June 2012

FINAL ENVIRONMENTAL ASSESSMENT

FOR THE ISSUANCE OF A NON-COMPETITIVE NEGOTIATED AGREEMENT FOR THE USE OF OUTER CONTINENTAL SHELF SANDS FOR CAMINADA HEADLAND BEACH AND DUNE RESTORATION (BA-45)

LAFOURCHE PARISH, LOUISIANA

PREPARED FOR:
UNITED STATES DEPARTMENT OF INTERIOR BUREAU OF OCEAN ENERGY MANAGEMENT

ON BEHALF OF:

Coastal Protection and Restoration Authority of Louisiana
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Prepared by

Baton Rouge, Louisiana

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Prepared by:

G.E.C., INC.
Baton Rouge, Louisiana

COASTAL PROTECTION AND RESTORATION AUTHORITY OF LOUISIANA
BATON ROUGE, LOUISIANA

June 5, 2012

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS (cont'd)

Section **Page**

TABLE OF CONTENTS (cont'd)

Section **Page**

TABLE OF CONTENTS (cont'd)

LIST OF TABLES

Number **Page**

LIST OF FIGURES

Figure **Page**

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The purpose of this project is to restore the beach and dune on a portion of the Caminada Headland barrier shoreline. Restoration will ensure the continuing geomorphic and hydrologic form and function of the landscape and protect commercial, public, and private infrastructure from increased exposure to storms and wave energy associated with continued shoreline retreat.

The Louisiana Coastal Protection and Restoration Authority (CPRA) has submitted a request to the Department of Interior's Bureau of Ocean Energy Management (BOEM) to dredge approximately 5 million cubic yards (mcy) of Outer Continental Shelf (OCS) sand resources to restore the headland. The sand would be taken from a borrow site located in the South Pelto area. The proposed borrow area for the project will involve the use of OCS sand resources located beyond the State of Louisiana's jurisdictional boundary. The United States Government, and specifically, BOEM has sole jurisdiction over all mineral resources on the Federal OCS. The U.S. Army Corps of Engineers (USACE) issued a Section 10/404 permit on May 10, 2012 and is the lead Federal agency, with BOEM as a cooperating agency, for consultation with other State and Federal agencies under National Environmental Policy Act (NEPA) and other relevant Federal Acts.

The Caminada Headland beach and dune in Lafourche Parish, Louisiana would be restored using sediment from the proposed borrow site in South Pelto Blocks 13 and 14 on Ship Shoal. The headland consists of sand dunes, beach berm, barrier marshes, and beach ridges interspersed with mangrove thickets, coastal dune shrub thickets, lagoons, and small bayous. The project area includes barrier shorelines, passes, and back-barrier marshes from Belle Pass (the mouth of Bayou Lafourche) east to Caminada Pass. Ship Shoal is located in OCS waters approximately 27 nautical miles (nm) southwest of the headland.

The CPRA intends for the design and construction of the Caminada Headland Project to serve as a portion of the State of Louisiana cost share towards the design and construction of the Barataria Basin Barrier Shoreline Restoration Study (BBBS Project). The BBBS Project was identified as a critical near-term restoration project in the *Louisiana Coastal Area, Louisiana Ecosystem Restoration Study Report* and was Federally authorized under the Water Resources Development Act of 2007. The final integrated construction report and final environmental impact statement for the BBBS project was completed in March 2012 (USACE 2012).

Ship Shoal is the largest of a series of inner shelf sand shoals off the Louisiana Coast. This shoal is a remnant of an ancient barrier shoreline modified by processes related to transgression and submergence of the Maringouin delta complex. The borrow area is located in two Ship Shoal OCS lease blocks, South Pelto Blocks 13 and 14, at the eastern end of the shoal.

The borrow area design volume is estimated to be 5 million cubic yards (mcy) of sand. The preliminary borrow area plan covers 220 acres with an average cut depth to -43 feet NAVD88 with a 2 ft allowable overdredge (-45 feet NAVD88). A total fill volume of 4.23 mcy of sand would be placed on the beach and/or dune of the western portion of the headland. The base

beach/dune fill template is 3.014 mcy; annual background erosion is 0.246 mcy (0.492 mcy over the 2-year period from the 2010 design survey to the anticipated start of construction in the Fall 2012); construction tolerance-compaction-settlement is 0.722 mcy; and the cut to fill ratio is 1.18.

An extended beach fill project has been identified to the east of the current Caminada Headland Beach and Dune Project. The Proposed Future Expansion Area will provide potentially suitable sediment for this project. Additional geotechnical studies may be needed prior to utilizing these borrow materials. An additional 4 mcy are contained in the aforementioned Proposed Future Expansion Area. The total volume of sand, including the expansion area, which could be mined in the future, is estimated to be 9 mcy. The proposed future expansion area is not part of this current proposed project.

Four Fill Templates were evaluated for the proposed project. Fill Template 1 runs from the east jetty at Belle Pass (Station 05+00) eastward to beyond Bay Champagne (Station 255+00) and involves placement of approximately 2,011,400 cy of sand to create beach and dune along 25,000 feet of shoreline. Fill Template 2 runs from the midpoint of the breakwater field (Station 140+00) eastward to the approximate location of Bayou Moreau (Station 315+00) and involves placement of approximately 2,045,700 cy of sand to create beach and dune along 18,500 feet of shoreline. Fill Template 3 runs from the east jetty at Belle Pass (Station 05+00) eastward to the approximate location of Bayou Moreau (Station 315+00) and involves placement of approximately 2,033,500 cy of sand to create beach along 31,000 feet of shoreline. Fill Template 4 runs from the east jetty at Belle Pass (Station 05+00) eastward to the approximate location of Bayou Moreau (Station 315+00) and involves placement of approximately 3,013,700 cy of sand to create beach and dune along 31,000 feet of shoreline.

Hopper and cutterhead dredges could be used. Two hopper dredges would likely be used to excavate the sand from the Borrow Area and transport it to the Caminada Headland. Excavated sand would be discharged into the hopper hulls for transport to the headland. Hopper dredges would suspend the sand within the hoppers and directly pump out the sand to the headland using a booster pump and sediment pipeline. Alternatively, a conventional cutterhead dredge, would excavate the sand mechanically using a rotating cutter, then use a large suction pump to pump it to the surface, then transfer it through a spider-barge distribution system into multiple scow barges. These scow barges would be towed to a pump-out area where a hydraulic dredge connected to a booster pump and sediment pipeline would offload the scows and pump the sand to the headland.

Sediment pipelines would be floated and/or placed on the channel bottom, laid on the beach, or existing access roads, therefore, conveyance corridors would not require dredging or excavation for sediment pipeline installation. No sediment transport pipelines will be placed on the OCS.

Five pump-out areas could be used to convey sand from the hopper dredges or scow barges to the headland. Two pump-out areas are located in Belle Pass: the Lower Belle Pass Pump-Out Area is near the inner end of the east jetty and the Upper Belle Pass Pump-Out Area is approximately 6,000 feet farther up Belle Pass, along the eastern shoreline. The Pass Fourchon

Pump-Out Area is located along the south shoreline of Pass Fourchon, near the junction with Belle Pass. The Offshore East Pump-Out Area is located approximately 1.7 nm offshore in the Gulf of Mexico approximately 7.8 nm east of Belle Pass. The Offshore West Pump-Out Area is located in the Gulf of Mexico, approximately 1.6 nm offshore of the Caminada Headland and 5.3 nm east of Belle Pass.

Four proposed fill templates (Fill Templates 1-4) and the no-action alternative were evaluated for their effects environmental resources. The physical, biophysical, critical biological, cultural, and socioeconomic and human resources were evaluated for direct, indirect, and cumulative effects. The project had either no effect or minor and short-term effects on these resources. As such, the cumulative effects were minor as well. Generally, the mid-term effects were positive in that the headland and associated habitats would be restored and preserved. The project would provide for habitat for all forms of fish and wildlife, as well as affording the infrastructure, including Port Fourchon, an increased level of storm protection. Certain procedures were incorporated into the project to reduce the effects on some of these resources. A bird abatement program was included to reduce impacts to avian communities, including shore birds (including the piping plover, which has critical habitat designated on the headland) and colonial nesting birds. Benthic communities at the headland and Ship Shoal areas would be affected for six months to three years. There would also be a potential for incidental takings of sea turtles during dredging operations, despite the implementation of all possible precautions (e.g., use of turtle exclusion devices, observers, etc.) to avoid, minimize, and reduce any such impacts.

FINAL ENVIRONMENTAL ASSESSMENT

FINAL ENVIRONMENTAL ASSESSMENT CAMINADA HEADLAND BEACH AND DUNE RESTORATION (BA-45)

LAFOURCHE PARISH, LOUISIANA

1.0 INTRODUCTION

The Louisiana Coastal Protection and Restoration Authority (CPRA) has submitted a request to the Department of Interior's Bureau of Ocean Energy Management (BOEM) to dredge approximately 5 million cubic yards (mcy) of Outer Continental Shelf (OCS) sand resources to restore the headland. The sand would be taken from a borrow site located in the South Pelto area.

The proposed borrow area for the project will involve the use of OCS sand resources located beyond the State of Louisiana's jurisdictional boundary. The United States Government, and specifically, BOEM has sole jurisdiction over all mineral resources on the Federal OCS. Public Law 103-426, enacted 31 October 1994, gave the Department of Interior the authority to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for shore protection, beach, or wetlands restoration projects, or for use in construction projects funded in whole or part or authorized by the Federal government. Those resources fall under the purview of the Secretary of the Interior, who oversees the use of OCS sand and gravel resources, and the BOEM as the agency charged with this oversight by the Secretary of the Department of the Interior. Following an environmental evaluation of the total project (including the sediment conveyance and fill area) as required by the National Environmental Policy Act (NEPA), the BOEM may issue noncompetitive negotiated agreements for the use of OCS sand to the requesting entities. The U.S. Army Corps of Engineers (USACE) issued a Section 10/404 permit on May 10, 2012 and is the lead Federal agency, with BOEM as a cooperating agency, for consultation with other State and Federal agencies under NEPA and other relevant Federal acts.

A Coastal Zone Management consistency determination is required from LDNR on BOEM-authorized OCS activities. Additionally, a Water Quality Certification from the Louisiana Department of Environmental Quality (LDEQ) is required. Federal agency consultations with the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS) and the U.S. Environmental Protection Agency (USEPA) will be accomplished through the USACE 10/404 regulatory process. Compliance with other environmental requirements is presented in Section 6.0.

The goal of the Caminada Headland Beach and Dune Restoration (BA-45) (Caminada Headland Project) is to protect and preserve the integrity of the barrier shoreline of the Caminada Headland. The Caminada Headland has eroded 37 ft/yr and Fourchon Beach has eroded 55 ft/yr from 1855 to 2005 (post Hurricane Katrina) and 191 ft and 76 ft from 2004 to 2005, respectively (Martinez *et al.* 2009). Benefits of the restoration of the headland shoreline would protect and sustain significant and unique coastal habitats, protect threatened and endangered species, and protect important fishery grounds. The restored barrier shoreline would reduce wave energy and saltwater intrusion from the Gulf of Mexico (Gulf) that is negatively affecting back-barrier environments, including beach ridges, marshes, and mangroves. Restoration of the headland barrier shoreline would also provide a sediment source to sustain barrier beaches east and west of the eadland. Incidental benefits from this ecological restoration would protect Port Fourchon, the Louisiana Offshore Oil Port (LOOP), local and state highways, and the only hurricane evacuation route available to the region along Louisiana Highway (LA Hwy) 1. This project is synergistic with future restoration projects by maintaining or restoring the integrity of the Louisiana coastline; the foundation on which future coastal restoration projects are dependent.

1.1 PROJECT SPONSOR AND FUNDING

CPRA serves as the local sponsor for the Caminada Headland Project. The project is sponsored by the Coastal Impact Assistance Program (CIAP) and would use CIAP funding and State of Louisiana surplus funds.

1.2 PROJECT LOCATION

The Caminada Headland beach and dune in Lafourche Parish, Louisiana would be restored using sediment from the proposed borrow site in South Pelto Blocks 13 and 14 on Ship Shoal (Figure 1-1). The headland consists of sand dunes, beach berm, barrier marshes, and beach ridges interspersed with mangrove thickets, coastal dune shrub thickets, lagoons, and small bayous. The project area includes barrier shorelines, passes, and back-barrier marshes from Belle Pass (the mouth of Bayou Lafourche) east to Caminada Pass. Ship Shoal is located in OCS waters approximately 27 nautical miles (nm) southwest of the headland.

1.3 PROJECT HISTORY

The CPRA intends for the design and construction of the Caminada Headland Project to serve as a portion of the State of Louisiana cost share towards the design and construction of the Barataria Basin Barrier Shoreline Restoration Study (BBBS Project). The BBBS Project was identified as a critical near-term restoration project in the *Louisiana Coastal Area, Louisiana Ecosystem Restoration Study Report* and was Federally authorized under the Water Resources Development Act of 2007. The final integrated construction report and final environmental impact statement for the BBBS Project was completed in March 2012 (USACE 2012).

1.4 PROJECT PURPOSE AND NEED

The purpose of this project is to restore the beach and dune on a portion of the Caminada Headland barrier shoreline. Restoration will ensure the continuing geomorphic and hydrologic form and function of the landscape and protect commercial, public, and private infrastructure from increased exposure to storms and wave energy associated with continued shoreline retreat.

