=0&id=13277.

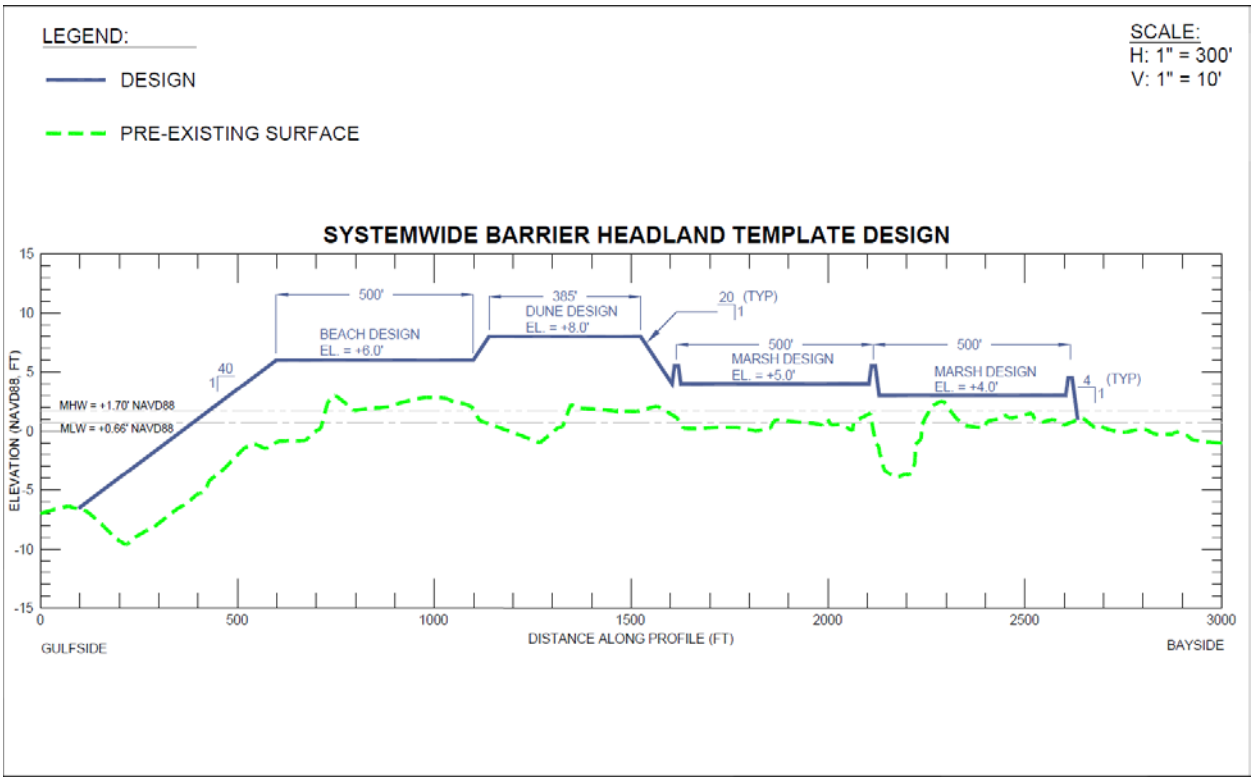

Figure 5: System-wide Barrier Headland Design Template

6.0 Future Plans

Future plans for Louisiana's barrier islands include additional projects, continuation of system-wide monitoring, and exploration and management of compatible sediment via acquisition of geotechnical and geophysical data, and overall understanding of sediment management requirements to support the sediment needs and prioritization of the current 2012 Coastal Master Plan projects.

6.1 Projects

In addition to the "Future Projects" listed above in Section 2, the 2012 Master Plan identifies barrier island restoration projects in four main groupings. These projects are listed as: Isles Dernieres Barrier Island Restoration (from Raccoon Island to Wine Island); Timbalier Islands Barrier Island Restoration (from Timbalier Island to Belle Pass); Belle Pass to Caminada Pass Barrier Island Restoration; and Barataria Pass to Sandy Point Barrier Island Restoration. In addition to these projects, to date Louisiana has procured, or received approval for, funding associated with *Deepwater Horizon* Oil Spill Restoration for seven barrier island projects:

- NRDA Caillou Lake Headlands (Whiskey Island) (NRDA Early Restoration- $110M)
- Shell Island West (NRDA Early Restoration- $101M)
- Chenier Ronquille (NRDA Early Restoration- $35M)
- North Breton Island (NRDA Early Restoration- $72M)

- Caminada Beach and Dune Increment II (NFWF- $147M)
- East Timbalier Island (Engineering and Design) (NFWF- $5.6M)
- West Grand Terre Beach Nourishment and Stabilization Project (Planning) (RESTORE- $7.3M)

Implementation of NRDA Early Restoration and NFWF projects is currently underway. Implementation of RESTORE projects will commence upon receipt of funding.