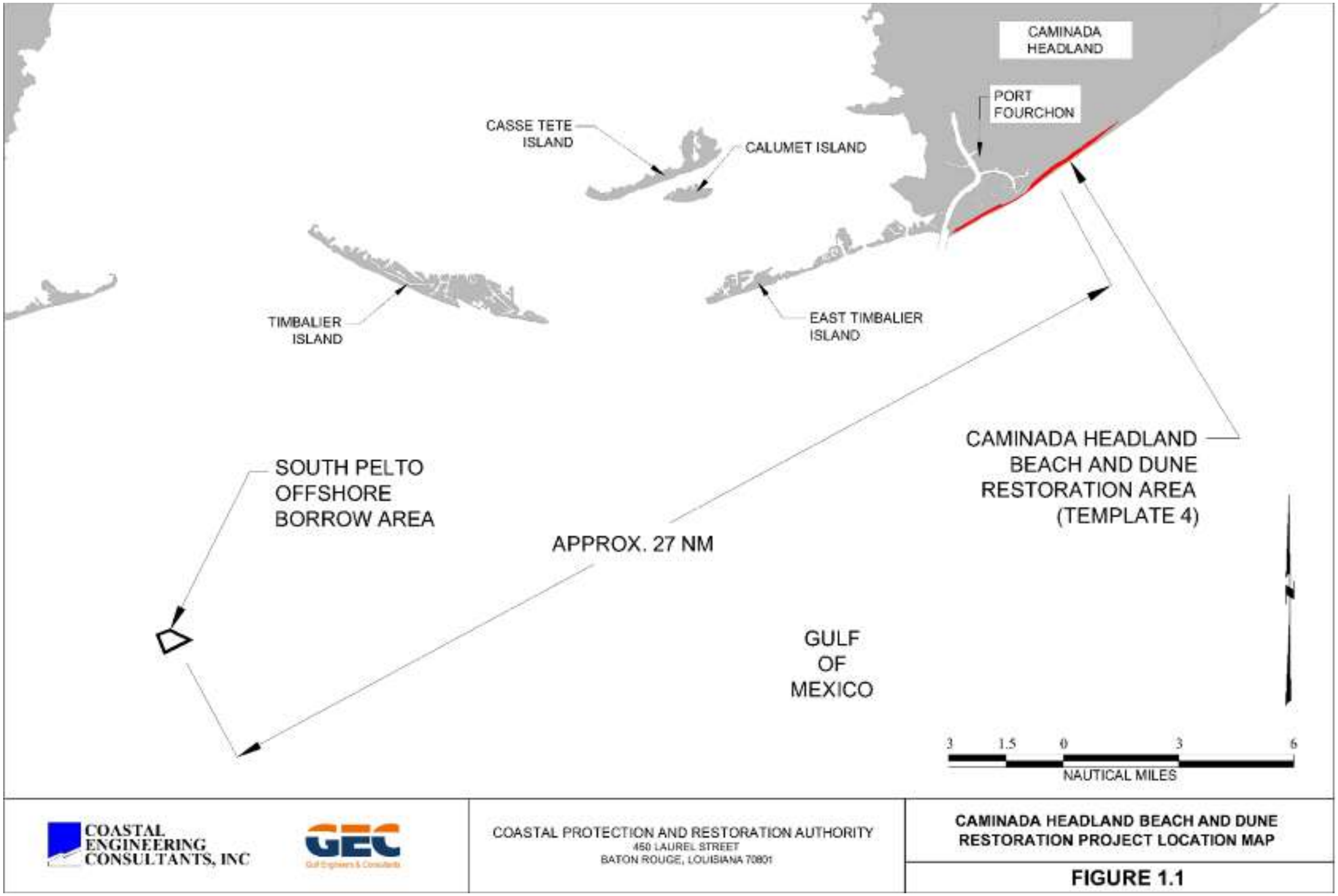


Figure 1-1. Caminada Headland Beach and Dune Restoration Project Location Map

Louisiana contains one of the largest expanses of coastal wetlands in the contiguous U.S. and accounts for 80 percent of the total coastal marsh loss occurring in the nation (USGS 1995). The coastal wetlands, built by the deltaic process of the Mississippi River, contain a diversity of habitats ranging from narrow natural levees and dunes to expanses of forested swamps and freshwater, intermediate, brackish, and saline marshes.

Restoration of these barrier shoreline landforms would decrease shoreline erosion and the loss of interior wetlands in the Barataria Basin by reducing the extent and intensity of tidal, wave, and storm processes behind the shorelines. An incidental benefit of the proposed action would be the reduction of storm surge due to enhanced shoreline integrity and preservation of backbarrier wetlands. Coastal landforms and wetlands are one of the first lines of defense for storm surges and thereby reduce the impact of flooding and storm surges on infrastructure in the coastal region (Gedan *et al*. 2011).

The primary infrastructure that would be protected by this project include the only evacuation route for Caminada Headland and Grand Isle (LA Hwy 1), as well as Port Fourchon and related petroleum storage and transport facilities, including the Fourchon Booster Station, the onshore component of the LOOP which supplies oil to the Clovelly Dome Storage Terminal. Crude oil from the LOOP can be pumped to nearly 50 percent of the nation's refining capacity through other pipelines connected to the terminal. These oil facilities are located on the inland portion of the headland. Port Fourchon supports 75 percent of the deepwater oil and gas production in the Gulf of Mexico as the point of departure for crew boats, equipment and supplies, rig components, and oilfield services.

1.5 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is to restore the Caminada Headland using sand resources from Ship Shoal, a bathymetric feature located offshore central Louisiana. Approximately 5 mcy of sand would be dredged from the South Pelto OCS borrow area.

1.5.1 Borrow Area

Ship Shoal (Figure 1-1) is the largest of a series of inner shelf sand shoals off the Louisiana Coast. This shoal is a remnant of an ancient barrier shoreline modified by processes related to transgression and submergence of the Maringouin delta complex (Krawiec 1966; Frazier 1967; Penland *et al*. 1988). The borrow area is located in two Ship Shoal OCS lease blocks, South Pelto Blocks 13 and 14 (Figure 1-2), at the eastern end of the shoal. Block 13 was estimated to contain 44 million cubic yards of sand (Kulp *et al.* 2001).

The borrow area design volume is estimated to be 5 million cubic yards (mcy) of sand. The preliminary borrow area plan covers 220 acres with an average cut depth to -43 feet NAVD88 with a 2 ft allowable overdredge (-45 feet NAVD88). A total fill volume of 4.23 mcy of sand would be placed on the beach and/or dune of the western portion of the headland. The base beach/dune fill template is 3.014 mcy; annual background erosion is 0.246 mcy (0.492 mcy over the 2-year period from the 2010 design survey to the anticipated start of construction in the Fall

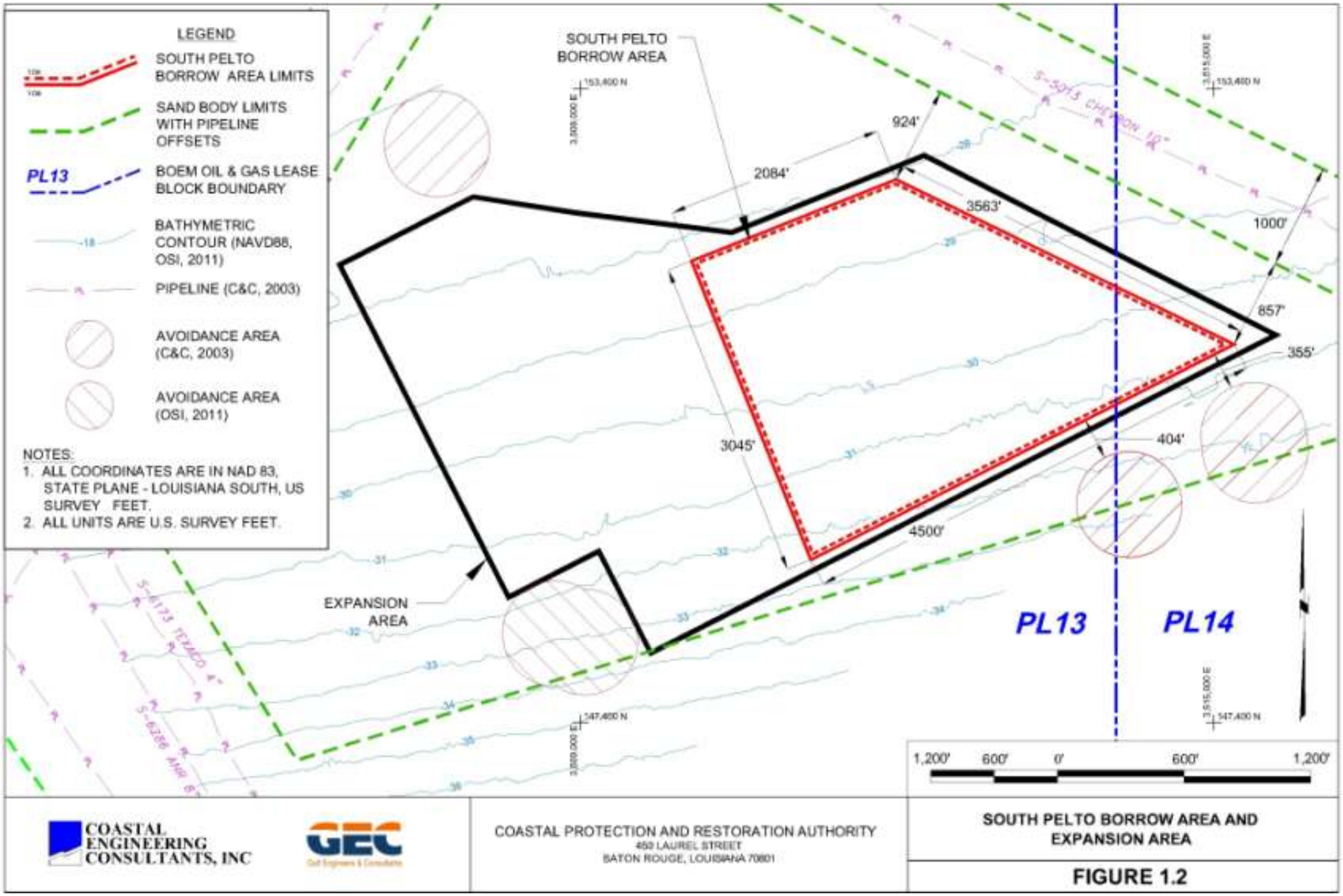


Figure 1-2. South Pelto Borrow Area

2012); construction tolerance-compaction-settlement is 0.722 mcy; and the cut to fill ratio is 1.18.

An extended beach fill project has been identified to the east of the current Caminada Headland Project. The proposed future expansion area would provide potentially suitable sediment for this project. Additional geotechnical studies may be needed prior to utilizing these borrow materials. An additional 4 mcy are contained in the proposed future expansion area. The total volume of sand, including the proposed future expansion area, is estimated to be 9 mcy. The proposed future expansion area is not part of this current proposed project.

1.5.2 Fill Templates

Fill Template 1

Fill Template 1 (Figure 1-3) runs from the east jetty at Belle Pass (Station 05+00) eastward to beyond Bay Champagne (Station 255+00) and involves placement of approximately 2,011,400 cy of sand to create beach and dune along 25,000 feet of shoreline. The fill template tapers to meet the native beach width and elevation at each end to blend the sediment and minimize end losses resulting from abrupt changes in shoreline alignment. Tapers are 1,000 feet long at the west end of the template and 3,000 feet long at the east end.

The breakwaters contribute to a reduction in shoreline erosion when compared to the average shoreline erosion along the headland, based on existing conditions, historical and current photographs, and documented shoreline change analyses. Based on shoreline change rates, a 33 percent reduction in erosion on the western end of the headland can be attributed to the breakwaters reducing wave energy in their lee and the jetty impounding sand. However, a significant erosional shadow exists east of the breakwater field along the Bay Champagne shoreline.

The width of the landward template design is limited from Belle Pass to the western edge of the existing breakwater field by environmental habitats and infrastructure to the north of the barrier shoreline. Sand placement is limited behind the breakwaters due to geographic constraints, the proximity of oil and gas facilities and LA Hwy 3090 (CEC and SJB 2008).

As a result, the dune component of the template would be omitted between Stations 100+00 and 145+00, in the lee of the offshore breakwater field. The restored dunes on each side of the gap will taper to meet the native beach to avoid abrupt elevation changes. Elsewhere, the dune would be constructed for a target elevation of +7.0 feet NAVD 88, with fore- and back-slopes of 1V:20H and a typical width of 290 feet. The target elevation of the beach will be +4.5 feet NAVD 88. Construction of Template 1 would create approximately 237 acres of beach and dune habitat.

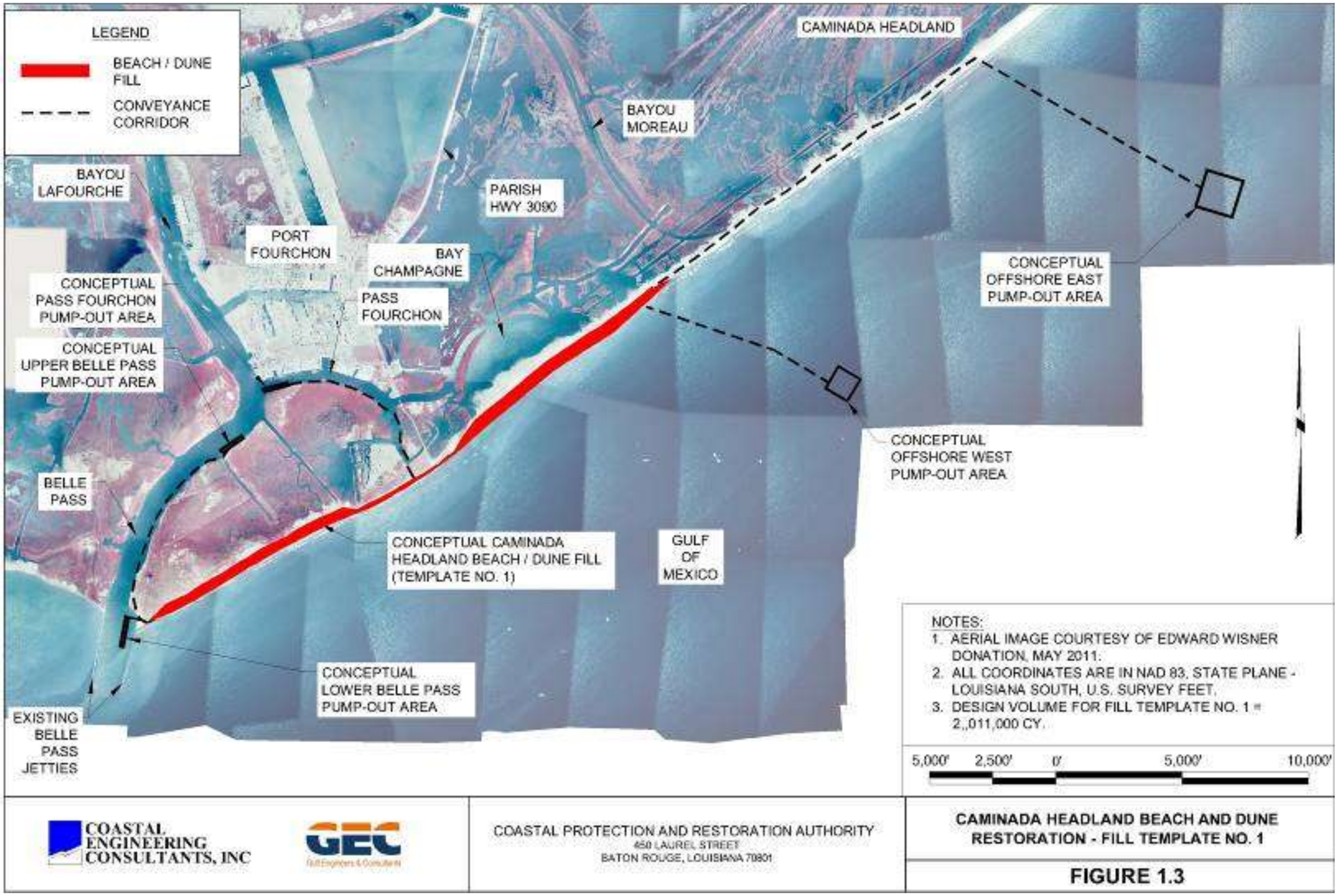


Figure 1-3. Caminada Headland Beach and Dune Restoration Project Fill Template No. 1

Figure 1-4. Caminada Headland Beach and Dune Restoration Project Fill Template No. 2

Fill Template 2

Fill Template 2 (Figure 1-4) runs from the midpoint of the breakwater field (Station 140+00) eastward to the approximate location of Bayou Moreau (Station 315+00) and involves placement of approximately 2,045,700 cy of sand to create beach and dune along 18,500 feet of shoreline. The fill template tapers to meet the native beach width and elevation at each end to blend the sediment and minimize end losses resulting from abrupt changes in shoreline alignment. The tapers are 2,000 feet long at the west end of the template and 5,000 feet long at the east end. The dune would be constructed at a target elevation of +7.0 feet NAVD 88, with fore- and back-slopes of 1V:20H and a typical width of 290 feet. The target elevation of the beach would be +4.5 feet NAVD 88. Construction of Template 2 would create approximately 201 acres of beach and dune habitat.

Fill Template 3

Fill Template 3 (Figure 1-5) runs from the east jetty at Belle Pass (Station 05+00) eastward to the approximate location of Bayou Moreau (Station 315+00) and involves placement of approximately 2,033,500 cy of sand to create beach along 31,000 feet of shoreline. The fill template tapers to meet the native beach width and elevation at each end to blend the sediment and minimize end losses resulting from abrupt changes in shoreline alignment. The tapers are 2,000 feet long at the west end of the template and 5,000 feet long at the east end. The dune component has been omitted to create the maximum length of beach within the Project fiscal constraints. The target elevation of the beach would be +4.5 feet NAVD 88. Construction of Template 3 would create approximately 280 acres of beach habitat.

Fill Template 4

Fill Template 4 (Figure 1-6) runs from the east jetty at Belle Pass (Station 05+00) eastward to the approximate location of Bayou Moreau (Station 315+00) and involves placement of approximately 3,013,700 cy of sand to create beach and dune along 31,000 feet of shoreline. The fill template tapers to meet the native beach width and elevation at each end to blend the sediment and minimize end losses resulting from abrupt changes in shoreline alignment. The tapers are 1,000 feet long at the west end of the template and 5,000 feet long at the east end. As with Template 1, the dune component would be omitted between Stations 100+00 and 145+00, in the lee of the offshore breakwater field. The dune would be constructed at a target elevation of +7 feet NAVD 88, with fore- and back-slopes of 1V:20H and a typical width of over 350 feet. The target elevation of the beach will be +4.5 feet NAVD 88. Construction of Template 4 would create approximately 328 acres of beach and dune habitat. Approximately 199.78 acres of dune would be sparsely planted with native dune grasses at 8-ft by 8-ft centers (Section 9.9 contains additional information on vegetative plantings).

1.5.3 Excavation, Transport, and Conveyance Methods

Hopper and cutterhead dredges could be used. Two hopper dredges would likely be used to excavate the sand from the Borrow Area and transport it to the Caminada Headland. Excavated

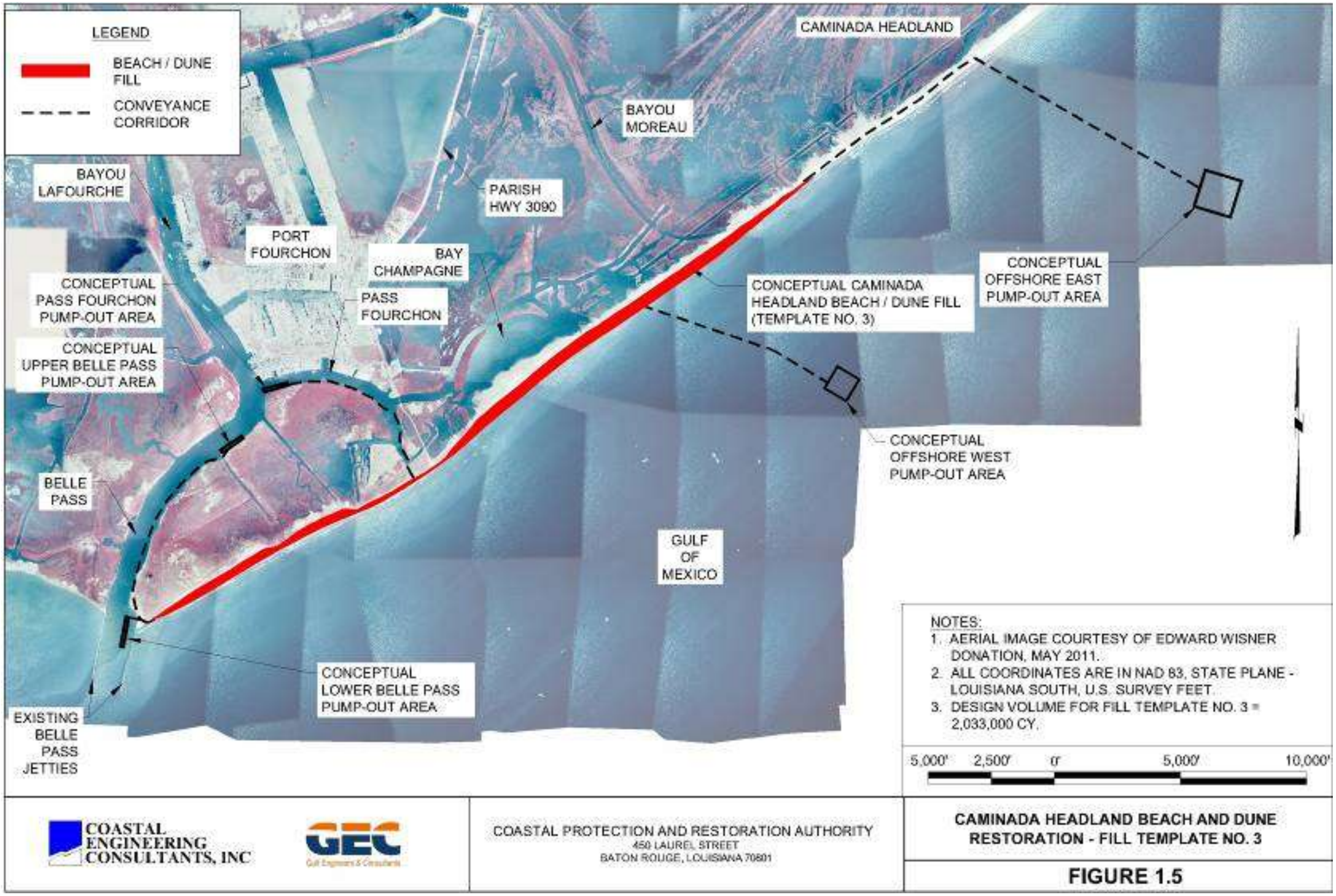


Figure 1-5. Caminada Headland Beach and Dune Restoration Project Fill Template No. 3

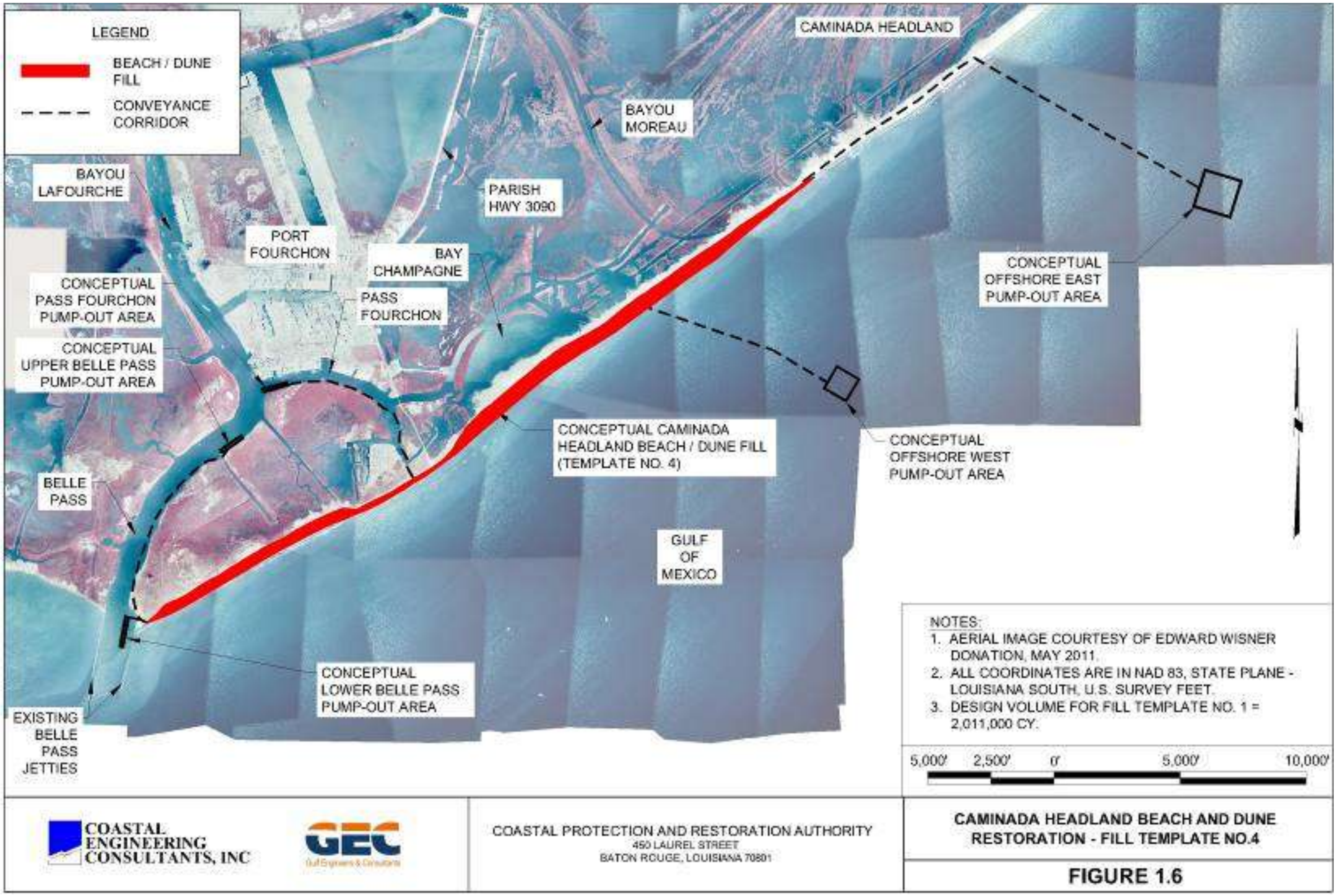


Figure 1-6. Caminada Headland Beach and Dune Restoration Project Fill Template No. 4

sand would be discharged into the hopper hulls for transport to the headland. Hopper dredges would suspend the sand within the hoppers and directly pump out the sand to the headland using a booster pump and sediment pipeline. Alternatively, a conventional cutterhead dredge, would excavate the sand mechanically using a rotating cutter, then use a large suction pump to pump it to the surface, then transfer it through a spider-barge distribution system into multiple scow barges. These scow barges would be towed to a pump-out area where a hydraulic dredge connected to a booster pump and sediment pipeline would offload the scows and pump the sand to the headland.

A cutterhead dredge with a direct sediment pipeline from the borrow area to the headland was also considered. However, the pumping distance of over 30 nautical miles (NM) would require at least 5 booster pumps and approximately 3000 segments of 60-foot long sediment pipeline. In addition, installation of the sediment pipeline (at a rate of 1,500 feet per day) would take approximately 120 days. It was determined that this long pipeline method is not technically feasible for this project and was not considered as an alternative.

1.5.4 Sediment Pump-Out at the Headland

Five pump-out areas were designed to convey the sand from the hopper dredges or scow barges to the headland restoration template (Figure 1-7). All of these pump-out areas would be made available to the construction contractors to enable a construction process that could take advantage of available physical plants and auxiliary/ancillary assets, thus providing the most flexibility during bidding and construction.

Two pump-out areas are located in Belle Pass: the **Lower Belle Pass Pump-Out Area** is near the inner end of the east jetty and the **Upper Belle Pass Pump-Out Area** is approximately 6,000 feet farther up Belle Pass, along the eastern shoreline. Both Belle Pass pump-out areas would require dredging using a barge-mounted bucket dredge or hydraulic cutterhead dredge to facilitate locating a booster pump/pump-out barge against the shoreline and moored alongside the hopper dredge or scow barges. A sediment pipeline would be laid from the pump-out areas along the water bottom of the Pass, parallel to the shoreline, maintaining a buffer distance from navigational channel limits, and extending to the fill template near the northern terminus on the eastern jetty.

The **Pass Fourchon Pump-Out Area** is located along the south shoreline of Pass Fourchon, near its junction with Belle Pass (Figure 1-7). This pump-out area would also require dredging as detailed above to avoid interference with vessel traffic. The sediment pipeline would be placed in Pass Fourchon, along the south shoreline, extending eastward across Pass Fourchon to the east shoreline at the BP Canal, and crossing the Chevron facility access road onto the headland. The sediment pipeline would be laid and secured on the channel floor in such a fashion as to ensure adequate clearance for vessel navigation to the Chevron storage/distribution facility. A vehicular access ramp would be constructed across the sediment pipeline where the pipeline crosses the access road to the Chevron facility. This corridor method was used during previous Pass Fourchon maintenance dredging events.