6.2 Monitoring

As discussed above in Section 3.1, the Barrier Island Comprehensive Monitoring (BICM) program has provided an extremely useful baseline of barrier island condition. Now that we have this tremendous tool, there is a need to continue this effort to assess how the islands continue to change over time. The CPRA will continue monitoring under BICM with a second increment of data collection through 2019. Also as discussed in Section 3.3 monitoring of subsidence (Phase 4) due to emplacement of sand during barrier island restoration will continue under Caminada-Moreau Subsidence Study.

6.3 Louisiana Sand Resources Database (LASARD)

The Coastal Protection and Restoration Authority developed the Louisiana Sand Resources Database (LASARD) to archive, populate, and maintain the geoscientific and related data acquired for ecosystem restoration on a GIS platform. The objective of LASARD is to centralize relevant data from various sources for archival and better project coordination while avoiding any duplication. That will facilitate future planning for delineating and utilizing sediment resources for a sustainable ecosystem restoration in coastal Louisiana by streamlining access to existing data sources, which will minimize the cost and time required to identify appropriate resources. To keep pace with the large amount of data being delivered to the CPRA from ongoing projects, the current LASARD database has been updated to incorporate these new data sets. Keeping LASARD current facilitates the benefit of real cost savings to upcoming projects by not only providing valuable data for planning, but also by reducing the potential for costly, redundant data collection efforts. This includes finalizing updates to the LASARD attribute formats, updating existing data to match these new formats, and processing additional data sets that are generated by ongoing implementation of coastal restoration projects. The data which has been collected during BICM 1 and which will be collected in future studies will ultimately reside in LASARD. The LASARD database, along with the mapping of surficial sediment distribution, is an important component of the Louisiana Sediment Management Plan (LASMP).

6.4 Louisiana Sediment Management Plan (LASMP)

One of the metrics the state has chosen to track their progress is average rate of land change for the next 50 years. The goal is to change the trajectory of land loss from net loss to one of net gain by the year 2042. To ensure the timeline as described in the 2012 Coastal Master Plan for reversing the trend of coastal land loss, it is realized that, the state must depend upon sound environmental and fiscal management of sediment resources. As such, introduction of river sediment and freshwater nutrients to coastal marshes must be an integral component of

restoration efforts, and sand deposits associated with ancient distributary channels and remnant shoals formed during the destructive phase of delta evolution should continue to be pursued as viable sources for barrier island and back-barrier marsh restoration. Moreover, sediment needs are likely to increase due to rapid subsidence in south Louisiana and potential increases in sea-level rise over the next century. Thus, the success of restoration efforts depends on locating, managing, and utilizing sediments in a cost-effective manner.

Khalil and Finkl (2009) and Khalil et al. (2010) stressed the importance of developing and implementing a sediment management plan for coastal Louisiana in support of coastal restoration efforts. Developing a clear understanding of the evolutionary processes controlling coastal sedimentation in deltaic environments is critical to any successful sediment management strategy. This involves direct knowledge of natural coastal processes (e.g., sea level change, subsidence, wave and current energy, sedimentation patterns, and geologic controls) and the impact of engineering activities (e.g., dredging/channels, levees/dams) on these processes.

Effective restoration efforts should be consistent with natural system evolution. Ultimately, one must understand the imbalance between sediment input and erosion (energy required to mobilize and transport sediment) to properly evaluate net sediment movement within wetlands to design effective restoration strategies. The CPRA is focused on long-term conservation and management of state natural resources. As part of this focus, the CPRA developed the Louisiana Sediment Management Plan (LASMP) framework that embraces a regional sediment management strategy upon which restoration projects are planned within a regional purview as opposed to merely a project-focused approach.