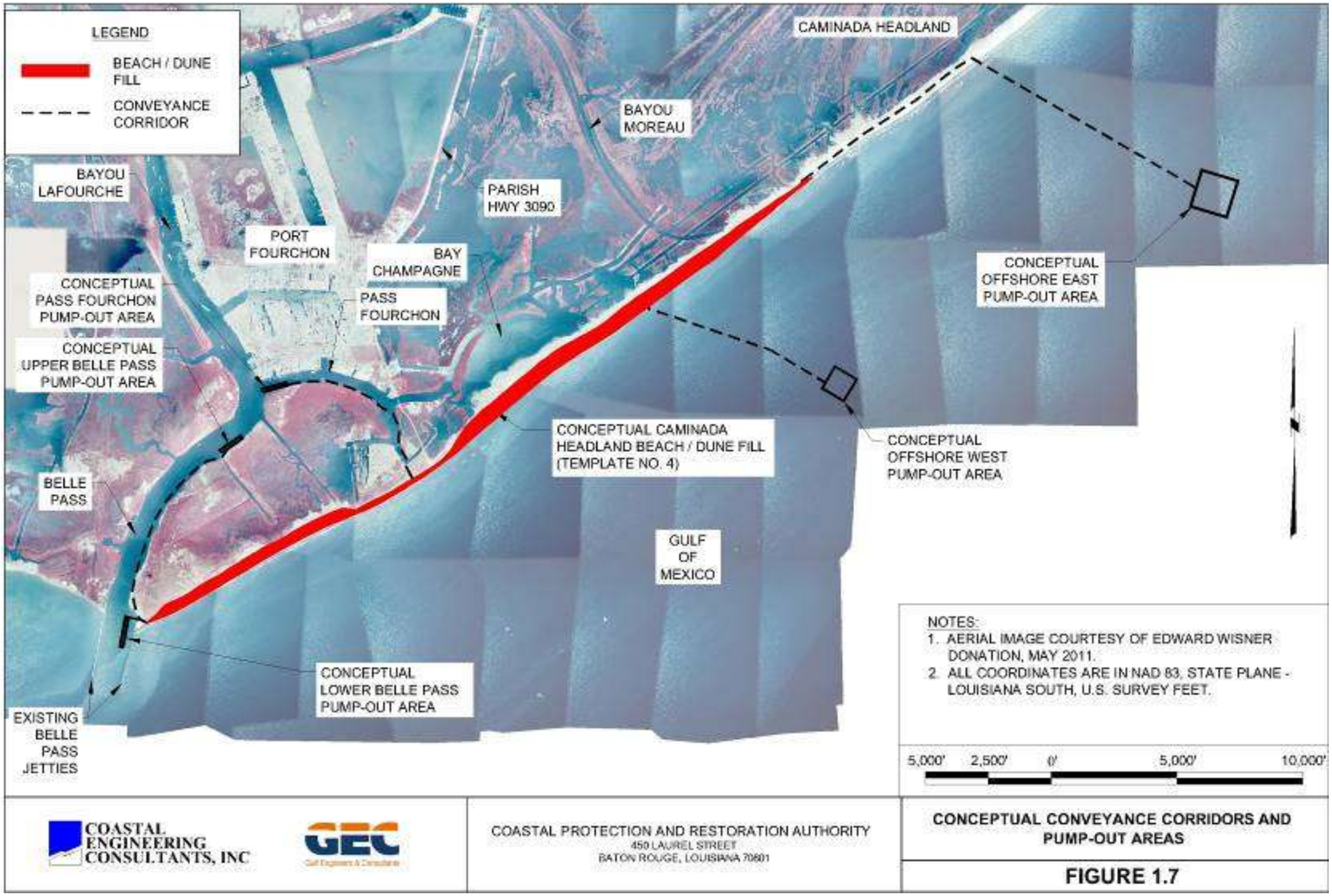


Figure 1-7. Conceptual Conveyance Corridors and Pump-out Areas

The **Offshore East Pump-Out Area** is located approximately 1.7 nm offshore in the Gulf approximately 7.8 nm east of Belle Pass (Figure 1-7). This location was chosen following a review of historical oil and gas databases, because it is free from conflicts with oil and gas pipelines. The **Offshore West Pump-Out Area** is located in the Gulf, approximately 1.6 nm offshore of the Caminada Headland and 5.3 nm east of Belle Pass (Figure 1-7). Based on a review of historical databases, this sediment pump-out area is generally free of conflicts with oil and gas pipelines; however, the sediment pipeline would cross one existing oil and gas pipeline within the conveyance corridor. Hopper dredges or scow barges at these sites would discharge directly to the fill template via a booster pump/pump-out barge or a floating or jack-up booster/pump-out barge. A sediment pipeline would be laid on the sea floor.

Sediment pipelines would be floated and/or placed on the channel bottom, laid on the beach, or existing access roads, therefore, conveyance corridors would not require dredging or excavation for sediment pipeline installation. To facilitate the location of a booster pump/pump-out barge, it will be necessary to dredge sediment from the Lower (157,500 cy) and Upper Belle Pass (11,200 cy) and Port Fourchon (31,900 cy) Pump-out Areas for these pump-out areas to be used. This sediment would be placed within the fill template below MLW on the Gulf side (Figure 1-8).

1.5.5 Temporary Upland Construction Access

Four access corridors would allow temporary upland construction access to the headland: three corridors near the terminus of Parish Highway 3090 and one corridor via Belle Pass near the Lower Belle Pass Pump-Out Area. The first corridor is direct access at the end of the highway onto the headland. Best management practices would be implemented to maintain hard shoreline protection structures. The second corridor provides access to the headland west of Parish Highway 3090 through use of the access road to the Chevron facility then via the existing sand road used by the landowner. The third corridor provides access to the headland east of Parish Highway 3090 through utilization of the existing sand road used by the landowner and oil spill cleanup crews. The fourth corridor from Belle Pass crosses the beach just north of the eastern jetty to the beach and dune fill template and would serve as an equipment staging and sediment offload site. The contractor would have the option to offload the excavated sediment from the Belle Pass or Pass Fourchon Pump-Out Areas at this location for transport and placement in the beach and dune fill template. All four access corridors have been located to avoid impacts to existing wetlands. The contractor would be confined to these corridors. Any corridor used for construction would be restored to pre-construction conditions for those areas not within the restoration fill template.

1.5.6 Shore Based Construction Equipment

Shore-based construction equipment would be used for placement of the shore segments of the sediment pipeline used for construction and fill template grading and shaping. Shore segments of the sediment pipeline could arrive to the restoration area by truck utilizing one of the upland access corridors or brought in by barge, offloaded, and staged in the Belle Pass staging area. The sediment pipeline would be transported along the headland by means of a frontend loader or skidder. Bulldozers and graders would be used to shape and grade the fill template. Personnel

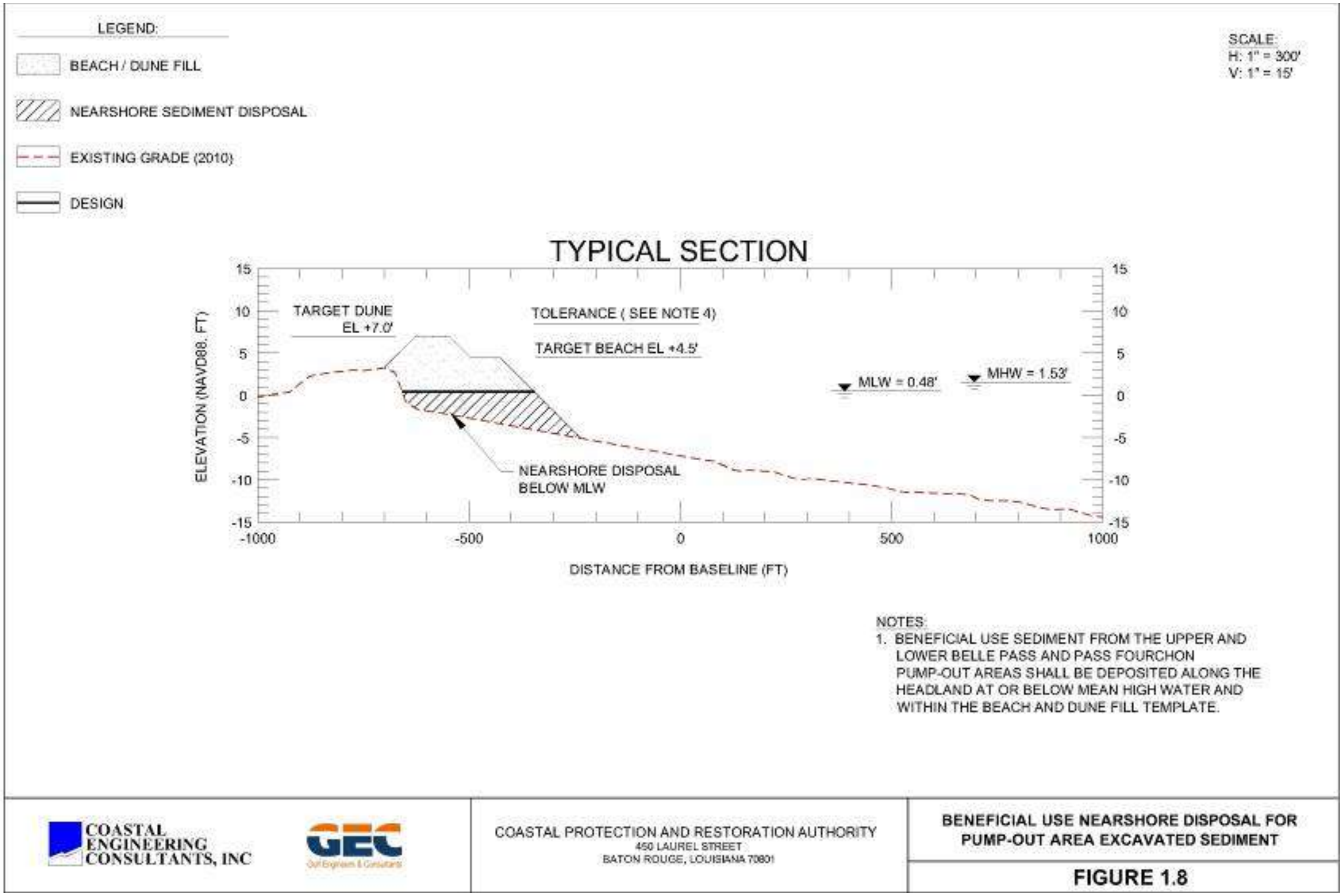


Figure 1-8. Beneficial Use – Nearshore Disposal for Pump-Out Area Excavated Sediment.

transport along the headland would be facilitated by the use of boats or small all-terrain vehicles. All construction equipment would be confined to the access corridors and fill template. If environmentally-sensitive habitats, such as bird loafing and roosting areas, are discovered adjacent to the fill template or access corridors, the construction contractor would consult with the appropriate wildlife agency including the USFWS and the Louisiana Department of Wildlife and Fisheries (LDWF). The contractor would then post the areas so construction equipment and personnel do not stray from the permitted fill template, conveyance corridors, or temporary construction contractor access and staging areas. The Resident Project Representative would be tasked with confirming that such signage is maintained by the construction contractor.

1.5.7 Sand Fencing

Depending on the fill template chosen during Final Design, approximately 17,600 (Fill Template 2), 21,400 (Fill Template 1), or 33,000 (Fill Templates 3 and 4) linear feet of sand fencing would be installed. The sand fences will reduce wind speed along the headland and accumulate sand transported by the wind on the downwind side of the fence. The sand fences will promote deposition of windblown sand, create or maintain dune features and protect vegetative plantings. The sand fencing would be constructed of wooden slats, appropriately spaced laterally, and secured with fencing wire to form a porous barrier four feet in height. The fencing would be installed in continuous 450-foot lengths, with 30 feet of overlap at each end. Overlapping sections would be parallel and separated by a three-foot gap for wildlife and pedestrian access.

1.5.8 Vegetative Plantings

Restoration of appropriate beach and dune vegetation is an important component of coastal ecosystem restoration. The project design includes revegetation of the entire length of the beach and dune restoration template at a planting density comparable to the generally sparse existing plant assemblages.

Dune Platform

The dune platform would be planted over 100 percent of the area on 8-foot centers after construction. These herbaceous plantings would include a mixture of some or all of the following species: bitter panicum (*Panicum amarum* var *amarum* 'Fourchon'), sea oats (*Uniola paniculata* 'Caminada'), marshhay cordgrass (*Spartina patens* 'Gulf Coast') and Gulf cordgrass (*Spartina spartinae*).

Woody Species

Woody species would be planted landward of the restored dune and supratidal back berm/swale area, at a planting density of 15 percent, to mimic the relatively sparse native vegetative assemblage. Woody species for the dune and supratidal swale areas would include matrimony vine (*Lycium barbarum*), wax myrtle (*Morella cerifera*), iva (*Iva imbricata*), eastern baccharis (*Baccharis halimifolia*), and hercules club (*Zanthoxylum clava-herculis*).

Aerial Seeding

Depending on when the project is completed, ground cover may be necessary before dune revegetation to stabilize the dune prior to damaging winter storms. Aerial seeding is the least-disruptive method. Appropriate grass species would be aerial seeded at a planting density of 15 percent, to mimic the relatively sparse native vegetative assemblage. These species would be selected to ensure compatibility with piping plover and other species of concern.

1.5.9 Construction Duration

Several pump-out areas were developed for the contractor to use to place sand on the headland. Sailing distances (times) from the South Pelto Borrow Area differ for each of these pump-out areas. Probable construction durations for each alternative fill template based on the probable pump-out area, or combinations thereof, are summarized in Table 1-1. The probable sailing times, dredge cycles per day, and sediment excavation times per day for each pump-out area, or combination thereof, are summarized in Table 1-2. Production rates were based on an average working time per day of 18 hours. Weather delays are factored into the probable construction duration. The anticipated construction start date is September 1, 2012.

Table 1-1. Probable Construction Durations

Sediment Pump-Out Area(s)	Probable Construction Duration (days)		
	Template 1	Template 2	Template 3
Lower Belle Pass	353	345	372
Upper Belle Pass	398	354	386
Pass Fourchon	384	373	407
Offshore West	375	365	399
Offshore East	374	364	397
Lower Belle Pass & Offshore West	388	398	417
Upper Belle Pass & Offshore West	412	369	392

Table 1-2. Cycle Times

Sediment Pump-Out Area(s)	Probable Sediment Excavation Time / Day (hrs.)	Probable Sailing Time / Day (hrs.)	Probable Pump-Out Time / Day (hrs.)	Probable Dredge Cycles / Day
Lower Belle Pass	1.1	13.4	3.4	2.6
Upper Belle Pass	1.0	13.9	2.8	2.2
Pass Fourchon	0.9	14.2	2.7	2.1
Offshore West	0.9	14.2	2.7	2.1
Offshore East	0.9	14.1	2.7	2.1
Lower Belle Pass & Offshore West	1.1 – 0.9*	13.4 – 14.2*	3.4 – 2.7*	2.6 – 2.1*
Lower Belle Pass & Offshore East	1.1 – 0.9*	13.4 – 14.1*	3.4 – 2.7*	2.6 – 2.1*
Upper Belle Pass & Offshore West	1.0 – 0.9*	13.9 – 14.2*	2.8 – 2.7*	2.2 – 2.1*

* The first number represents the first pump-out area listed and the second number represents the second pump-out listed. Pump-out areas would be used sequentially (not concurrently) as fill placement progresses along the headland.

1.6 RELATED NEPA AND OTHER ENVIRONMENTAL DOCUMENTS

The *Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline Restoration (BBBS) Final Integrated Construction Report and Final Environmental Impact Statement (FEIS)* (USACE 2012a) assessed the impacts of restoring the Caminada Headland and Shell Island. Associated with the FEIS is the *Biological Assessment: Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline Restoration Feasibility Study Caminada Headland and Shell Island Restoration* (USACE 2009), the Supplemental Biological Assessment (USACE 2010), and the *Louisiana Coastal Area Barataria Basin Barrier Shoreline Restoration Project, Jefferson, Lafourche, and Plaquemines Parishes, Louisiana Biological Opinion 04EL1000-20120F-0594* (USFWS 2011a).

The *Final Louisiana Coastal Area (LCA), Louisiana Ecosystem Restoration Study Programmatic Environmental Impact Statement (PEIS)* and the *Final Louisiana Coastal Area (LCA), Louisiana - Ecosystem Restoration Study* assessed the impacts of restoring the Caminada Headland and Shell Island Reaches (USACE 2004a). Associated with the PEIS is the *Louisiana Coastal Area (LCA) Ecosystem Restoration Study Programmatic Biological Assessment* (USACE 2004b).

The *CIAP Programmatic Environmental Assessment* (DOI-MMS 2007) establishes procedures and guidelines for States and coastal political subdivisions to follow when applying for CIAP funds.

Several documents assessed the impacts of dredging Ship Shoal for sand, including the *Environmental Assessment for Issuance of Non-Competitive Leases for the Use of Outer*

Continental Shelf Sand Resources from Ship Shoal, Offshore Central Louisiana for Coastal and Barrier Island Nourishment and Hurricane Levee Construction (Ship Shoal Multi-Project EA) (DOI-MMS 2004). The Ship Shoal Multi-Project EA tiered from the *Final Environmental Impact Statement for Proposed Central Gulf of Mexico OCS Oil and Gas Lease Sales 185, 190, 194, 198, and 201, and Proposed Western Gulf of Mexico OCS Oil and Gas Lease Sales 187, 192, 196, and 200* (CPA/WPA Multisale FEIS) (DOI-MMS 2002). The *Multi-Project Biological Assessment, Ship Shoal, Offshore Louisiana* (DOI-MMS 2004) and the *Endangered Species Act – Section 7 Consultation Biological Opinion for Hopper and Hydraulic Cutterhead Dredging Associated with Sand Mining for Coastal Restoration Projects Along the Coast of Louisiana Using Sand from Ship Shoal in the Gulf of Mexico Central Planning Area, South Pelto Blocks 12, 13, and 19, and Ship Shoal Block 88* (NMFS 2004).

1.7 CORRESPONDENCE AND OTHER PROJECT DOCUMENTS

Federal and State Agency correspondence and copies of permits and approvals associated with the USACE and LDNR permit actions for this project are presented in Appendix A. Project reports are presented in Appendix B.

2.0 ALTERNATIVES

This section describes the four fill template alternatives and the No-action Alternative. Based on the information and analysis presented in Section 3.0 (Affected Environment) and Section 4.0 (Environmental Effects) this section presents the beneficial and adverse environmental effects of all alternatives in comparative form, providing a clear basis for choice among the options for the decision maker and the public. This section also describes prior sand source investigations.

2.1 BORROW AREA PRIOR INVESTIGATIONS

A sand source search by the Louisiana Geological Survey in the early 1980's (Suter *et al.* 1991) identified numerous sand body *targets* in Louisiana and adjacent Federal waters. Ebb-tidal deltas, distributary mouth bars, and channel fill (undifferentiated fluvial or tidal inlet channels) associated with geologic depositional systems in the Barataria area were examined by Kindinger *et al.* (2002). However, many fluvial channels previously reported as sand-filled were found to be mud-filled, few fluvial subsystems in this region had abundant sand resources, and at least 90 percent of these sand resources required overburden sediment removal (Kindinger *et al.* 2002).

Tiger and Trinity Shoals, St. Bernard Shoal, and Ship Shoal contain large volumes of sand without muddy overburden (Khalil and Finkl 2009). Ship Shoal, the largest of these shoals, is located in Federal waters to the south, off Caillou and Terrebonne Bays. Kindinger *et al*. (2001) recommended using Ship Shoal. Khalil *et al* (2007) estimated that the total sand-dredgeable area of Ship Shoal may be less than 10 percent of what had been previously estimated, and is restricted to Ship Shoal Blocks 88 and 89, South Pelto Blocks 12 and 13, and western Ship Shoal Blocks 84, 85, 98, and 99.

The LCA Study (USACE 2004) proposed to create dune and beach along 13 miles of shore on the Caminada Headland from material dredged from Ship Shoal. The BBBS Study (USACE 2004b) designated the South Pelto blocks as the sand source for the BBBS. The South Pelto sand body was also identified as one of the selected borrow areas remaining after a detailed screening process was completed to identify potential project borrow areas for the restoration of the Terrebonne Basin Barrier Islands by the Terrebonne Basin Barrier Shoreline Restoration Project (USACE 2010).

The designated borrow area for this project is located in two lease blocks, designated as South Pelto Blocks 13 and 14, at the far eastern end of Ship Shoal.

2.2 FILL TEMPLATES

Four fill templates (Figures 1-3 through 1-6) are proposed for the project. These fill templates were described in detail in Section 1.5; differences between these templates are summarized in Table 2-1.

Table 2-1. Summary of Differences between the Fill Templates

Fill Template	Fill (CY)	Fill Template Tapers (ft)		Dune Target Elevation (ft)	Dune Typical Width (ft)	Shoreline Length (ft)	Habitat Created
		West	East	NAVD88			
1	2,011,400	1,000	3,000	+7.0	290	25,000	237 acres beach and dune
2	2,045,700	2,000	5,000	+7.0	290	18,500	201 acres beach and dune
3	2,033,500	2,000	5,000	No dune component		31,000	280 acres beach only
4	3,013,700	1,000	5,000	+7.0	350	31,000	328 acres beach and dune

2.3 NO-ACTION ALTERNATIVE

Evaluation of the No-Action Alternative is a requirement of NEPA regulations (40 CFR Part 1500 *et seq*.). The No-Action Alternative assumes the project will not be constructed. The high erosion rate at the Caminada Headland would continue. As this shoreline recedes, coastal infrastructure, such as Port Fourchon, roads, pipelines, etc. would be more susceptible to damage from storms.

2.4 COMPARISON OF ALTERNATIVES

The major features and consequences of the proposed project (Fill Templates 1-4) and the No-Action Alternative are described in Table 2-2. Section 4.0 (Environmental Effects) includes a more detailed discussion of the impacts of the alternatives. The Fill Template 1-4 Alternatives would have similar effects on resources.

Table 2-2. Comparison of the Alternatives

Environmental Resource	Fill Template 1-4 Alternatives	No-Action Alternative
PHYSICAL RESOURCES		
- Oceanographic and Coastal Processes	Placement of borrow area sediment would unavoidably bury existing dune, supratidal, Gulf intertidal and Gulf subtidal habitats, thus altering the topography and bathymetry within the Fill Template. Unlikely to affect wave conditions at the shoreline. The restoration would decrease wave energy in the back barrier. Minimal net longshore sediment transport impacts are expected on small-scale mining at the Borrow Area (Stone 2004, 2009*). Project should indirectly benefit downdrift flanking barrier islands due to introduction of new sand to the system following sediment transport along the headland due to equilibrium and spreading processes associated with beach fill. Excavation of the borrow area will directly affect the existing water bottoms by altering the bathymetry within the dredge footprint and side slopes of the dredge cut. Physical removal of sediments at the borrow area will alter the bathymetry of the seabed, creating pits. Bathymetry changes can locally reduce currents, lower dissolved oxygen levels, and increase the accumulation of fine sediments. These effects would be minor and short-term.	Existing conditions of coastal erosion and land loss would continue. No effect on bathymetry would occur. Continued erosion of the headland may affect wave conditions at the shoreline. Continued erosion of the headland may affect sediment transport at the shoreline.

- Geology	Project would restore barrier shorelines, headlands, and islands. Restoration of the headland via placement of over 2 mcy of beach and dune compatible sand will improve the ability of the headland to resist shoreline erosion, wave overtopping, and breach formation. Installation of sand fencing and dune vegetation will provide a mechanism for future aeolian sand transport and dune enhancement, which furthers shoreline protection.	Continued erosion of the headland would diminish barrier shorelines, headlands, and islands.
- Air Quality	Small, localized, temporary increases in concentrations of air pollutant emissions. The short-term impact from emissions by the dredge or the tugs would not affect the overall air quality of the area.	No impact.
- Water Quality	Temporary reduction of water quality due to turbidity from the dredging and filling operation. These impacts would be minor and short-term.	No impact.
- Noise	A temporary increase in the noise level during construction near the construction operation would occur. These effects would be localized, short-term, and minor.	No impact.

BIO-PHYSICAL RESOURCES		
- Vegetation	The direct effects of implementing the project would create 201 to 328 acres of beach and dune habitat, providing for essential vegetated habitats used by fish and wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; and increased vegetation growth and productivity.	Continued erosion of the headland would lead to the loss of the existing vegetative communities.
- Benthic	Temporary impacts to infaunal benthic communities on the headland due to entrainment, increased turbidity and sedimentation; and changes to the soft bottom bathymetry. Effects would be short-term, recovery in six months to two years. For Ship Shoal, the primary impact-producing factor affecting nearshore benthic resources would be from mechanical disturbance of the sea bottom and benthic faunas in the proposed borrow area on Ship Shoal. Direct impacts would be mid-term, as it would take two to three years for the dredged area to recover to existing conditions. Physical disturbances at Ship Shoal include: (1) disruption of the sea bottom by removing sand, (2) suspension of fine-grained sediments at the bottom and in a surface dredge plume, and (3) dispersion and persistence of turbidity.	Continued erosion of the headland could affect beach/shoreline-related benthic infaunal communities. No impacts on Ship Shoal would occur.
- Plankton	Minor, short-term, and localized adverse impacts due to construction activities.	No impact.

- Fish and Macroinvertebrates	Impacts could include entrainment of organisms during dredge operation; vessel strike; behavioral alterations due to sound, light, and structure; increased turbidity and sedimentation; changes to soft bottom bathymetry in the borrow area during dredging; and temporary loss of prey items and foraging habitat. Effects would be short-term and localized; similar undisturbed habitat is adjacent to the borrow area.	Continued erosion of the headland could impact habitat of fish and invertebrates.
- Invasive Species	No impact.	No impact.
- Amphibians, Reptiles, Terrestrial Mammals, and Invasive Wildlife Species	These populations are naturally low on the headland, therefore there would be no direct impact; reduced erosion would increase available habitat.	Continued erosion of the headland could impact habitat of amphibians, reptiles, terrestrial mammals, and invasive wildlife species.
- Marine Mammals	Although unlikely, possible impacts could include entrainment of organisms during dredge operation; vessel strike; behavioral alterations due to sound, light, and structure; increased turbidity and sedimentation; and changes to soft bottom bathymetry in the borrow area during dredging.	No impact.

- Avian Communities	No direct impacts. Minor, short-term, and indirect impacts would include air emissions; water quality degradation from a dredge plume at the dredging site and slurry discharge at the beach restoration site; dredge, service vessel, or helicopter noise; light attraction; and discarded trash and debris from dredge or service vessels.	Continued erosion of the headland would lead to continued avian habitat loss.
CRITICAL BIOLOGICAL RESOURCES		
- Threatened and Endangered Species	Impacts to threatened and endangered species due to dredging could include potential lethal and sub-lethal effects to sea turtles, marine mammals and foraging piping plover. Temporary loss of foraging habitat for piping plover. Gulf sturgeon and whales are unlikely to be in the project area.	Continued erosion of the headland could impact threatened and endangered species, including sea turtles and piping plover. Gulf sturgeon and whales are unlikely to be in the project area.
- Essential Fish Habitat (EFH)	For the headland, the project would not likely adversely affect EFH. For Ship Shoal, the impacts could include changes to soft bottom bathymetry in the borrow area due to dredging and temporary loss of prey items and foraging habitat. Effects would be short-term and localized; similar undisturbed habitat is adjacent to the headland and borrow area.	Continued erosion of the headland could impact EFH.

CULTURAL	Identified targets are not located within the dredge template. Archaeological sites on the headland would be avoided and the fill would protect these sites from further erosion.	Archaeological sites on the headland would be subject to erosion.
SOCIOECONOMIC AND HUMAN RESOURCES		
- Population and Housing	The proposed project would create temporary jobs and the need for short-term housing in adjacent areas. However, fluctuations in jobs and housing are common in this area due to the oil and gas industry.	No impacts.
- Employment and Income	The proposed project would create temporary jobs; the overall effect would be minor and short-term.	No impacts.
- Environmental Justice	No disproportionate impacts on ethnic or racial minorities or poor people would result from the project.	No impacts.
- Commercial Fisheries	The proposed project would not be expected to have adverse effects on commercial fisheries. Fishing areas would temporarily not be available and fishing gear could be damaged. However, the project would preserve fishery habitat that support the commercial fisheries.	Continued erosion and habitat loss could lead to reduced commercial fisheries populations.
- Infrastructure	The proposed project would be expected to have negligible impacts on the region's existing onshore and offshore infrastructure, land-use patterns, navigation, and Port usage. Restoration of the headland could provide some storm damage reduction for the infrastructure, including roads, utilities, and Port Fourchon	No impacts.

SOCIOECONOMIC AND HUMAN RESOURCES		
- Population and Housing	The proposed project would create temporary jobs and the need for short-term housing in adjacent areas. However, fluctuations in jobs and housing are common in this area due to the oil and gas industry.	No impacts.
- Employment and Income	The proposed project would create temporary jobs; the overall effect would be minor and short-term.	No impacts.
- Environmental Justice	No disproportionate impacts on ethnic or racial minorities or poor people would result from the project.	No impacts.
- Commercial Fisheries	The proposed project would not be expected to have adverse effects on commercial fisheries. Fishing areas would temporarily not be available and fishing gear could be damaged. However, the project would preserve fishery habitat that support the commercial fisheries.	Continued erosion and habitat loss could lead to reduced commercial fisheries populations.
- Infrastructure	The proposed project would be expected to have negligible impacts on the region's existing onshore and offshore infrastructure, land-use patterns, navigation, and Port usage. Restoration of the headland could provide some storm damage reduction for the infrastructure, including roads, utilities, and Port Fourchon	No impacts.

- Waterborne Commerce	The Ports of Terrebonne and Fourchon can provide the relatively low level of support services necessary for the project. No onshore expansion or construction would be expected to result from the proposed project. No significant changes would be expected for land-use patterns, navigation, and Port usage.	No impacts.
- Oil, Gas, and Minerals	Implementing these alternatives would have no direct impact on protecting oil, gas, and mineral reserves. The project would cover any existing pipelines in the project area, providing additional protection against storm surges. Implementing these alternatives would protect oil and gas reserves at Port Fourchon by reducing the impact of coastal deterioration with an additional layer of soil protection, thereby increasing protection from future storm surges.	No direct impacts. Indirect impacts of not implementing the barrier restoration would result in the continued deterioration of existing conditions for oil and gas infrastructure.
- Aesthetic	Implementation of the project would greatly increase the visual interests in the area by improving beach and dunes, mixed with some vegetation. Preserved vegetation and marsh could enhance the intrinsic scenic quality of the drive along Louisiana Highway 1. During construction, equipment used for dredging and filling would be visible, resulting in a temporary reduction in the aesthetic value offshore.	Continued erosion of the headland would negatively impact aesthetic resources.

- Recreational	Preservation of the headland would provide recreational opportunities for many outdoor activities. In the short-term, the impact-producing factors associated with transport, and beach nourishment that could have minor and short-term effects on recreational resources at the Caminada Headland and pump-out areas. These include: (1) increased turbidity and water quality degradation from resuspended organic matter in the dredge plume, (2) material spills from vessels, (3) visual impacts from shore, and (4) temporary unavailability of preferred recreational fishing space due to presence of the dredge vessel or dredge plume.	Continued erosion of the headland could impact recreational resources with loss of shoreline, wetlands, and fishery habitat loss.
- Navigation and Public Safety	During dredging operations, it may be necessary to restrict watercraft access to the construction area in the interest of public safety. These restrictions would be of short duration and are expected to be minor to boat operators. During dredging and placement, the use of the area immediately surrounding the borrow area and the headland in the vicinity of the shore restoration would be temporarily restricted for public safety.	Continued erosion of the headland could impact navigation.