LASMP is a working model to incorporate the influence of scale on resource availability (river, in-shore, and continental shelf) and resource distribution for effective restoration. Although technical considerations associated with sediment borrow areas, river sediment, and engineering activities are critical for successful plan implementation, coastal policy/regulation requirements are expected to have significant influence on plan implementation.

The desired result of LASMP is a more cost-effective implementation of the Master Plan via comprehensive management of renewable and non-renewable sediment resources; a reduction in project costs and environmental impacts; and a long-term, safe and sustainable coast to protect Louisiana communities, national critical energy infrastructure, and state natural resources for future generations.

7.0 References

Byrnes, M. R., Hedderman, C., Hasen, M., Roberts, H., Khalil, S., and Underwood S. G., 2015. Differential sediment consolidation associated with barrier beach restoration: Caminada headland, south Louisiana. Proceedings of Coastal Sediments 2015. World Scientific Publishing Company

Campbell, T., Benedet, L. and Finkl, C. W. 2005. Regional strategies for barrier island restoration. *In:* Finkl, C.W. and S. M. Khalil, (eds.), *Louisiana Barrier Island*

Restoration. West Palm Beach, Florida: *Journal of Coastal Research*, Special Issue No. 44, 240–262.

Coastal Engineering Consultants, Inc. 2012. Barrier Island Performance Analysis. Prepared for Coastal Protection and Restoration Authority under contract 2503-12-22. http://cims.coastal.la.gov

Coastal Engineering Consultants, Inc. 2015. Barrier Island / Barrier Headland Restoration, Design Template Development, Technical Memorandum, CEC File No. 13.084. http://cims.coastal.la.gov

Coastal Protection and Restoration Authority (CPRA). 2012. Louisiana's Comprehensive Master Plan for a Sustainable Coast. Baton Rouge, LA.

Coastal Protection and Restoration Authority (CPRA). 2016. Integrated Ecosystem Restoration & Hurricane Protection in Coastal Louisiana: Fiscal Year 2016 Annual Plan. Baton Rouge, LA. http://cims.coastal.louisiana.gov/DocLibrary/FileDownload.aspx?Root=0&id=11477

Ewing, L. and Pope, J. 2006. Viewing the Beach as an Ecosystem? Shore & Beach, 74 (1), 2.

Georgiou, I.Y., Fitzgerald, D.M., and Stone, G.W. 2005. The impact of physical processes along the Louisiana coast, Journal of Coastal Research, Special Issue No. 44, pp. 72-89.

Khalil, S.M. and C.W. Finkl. 2009 Regional sediment management strategies for coastal restoration in Louisiana, USA. Journal of Coastal Research, Special Issue No. 56, pp. 1320-1324.

Khalil, S.M., Finkl, C.W., Roberts, H.H., and Raynie, R.C. 2010. New approaches to sediment management on the inner continental shelf offshore coastal Louisiana, Journal of Coastal Research, 26 (4), 591-604.

Khalil, S.M., and Raynie, R.C., 2015. An integrated system-based approach to restoration of Louisiana's barrier islands. Proceedings of Coastal Sediments 2015. World Scientific Publishing Company

Kindinger, J.L., Buster, N.A., Flocks, J.G., Bernier, J.C., and Kulp, M.A., 2013, Louisiana Barrier Island Comprehensive Monitoring (BICM) Program Summary Report: Data and Analyses 2006 through 2010: U.S. Geological Survey Open-File Report 2013–1083, 86 p., at http://pubs.usgs.gov/of/2013/1083/.

McBride, R.A. and M.R Byrnes. 1997. Regional variations in shore response along barrier island systems of the Mississippi River delta plain: historical change and future prediction. Journal of Coastal Research 13(3):628-655.

Rosati, J. D. 2009. Barrier Island Migration Over a Consolidating Substrate. Coastal Inlets Research Program, U.S. Army Engineer Research and Development Center, Coastal and Hydraulics Laboratory. ERDC/CHL TR-09-8. Vicksburg, MS. 219 pp.

U.S. Army Corps of Engineers. 2010. Louisiana Coastal Area Ecosystem Restoration Study. Vol. V of VI. Integrated Feasibility Study and Final Environmental Impact Statement for the Terrebonne Basin Barrier Shoreline Restoration, Terrebonne Parish, Louisiana. New Orleans, Louisiana.