*Modeling by Stone (2004) concluded that although Ship Shoal has a measurable effect on the waves that cross the shoal, removal of part of the shoal will not have a negative influence on the wave climate at the adjacent shorelines. Stone *et al*. (2009) concluded that targeted small-scale mining would have minimal physical impacts; these impacts are expected to be mitigated through natural processes within several years after the termination of sand extraction.

3.0 AFFECTED ENVIRONMENT

The Affected Environment section describes the existing environmental resources of the areas that would be affected if any of the alternatives were implemented. This section describes only those environmental resources that are relevant to the decision making process. This section, in conjunction with the description of the No-Action Alternative, forms the baseline conditions for determining the environmental impacts of the reasonable alternatives.

A resource is considered important if it is recognized by statutory authorities including laws, regulations, Executive Orders (EO), policies, rules, or guidance; if it is recognized as important by some segment of the public; or if it is determined to be important based on technical or scientific criteria. The final PEIS for the LCA Study (USACE 2004a), the Ship Shoal Multi-Project EA (DOI-MMS 2004), and the CPA/WPA Multisale FEIS (DOI-MMS 2002) presented detailed historic and existing information relevant to this project and that information is incorporated by reference.

Recent History of the Caminada Headland

Historically, Bayou Lafourche, a 93-mile long major distributary of the Mississippi River, carried about 12 percent (over 40,000 cfs) of the Mississippi River discharge until it was closed by a levee at Donaldsonville in 1904 as a flood protection measure (Reed 1995). There was no input of Mississippi River water to Bayou Lafourche until 1955 when pumps were installed at Donaldsonville to maintain a flow of 260 cubic feet per second (cfs) (7.36 cubic meters per second). Bayou Lafourche is currently being dredged and cleared to increase the flow and improve water quality for cities along the bayou. The Gulf Intracoastal Waterway crosses Bayou Lafourche at Larose, Louisiana, about 40 miles from the Gulf. Bayou Lafourche splits into two passes near the Gulf of Mexico, Pass Fourchon, to the east, and Belle Pass, to the west. The Pass Fourchon entrance from the Gulf of Mexico was closed in 1985.

Two steel sheetpile jetties with riprap at the ends were constructed at Belle Pass in 1939. Due to storm damage, these jetties were reinforced and extended in subsequent years. The River and Harbor Act of 1960 provided for the restoration and extension of the jetties and dredging of the pass to a channel depth of 12 ft (3.7 m). However, a deeper channel was needed to satisfy the local interests. The Greater Lafourche Port Commission had the channel dredged to 20 ft (6.1 m) deep and 300 ft (91.4 m) wide; dredging was completed in 1968. The 300-foot-wide Belle Pass channel is currently maintained at a 27 foot depth. Inland of the jetties, the Bayou Lafourche channel is 24 feet deep. The beaches west of Belle Pass have experienced extreme shoreline erosion due to the reduction in sediment from the Caminada Headland. The sediment supply from the headland stopped when the jetties were extended. The jetties currently extend 2,600 feet into the Gulf.

Breaches have temporarily segmented the Caminada Headland following storms since at least the early 1800s. These breaches often occurred where abandoned distributaries of the Lafourche delta complex once intersected the Gulf shoreline. Prior to 1934, the headland morphology changed little except when Belle Pass, Pass Fourchon, and Bayou Moreau occasionally segmented the central Headland. By 1956, the portion of the headland between Lake (Bay) Champagne and the Gulf was breached as the shoreline retreated. The pattern of Gulf shoreline breaching at Bay Champagne after minor tropical and extra tropical storms continues today as the shoreline retreats landward and the bay recedes.

From 1956 to 1978, Bayou Lafourche and Pass Fourchon widened while the downdrift offset (downdrift side of the inlet is offset seaward) became more acute and Bay Marchand was significantly reduced in size. By 1988, continued shoreline retreat removed large quantities of sediment from central portions of the headland. Some of the sediment was carried toward Grand Isle but some is retained in the Caminada Pass ebb-tidal delta and the Caminada Pass spit that has accreted into Caminada Bay along Cheniere Caminada. Some sediment was transported west; however, the Belle Pass jetties prevented the sediment from reaching the Timbalier Islands, contributing to the erosion of the portion of the Caminada Headland west of Belle Pass. Bay Champagne continued to diminish and Bay Marchand nearly disappeared. Bayou Moreau breached the eroding shoreline at several locations; and numerous pipeline canals were constructed that further divided the headland.

Completed and Ongoing Restoration and Protection Projects

In 1985, the state, Port Fourchon, and private interests combined to protect the headland shoreline. Protection efforts included closing old Pass Fourchon, relocating a beach road, and restoring the dunes. Additional state emergency work involved hydraulic dredging to pump approximately 700,000 cy of beach fill material into spoil-retention areas to restore the beach and dunes after damage from the 1985 hurricane season. The Greater Lafourche Port Commission revegetated the area for continued stabilization.

In 1986 after Hurricane Juan, a section of the Caminada Headland seaward of Port Fourchon was armored with a cement-filled geotextile tube *(boudin bag)* revetment (geotubes). Sand was added in front of the geotubes and dredged material was backfilled landward of the revetment. Ergomat (interconnected concrete blocks) was laid on part of the beach in front of the geotubes. The revetment interrupts natural coastal processes including cross-shore sediment transport by washover and backwash events, as well as Aeolian processes. In 1992, Hurricane Andrew caused considerable damage to the revetment, displacing the bags as much as 130 ft (39.6 m) landward.

Fourchon Beach *BeachCone* Demonstration Project was installed in 1992 offshore of Old Pass Fourchon. BeachCones are glass-fiber reinforced concrete, conical rings connected by an interstitial wave block. BeachCones have an outside diameter of 3 ft and weigh 70 lbs and are designed to disperse incoming wave energy and capture suspended sand. Six BeachCone units were installed. Considerable sand accreted in the BeachCone area over a seven-month test period. Most sand accreted during the first three months and the cones were completely covered during a February 1993 survey (Law 1995).

In 1995, after Hurricane Andrew damaged the beach, 12 barges sunk at 300-ft intervals were filled with stones to create detached breakwaters along the beachfront. Barges were located in 6 to 8 ft (1.8 to 2.4 m) depths off the western portion of the headland near the location of the Old Pass Fourchon entrance. After Hurricane Georges damaged the barges in 1998, seven of the barges were topped with double rows of interlocking concrete units (A-Jacks). A total of 575 10-ft A-Jacks (about 1,400 ft total) were used for the project.

The Fourchon Dune and Beach Community Restoration (Project #7003) was completed in 2008. Volunteers installed sand fencing and barley hay bales and planted approximately 456 m of dunes at Fourchon Beach in the washover area in front of Bay Champagne to restore dune habitat (Gulf of Mexico Foundation 2008). In September 2011, volunteers planted over 2,500 mangrove trees near Port Fourchon to help restore five acres of marsh (CRCL 2011a).

In 2006, sand fences were installed on Elmer's Island to build dunes and 306 pots of marshhay cordgrass (*Spartina patens*) plants and 1,014 pots of bitter panicum (*Panicum amarum*) plants were planted around the fence to reduce erosion (Green 2006). In 2009, LDWF planted cordgrass and installed additional fencing (NOAA 2009). In 2010, volunteers installed approximately 1,200 feet of sand fence and planted 12,000 smooth cordgrass *(S. alterniflora)* plants in two efforts (Dequine 2010). In 2010, approximately 3000 marshhay cordgrass, 1000 bitter panicum, and 600 Gulf bluestem (*Schizachyrium maritimum*) were planted alongside pre-existing sand fences and along the pre-established shoreline sand dunes (USDA-NRCS 2010). In 2011, volunteers installed 2,000 feet of sand fence and planted 6,000 plugs of dune grass (CRCL 2011b).

The Bayou Lafourche Federal Navigation Channel is dredged roughly every two years. Dredged material is generally placed on the shoreline east and west of the jetties or in the CWPPRA West Belle Pass marsh restoration placement area. The channel was most recently dredged in 2001 (marsh placement); 2003, 2005-2006, 2009 (beach placement); and 2007, 2012 (beach and marsh placement) (USACE 2012a).

The West Belle Pass Headland Restoration (TE-23) CWPPRA project on the headland west of Belle Pass was completed in 1998. Approximately 1.5 mcy of material dredged from Bayou Lafourche was used to build 184 acres of marsh on the west side of Belle Pass. Another 240,000 cy of material were placed on the shore for beach renourishment. A water control structure was placed in the Evans Canal, and plugs were placed in other canals to minimize saltwater intrusion and reduce the encroachment of Timbalier Bay into the marshes on the west side of Bayou Lafourche and Belle Pass. Almost 17,000 ft of rip-rap were placed on the west shore of Belle Pass and Bayou Lafourche to protect the shoreline from persistent wave-induced erosion (Louisiana Coastal Wetlands and Restoration Task Force 2012).

The West Belle Pass Headland Restoration (TE-52) CWPPRA project currently under construction will use approximately 2 mcy of material dredged from Bayou Lafourche to rebuild about 9,300 feet of beach and dune on the Caminada Headland west of Belle Pass. Nearly 1 mcy of additional dredged material will be used to rebuild 150 acres of marsh habitat. Native vegetation will be planted after construction to help stabilize the rebuilt marsh and dune habitat (Louisiana Coastal Wetlands and Restoration Task Force 2012). Construction is expected to be completed in September 2012 (CPRA 2012).

The Maritime Forest Ridge and Marsh Restoration Project is designed to restore the Fourchon Maritime Forest Ridge north of Port Fourchon. Dredged material from the port's expansion is being used to create over 2.25 miles of ridge and marsh habitat. The project was divided into three phases. Phase I (2002-2004) and II (2004-2005) created over 60 acres of salt marsh, and another 60 plus acres of a 400-foot wide ridge/salt marsh corridor with maximum elevations of +8 feet NAVD 88 for the ridge and +1.6 feet NAVD 88 for the marsh platform (Greater Lafourche Port Commission 2006; BTNEP 2006). The 2005 hurricanes and subsequent drought resulted in high soil salinities and prevented many initial plantings from becoming established. Subsequent plantings have been more successful and efforts are continuing to increase vegetative cover (BTNEP 2006). Phase III will begin within the next few years (Greater Lafourche Port Commission 2006).

Several protective measures were undertaken at Fourchon Beach with the goal of minimizing the amount of oil that reached the marsh and back bays. One of the protective measures included the installation of sand bags, rock, and sheet pile bulkheads to close breaches along the beach. The breach closure structures were installed under LDNR Emergency Use Authorization (EUA) 10-036-1, which includes a condition requiring their removal by no later than July 1, 2012. The follow-up Coastal Use Permit, P20100670, is currently in the application process and will include the same removal date condition.

A breach formed in Elmer's Island in early 2010 approximately one mile from the Caminada Pass Bridge. The National Guard placed approximately 5,666 tons of rip-rap, 4,000 linear feet of Geo Tek fabric, and 4,000 cy of sand on top of previously placed 200-300 sand and concrete bags (8,000 lbs) to prevent oil from entering and affecting the interior marsh and bay (MVN-2010-1039-EFF, LDNR EUA 10-035, LDNR EUA 10-036) (USACE 2010).

3.1 PHYSICAL RESOURCES

3.1.1 Oceanographic and Coastal Processes

3.1.1.1 Meteorology

Wind fields related to tropical and extra-tropical storms have great effects on fluvial sediment dispersal and transport on the inner shelf off the Louisiana coast (Stone *et al*. 2009). Large volumes of riverine sediments are provided in the spring; this coincides with frontal passages, and this material is deposited farther south onto the inner shelf and shallow shoals (Stone *et al*. 2009). The prevailing westward dispersal pattern during the winter-spring season shifts to the southeast following strong post-frontal northwesterly winds, which in turn facilitates the generation of southeastward currents and further transports fluvially-derived fine sediments from the Atchafalaya River/Bay farther southeast. During tropical cyclones, sediment is transported by strong local sediment re-suspension and is redistributed on the Atchafalaya Shelf and adjacent shoals (Stone *et al*. 2009).

The average wind speed in coastal Louisiana is approximately 2.7 ft/s from the southeast (Stone 2000; DOI-MMS 2004). Hourly wind data from the National Oceanographic and Atmospheric

Administration (NOAA) station (GDIL1) on Grand Isle, Louisiana, at 29° 27' N latitude and 89° 96' W longitude were examined. Wind speed during the period of analysis averaged 4.8 m/s, with a mean direction toward the southwest (228°).

Extratropical storms (typically low-pressure systems in this area) occur roughly every five days and may be responsible for most of the observed variability in wind speed, a result consistent with other studies in the northern Gulf (Stone 2000; DOI-MMS 2004). Nine extratropical storms occurred during the 61-day period of the Stone (2000) study, a frequency of one every 6.8 days. Mean wind speed and direction were 8.1 m/s and 174° during storms, and 3.8 m/s and 293° during fair weather. During the period of analysis, storms were characterized by strong southward winds, whereas the mean wind direction during fair weather was westerly (Stone 2000; DOI-MMS 2004).

Hurricanes and tropical storms typically occur in the Caminada Headland area between June and November (USACE 2012). On average, since 1871, a tropical storm or hurricane impacts Louisiana every 1.2 years, and hurricanes make landfall about every 2.8 years (Stone *et al.* 1997; Roth 1998; USACE 2012). The hurricane storm surge, a dome of water near the center of the storm, is generally the major component of destruction to coastal areas. Storm surge flooding in Southeast Louisiana is greater than in surrounding areas because the Mississippi Delta is oriented perpendicular to the rest of the Gulf coast; this amplifies the effects of the storm surge (Roth 1998). Consequently, low-lying coastal wetlands, headlands, and barrier islands are eroded more quickly when a hurricane or storm crosses Louisiana (Guntenspergen 1998). Additional hazards from hurricanes include high winds, extreme rainfall, river flooding, salinity intrusion, sediment transport, tornadoes, levee collapse, and pollution of surge waters (Huh 2001; Pielke 1997; USACE 2012).

3.1.1.2 Freshwater Inflow and Salinity

Caminada Headland

The Caminada Headland is located at the mouth of Bayou Lafourche on the western edge of the Barataria Basin. Freshwater input is from Bayou Lafourche, the Davis Pond diversion, and direct rainfall. Besides Bayou Lafourche, circulation and flushing patterns in neighboring estuaries are driven by tides, rainfall, and winds (USACE 2002; 2011).

Long-term salinities in the Gulf of Mexico around adjacent Grand Terre Island follow annual river patterns and are approximately 28 parts per thousand (ppt) in the fall (Kohdrata 2004; Baumann 1987) when river flows are low and 16 (Baumann 1987) to 18 ppt (Kohdrata 2004) in the spring when river flows are high. Inland, the seasonal salinity pattern is bimodal with higher salinities during the spring and fall. Coastal salinities are inversely proportional to Mississippi River discharge (Barrett 1971). However, the River usually peaks in the spring when local rainfall is also frequently higher.

Ship Shoal

Bottom water salinities over Ship Shoal are generally greater than 30 ppt and no spatial patterns were evident across the shoal (Stone *et al.* 2009). During the summer, low-salinity waters from the Atchafalaya and Mississippi Rivers spread out over the denser salt water on the continental shelf to create a stratified water column (DOI-MMS 2004). The maximum discharge from the Atchafalaya River is approximately 600,000 cfs (Stone *et al*. 2009).

3.1.1.3 Tides and Currents

Caminada Headland

The nearest tide gauge (NOAA Tide Gauge 8761724) is located at Grand Isle, Louisiana, adjacent to the easternmost portion of the Caminada Headland (USACE 2012). Tides at Grand Isle are diurnal, with a mean tide range of approximately 1.1 feet (33.5 cm). Velocities of the offshore current (a prevailing nontidal current usually parallel to the shore outside the surf) average between 0.7 to 1.0 ft/s (0.2 to 0.3 m/s). Velocities of the littoral current (a current that travels along the coastline that is generated by waves intersecting the coastline at an oblique angle) average between 1.2 to 1.7 ft/s (0.4 to 0.5 m/s) (USACE 2002, 2012).

Ship Shoal

The Louisiana inner shelf is a low-energy environment where significant hydrodynamic activity is generated almost exclusively by local tropical and extra-tropical storms. Ship Shoal has an important effect on regional hydrodynamics and appears to be responsible for measurable wave energy attenuation (Stone 2000; DOI-MMS 2004). However, neither large-scale nor small-scale sand mining should result in abrupt changes in current patterns (Stone *et al*. 2009).

Significant wave height (zero-moment wave) observed during storm events was several times the mean fair weather heights and was clearly higher at a site on the windward side of Ship Shoal than a site on the leeward side. This has important implications for bottom boundary layer dynamics and sediment transport on the south-central Louisiana inner shelf. The area appears to be storm dominated; storm events significantly increase wave height and current velocities. Dramatic increases in mean and wave-driven flow tended to accompany storms (Stone 2000; DOI-MMS 2004). Kobashi and Stone (2009) demonstrated spatially varying hydrodynamics over the shoal by numerical modeling of spectral waves and three-dimensional currents; model results were associated with hydrodynamic forcing and water depth. The magnitude of these hydrodynamic parameters has an east-west trend following changes in bathymetry. Sediment re-suspension intensity (RI) was highest on the western flank, decreased gradually toward the east, and lowest on the eastern flank during moderate and weak storms. The magnitude of the RI was conspicuous difference between the western and eastern flanks. Without the shoal, the RI was much lower than the RI with the shoal for moderate and weak storms; however, both RIs had similar values for severe and strong storms. The results were consistent with in-situ data, leading to the conclusion that the deeper eastern shoal favored fluid mud accumulation during winter storms.

3.1.1.4 Sediment Transport

Caminada Headland

In general, there has been a net export of material from the barrier headland shoreline in and around the Caminada Headland. All of the barrier island and headland segments in the area are retreating. Erosion, reworking, and redistribution of the coarser deltaic material led to the development of the present-day barrier island and headland chain. Much of the erosion and transport of material occurs during storms (frontal passages and tropical storms/hurricanes). Longshore transport results in island migration and spit development on the ends of island and headland segments. Increasing bay area has increased the volume of water that passes though tidal inlets during each tidal cycle. This process has resulted in increased cross-sectional areas of tidal inlets and the development of new tidal inlets along barrier shorelines. Ebb-tidal deltas associated with the tidal inlets capture much of the alongshore sediment, and as the flow increases at inlets, the efficiency of ebb-tidal delta sediment trapping increases.

Sediment transport along the Caminada Headland is presented in Figure 3-1. The node of divergence of sediment transport is located near Bayou Moreau, approximately 3½ miles east of Belle Pass (Ritchie *et al.* 1995). The cumulative volume of sediment change along the Caminada Headland between 2000 and 2005 was approximately 615,000 cy per year (USACE 2012). The overwash accumulation on the landward side of the dune for the same period was approximately 311,000 cy per year. The cumulative change includes the overwash accumulation. The total net Gulf shoreline erosion loss from the headland is approximately 926,000 cy per year (USACE 2012). The sediment budget is presented in Figure 3-2.

Surveys in 2000 and 2005 were compared to calculate the volume of shoreline changes on the Caminada Headland. The total cumulative shoreline volume change was estimated at -3,072,630 cubic feet, with a volume change rate of -614,526 cubic feet/year. The overwash total volume change was estimated at 1,554,576 cubic feet with a volume change rate of 310,915 cubic feet/year (USACE 2012).

Shoreline Change Rates

Shoreline change rates for the project area are well documented. However, different methods were used in these studies. Williams *et al*. (1992) based shoreline change data on shore-normal survey transects. Penland *et al*. (2005) used computerized cartographic analyses on digitized historical cartographic and aerial GIS imagery. Martinez *et al*. (2009) used the same data, but applied different analytic techniques to establish the position of the High Water Line (HWL), based on visible color and near-infrared spectral differentiation. Comparable rates were:

Caminada-Moreau Headland –

(1887-1988) Williams *et al*. (1992), -44.6 ft/yr
(1884-2002) [*Long-term shoreline change*] Penland *et al*. (2005), -41.4 ft/yr
(1885-2005) [*Historic change*] Martinez *et al*. (2009), -36.9 ft/yr

Fourchon Beach – (See note below)

(1855-2005) [*Historic change*] Martinez *et al*. (2009), -55.3 ft/yr

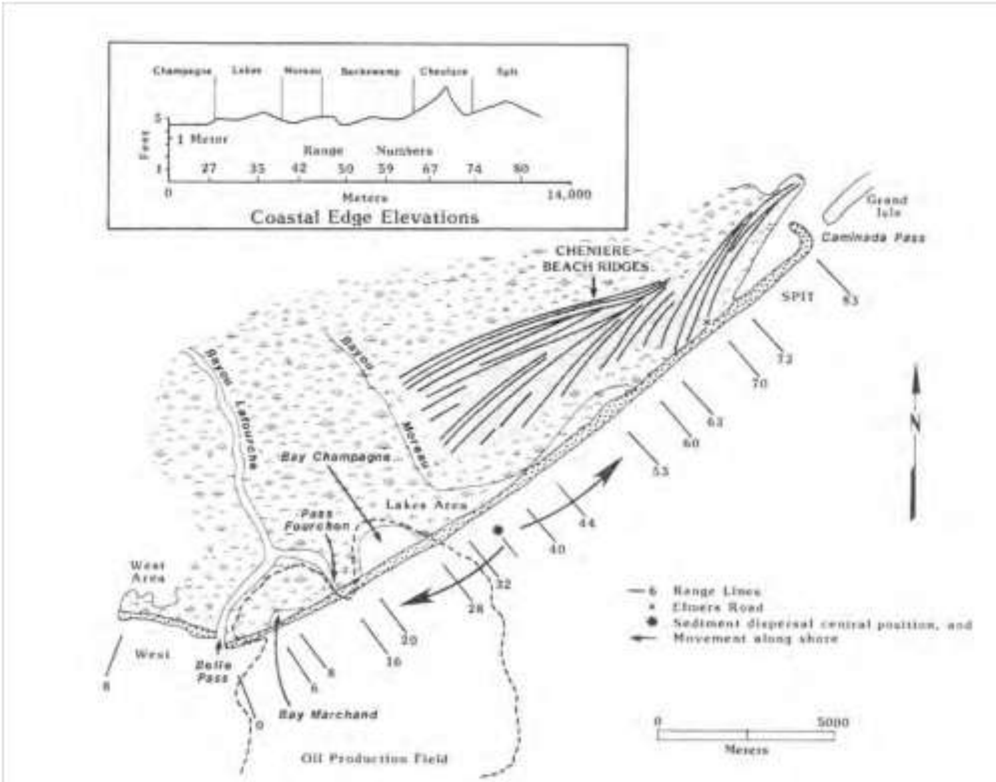


Figure 3-1. Sediment Dispersal along the Caminada Headland (from Ritchie *et al.* 1995; USACE 2012)

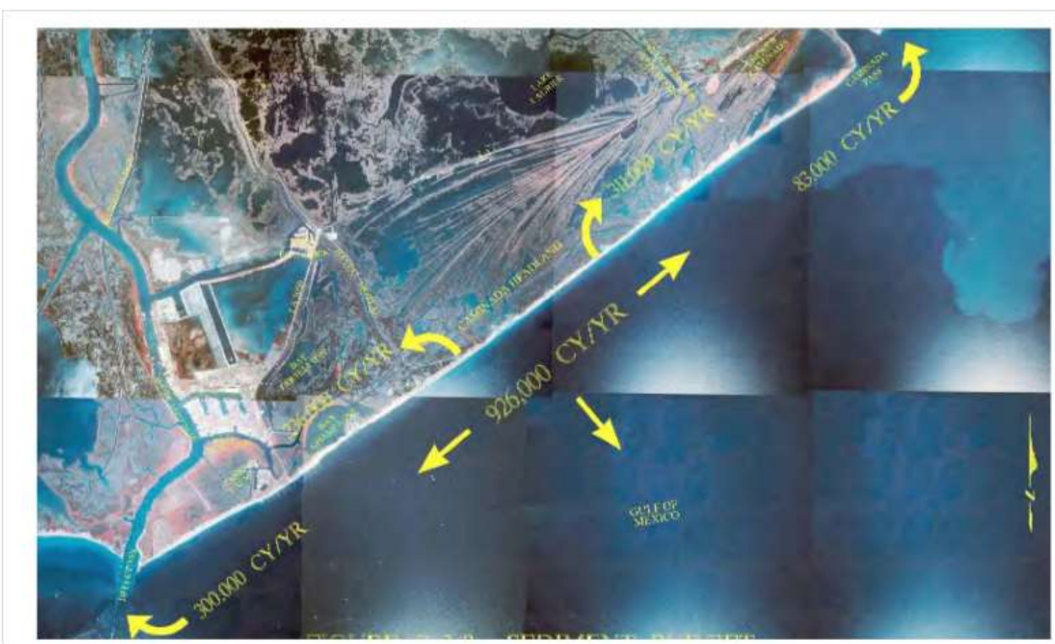


Figure 3-2. Estimated sediment budget for the Caminada Headland (from USACE 2012)

Raccoon Spit –

(1887-1988) Williams *et al*. (1992), -90 ft/yr
(1884-2002) [*Long-term shoreline change*] Penland *et al*. (2005), -81.8 ft/yr
(1885-2005) [*Historic change*] Martinez *et al*. (2009), -83.8 ft/yr

Note: Martinez *et al.* (2009) differentiated the Caminada Headland into two reaches: Fourchon Beach (3.0 miles in length) and Caminada Headland (10.9 miles in length). This makes direct comparison with other overall estimated erosion rates difficult.

Change rates for other time intervals were also calculated:

Caminada-Moreau Headland –

(1887-1934) Williams *et al*. (1992), -51.8 ft/yr
(1904-2005) *[Long-term change]* Martinez *et al*. (2009), -35.9 ft/yr
(1988-2002) *[Short-term shoreline change]* Penland *et al*. (2005), -8.6 ft/yr
(1996-2005) *[Short-term change]* Martinez *et al*. (2009), -24.8 ft/yr
(2004-2005) *[Near term change]* Martinez *et al.* (2009), -190.9 ft/yr

Fourchon Beach –

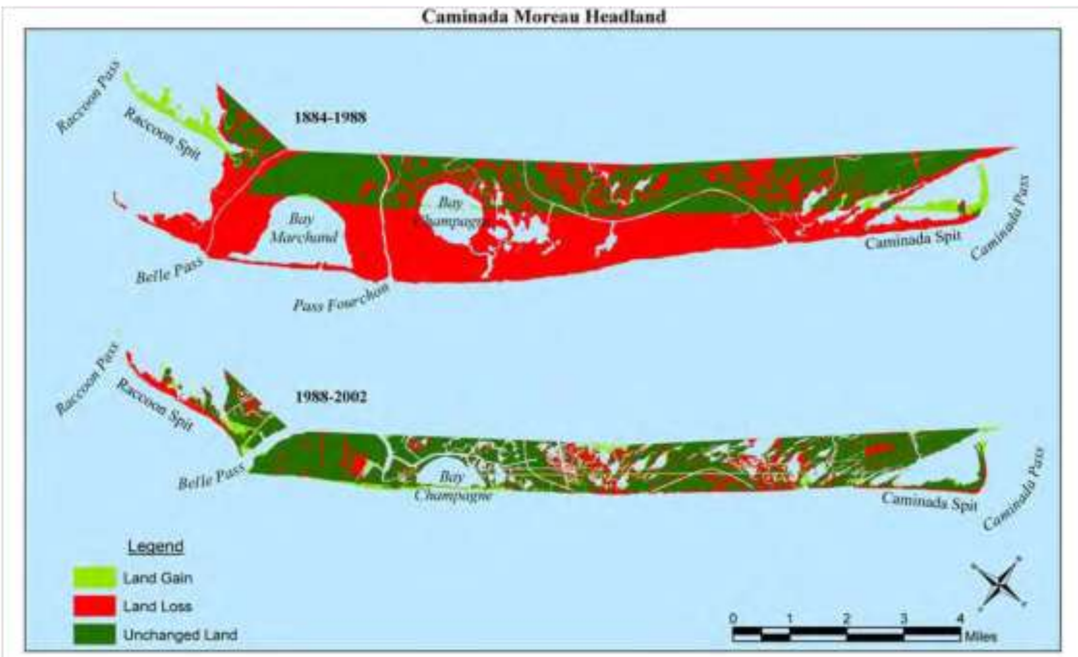
(1904-2005) *[Long-term change]* Martinez *et al*. (2009), -23.7 ft/yr
(1996-2005) *[Short-term change]* Martinez *et al*. (2009), 8.4 ft/yr
(2004-2005) *[Near-term change]* Martinez *et al*. (2009), -76.1 ft/yr

Raccoon Spit –

(1887-1934) Williams *et al*. (1992), -135.4 ft/yr
(1904-2005) *[Long-term change]* Martinez *et al*. (2009), -35.9 ft/yr
(1988-2002) *[Short-term shoreline change]* Penland *et al*. (2005), -20.5 ft/yr
(1996-2005) *[Short-term change]* Martinez *et al*. (2009), -58.3 ft/yr
(2004-2005) *[Near term change]* Martinez *et al.* (2009), -135.2 ft/yr

The Belle Pass jetties have adversely affected the longshore transport along the Caminada Headland to the west, trapping sand, and disrupting the downdrift sediment transport to the Timbalier Islands (Penland and Suter 1988; Moss *et al.* 1985). The jetty/bar reach of the Federal navigation channel is dredged annually, removing approximately 600,000 cy of sediment per year (Ed Creef, USACE, pers. comm., 2009, cited in USACE 2012). Material dredged from the channel is placed on the beach near the jetties. Other potential sources of sediment, such as freshwater inputs and stormwater runoff, are considered negligible because Bayou Lafourche has a small drainage basin with little slope. Bayou Lafourche, a distributary of the Mississippi River, was primarily responsible for the land building in the area, including the Caminada Headland. However, construction of the Mississippi River flood control levees in the early 20th century closed the connection between Bayou Lafourche and the Mississippi River. Bayou Lafourche is tidally influenced; tidal current velocities are significant in the lowermost reach. Degrading wetlands provide a continuous source of sediments that can be transported by tidal currents into the channel. Much of this sediment is in suspension in lower salinity waters. Once transported to lower Bayou Lafourche and Belle Pass, the suspended sediment encounters higher salinity waters, flocculation occurs, and the clay material is deposited. This process could provide a significant source of sediment to Belle Pass, along with the longshore-transported sand that bypasses the upper part of the jetty.

Caminada Pass is armored, with a jetty on the eastern side. There is evidence of longshore transport from west to east along the eastern portion of the Caminada Headland, including spit growth at an unknown rate (Ritchie *et al.* 1995) and about 83,000 cy of sediment per year bypass to Grand Isle (USACE 2004a, 2011). Shoreline change in the area from 1884-2002 is presented in Figure 3-3.



Source: USACE 2004a.

Figure 3-3. Caminada Headland Shoreline Change 1884-2002

The Caminada Headland has experienced severe erosion due to numerous hurricanes and tropical storms; recent storms included Hurricanes Katrina (2005), Gustav (2008), Ike (2008) (USACE 2012), and Tropical Storm Lee in 2011. Recently, Hurricanes Gustav and Ike have necessitated maintenance dredging of Bayou Lafourche. It is estimated that approximately 560,000 cy of material between miles 0.5 and 1.8 will require removal to maintain navigation. Bayou Lafourche maintenance dredging material is generally deposited along the Gulf of Mexico shoreline adjacent to the jetties for beach restoration.

The historical shoreline change rates reported along the Caminada Headland were highest just east of Bay Champagne, slightly lower west to Belle Pass, and significantly lower east to Caminada Pass (Williams *et al.* 1992). The computed shoreline change rates at MHW were highest at Bay Champagne and approximately 33 percent lower to the west (USACE 2012). This reduction in shoreline change rate is attributed to the breakwaters and jetty impounding sand. Shoreline change rates to the east do not exhibit any trends.

Ship Shoal

Ship Shoal has a steeper shoreward slope and a flatter seaward slope; this asymmetry generally indicates that a feature has a long-term shoreward migration. Based on comparison of bathymetric profiles between 1887 and 1983, migration rates are approximately 23-49 ft/yr (7-15 m/yr) resulting in approximately 0.6 mi (1 km) of migration during the last century (Penland *et al.* 1989).

Sediment transport at Ship Shoal during the winter is dominated by the strongest storms, when net sediment flux tends to be seaward (DOI-MMS 2004). Considerable variability exists between, as well as during, storms; this is reflected in hydrodynamic, bottom boundary layer, and sedimentary parameters. Some indices are several orders of magnitude greater during strong storms than during fair weather. Despite this considerable variability, storms are generally characterized by increases in wave height, near-bed orbital velocities, mean current speed, shear velocity, suspended sediment concentration, and sediment transport. Decreases in wave period and bottom roughness are also apparent (DOI-MMS 2004).

Four sediment transport events on Ship Shoal were observed by Stone (2000). High rates of sediment transport were generally associated with storms. Episodic increases in current- and wave-current shear velocity were associated with storm activity. Shear velocity was particularly high during the period of strong wave-orbital flow for three of the observed storm events, when mean flows were particularly strong (Stone 2000; DOI-MMS 2004). The sediment transport direction varied considerably between storms, as well as during individual storms. Two of the most significant storms were characterized by opposing trends in sediment transport direction; one storm was dominated by onshore and eastward (northeast) transport, and another storm event was dominated by offshore and westward (southwest) transport. The transport direction within these storms fluctuated by 180° over a very short time scale (several times per storm). This may have been related to diurnal fluctuations resulting from tidal or inertial current flow, or to other variations in relative wave and current energy and direction (DOI-MMS 2004).

The magnitude difference in hydrodynamic parameters between actual and hypothetical bathymetry was evaluated for three mining areas on Ship Shoal by Stone *et al*. (2009). Storm magnitudes evaluated included a mid-February cold front and Hurricane Lili (2002). Small-scale sand mining (8-10 mcy) on South Pelto, the upper volume range anticipated for this Project is not expected to measurably affect hydrodynamics or sediment transport over the Shoal.

3.1.1.5 Waves

Caminada Headland

The mean significant wave height was 3.28 ft (1.0 m) for all waves at the Caminada Headland with a mean period of 5 seconds (USACE 2012). Significant wave height is approximately equal to the average of the highest one-third of the waves, as measured from the trough to the crest of the waves.

Approximately 66 percent of waves in the Caminada Headland area originate between 79° and 214° (USACE 2012). Southwest Pass provides the headland little protection from major storm systems from the southeast. Offshore wave heights for the 20, 10, and 5 percent (5-, 10-, and 20-year) conditions range from 15 to 20 ft (4.6 to 6.1 m), with corresponding periods of 11.3 to 13.5 seconds from the south (183°) (USACE 2012).

Ship Shoal

During storms, Ship Shoal mitigates the wave field off the central Louisiana coast, but during fair weather, wave interaction with the shoal is negligible (Stone *et al.* 2004). Wave periods tend to be higher and longer on the seaward side of the shoal (DOI-MMS 2004). Annual mean significant wave heights of 3.3±0.7 ft (1.0±0.2 m) with a mean peak period of 4.5 to 6.0 seconds were observed at hindcast stations adjacent to a Ship Shoal study area over a 20-year (1956-1975) period (Hubertz and Brooks 1989; DOI-MMS 2004). The maximum hindcast wave heights at these stations exceeded 16.4 ft (5 m), and the peak period associated with the largest wave exceeded 11 seconds. The monthly mean significant wave heights during the winter (December-March) were 0.7 to 2.0 ft (0.2 to 0.6 m) higher than the rest of the year. The predominant wave direction was from the southeastern quadrant. Tropical storms and hurricanes significantly influence sea state, despite the dominant low wave energy environment in the study area. The significant height of hurricane waves for a 50-year return period is greater than 15 m for the 20-year hindcast. The 5-year return period significant wave height is approximately 19.7 to 23.0 ft (6 to 7 m) (DOI-MMS 2004). Wave heights on the western flank of Ship Shoal were significantly less than waves on the eastern flank (Kobashi and Stone 2009).

From the seaward to the landward flank of Ship Shoal, wave modeling indicated that significant wave height attenuation was 22 percent for southerly waves and 28 percent for northerly waves (Stone *et al*. 2009). This level of wave energy attenuation suggests that the shoal is effective in reducing erosion on the existing coastline (Stone *et al*. 2009). Modeling also suggests that the shoal can have an effect on waves and wave-induced sediment resuspension. However, the effect of proposed shoal mining projects on wave and sediment re-suspension was determined to be insignificant (Stone *et al*. 2009).

3.1.2 Geology

3.1.2.1 Sea Level Change and Relative Subsidence

The average rate of global sea level rise estimated from tide gauge data was 1.8 ± 0.5 mm/year (IPCC 2007). For the Gulf of Mexico, sea level rise has been measured at 2.10 ± 0.26 mm/year at the NOAA tide gauge 8729840 in Pensacola, Florida (NOAA 2008a). This tide gauge lies on a geologically stable platform. Relative sea level rise consists of eustatic sea level rise and subsidence. Eustatic sea level change is defined as the global change in oceanic water level relative to a fixed vertical datum (e.g. NAVD88). Subsidence is defined as a local decrease in land elevation relative to a fixed vertical datum. Relative sea level change would include both sea level change (eustatic) and relative subsidence.

The high rate of relative sea level change is resulting in significant land loss along the Louisiana coast. The rate of relative sea-level rise can be estimated from local tide gauges because they measure water levels relative to a fixed datum, reflecting the combined influence of subsidence and eustatic sea level rise. The 1947-2006 record from NOAA Tide Gauge 8761724 at Grand Isle, Louisiana shows a relative sea-level rise rate of 9.24 (±0.59) mm/yr (NOAA 2008b). This suggests that relative sea-level rise at this location is mainly due to subsidence.

3.1.2.2 General Geology

Caminada Headland

The Mississippi River deltaic plain is the product of multiple, temporally and spatially offset deltaic depocenters separated by periods of deltaic abandonment and reworking by marine processes (Penland *et al.* 1985, 1986; Roberts 1997; Coleman *et al.* 1998). The Mississippi River has built six major delta complexes over the past 7,000 years (Frazier 1967). Deltaic abandonment results in reworking by marine processes and subsidence; products include erosional headlands, barrier islands, and offshore sand shoals (Roberts 1997). Penland *et al*. (1988) proposed a three-stage conceptual model for the evolution of deltaic barrier islands and ultimately inner shelf sand shoals. Riverine input wanes after fluvial abandonment and former delta lobes become erosional headlands (e.g., the Caminada Headland) with flanking barrier islands (e.g., Grand Isle and Timbalier Islands). Continued erosion and submergence of backbarrier wetlands result in mainland detachment and development of a barrier island arc (e.g., the Isles Dernieres). As relative sea-level rise continues, sandy sediment is no longer available to replenish sediment removed from the system and the barrier island system undergoes transgressive submergence and conversion to an inner-shelf shoal (e.g., Ship Shoal).

The Caminada Headland Gulf shoreline is approximately 13 miles (20.9 km) long, extending from Caminada Pass on the eastern end to Belle Pass on the western end. Grand Isle is east of the headland and the Timbalier Islands are to the west. The back-barrier marsh component of the Caminada Headland is separated from the Cheniere Caminada beach ridges to the north by a pipeline canal; the Gulf shoreline is the southern boundary. The beach ridges support a maritime forest important to the physical integrity of the estuary and are home to many Neotropical migratory birds. These ridges were produced during the seaward progradation of the Bayou Moreau delta lobe. As the lobe prograded, eroded sand was transported alongshore by waves and trapped updrift of the prograding Bayou Moreau delta lobe. Continued progradation of the lobe resulted in successive shorelines and dune ridges building seaward and producing amalgamated ridges and swales (Gerdes 1982; Kulp *et al*. 2005a). This area has suffered land loss from subsidence and hydrologic isolation caused by impoundment from the construction of roadways (USACE 2012).

Elevations average 3.5 ft (1.07 m) North American Vertical Datum of 1988 (NAVD88), ranging from a maximum of approximately 5 ft (1.52 m) NAVD88 on the highest dunes to near 0 feet (0 m) NAVD88 in the back-barrier marshes (USACE 2012). Mean High Water is 1.53 ft (0.47 m) NAVD88 and Mean Low Water is 0.48 feet (0.15 m) NAVD88 (USFWS 2011a, b).

The headland subsurface is generally composed of less than 20 ft (6.1 m) of fine sand with shell material overlying up to 100 ft (30.48 m) of marsh/interdistributary deposits containing very soft gray clay with organics and minor shell material (USACE 2012).

Ship Shoal

Ship Shoal is a reworked remnant of an ancient barrier shoreline that was modified by processes related to transgression and submergence of the Maringouin delta complex (Krawiec 1966; Frazier 1967; Penland *et al*. 1988). After submergence, the shoal continued to migrate landward over a distance of at least equal to its width; therefore, no barrier island deposits are preserved within the shoal sand body (Penland *et al*. 1988).

Ship Shoal is approximately 31 mi (50 km) long and 3 to 9 mi (5 to 12 km) wide. Water depths range from 23 to 30 ft (7 to 9 m) on the eastern side of the shoal to approximately 10 ft (3 m) on the western side. The shoal rises from about 16 to 22 ft (4.9 to 6.7 m) above the adjacent shelf floor. An estimated 216 mi^2 (559 km^2) of the shoal crest has a surface sand thickness greater than 3.3 ft (1 m) (USACE 2012).

The stratigraphy of Ship Shoal is composed of three distinct deposits (shoal crest, shoal face, and shoal base) based on grain size and position within the shoal body (Penland *et al*. 1988). The shoal front/foreslope and shoal crest are composed of greater than 90 percent fine to very fine sand of compatible texture to the Mississippi River delta plain barrier and headland beaches. Ship Shoal contains an estimated 1.57 billion cy [1.2 billion cubic meters (m^3)] of very fine to medium-grained sand (DOI-MMS 2004; USACE 2012). This includes 146.5 mcy (112 million m^3) in the shoal crest, 562.4 mcy (430 million m^3) in the shoal front, and 837 million cy (640 million m^3) in the shoal base. An additional estimated162 mcy (123 million m^3) of sand are contained in distributary-channel fill deposits under the shoal (Kulp *et al.* 2001). Estimates of the volume of fine and very fine-grained sand in Ship Shoal by shoal location are presented in Table 3-1. Access to some of this sand is currently obstructed by oil and gas infrastructure and potential cultural resources.

The bottom sediment distribution of Ship Shoal was strongly affected by fine-grained sediment outputs from the Atchafalaya River (Kobashi *et al.* 2007a, 2007b; Kobashi and Stone 2009). A distinct fluid mud layer approximately 10-15 cm in thickness was deposited on the Shoal during

Table 3-1. Estimates of Beach Quality Sand Contained in Ship Shoal by Depositional Environment (from DOI-MMS 2004)

Depositional Environment	Estimate of Beach Quality Sand (million m^3)	Estimate of Beach Quality Sand (million yd^3)
Shoal crest	112	146.5
Shoal front	430	562.44
Shoal base	640	837.12
Entire shoal	1,200	1,569.7

The bottom sediment distribution of Ship Shoal was strongly affected by fine-grained sediment outputs from the Atchafalaya River (Kobashi *et al.* 2007a,b; Kobashi and Stone 2009). A distinct fluid mud layer approximately 10-15 cm in thickness was deposited on the Shoal during fair weather; this fine-grained sediment was ephemeral, and was subsequently reworked by storm waves during pre-frontal conditions (Kobashi *et al.* 2007a,b; Kobashi and Stone 2009).

3.1.2.3 Sediment Compatibility

Compatibility of the native beach sand and borrow area sand is critical in maintaining restored beaches. Beaches restored with sand that is compatible with the native beach sand have a planform centroid that is relatively insensitive to wave direction. However, restoration sand that is finer or coarser than the native sand may cause the restoration planform centroid to migrate downdrift or updrift. Sand sources with a high percentage of fines (silt/clay material) generally are avoided because they are unsuitable as beach material, and increased turbidity and sedimentation have adverse effects on biota in adjacent habitats (Committee on Beach Nourishment and Protection 1995). An overfill factor is typically used to evaluate sediment compatibility and to relate the volume of borrow area fill required so that it would perform similarly to the native beach sand. An overfill factor of 1.0 indicates the sand is perfectly compatible; factors over 1.0 indicate the percentage of additional volume necessary.

The Caminada Headland is composed of very well sorted fine to very fine sand (Ritchie *et al.* 1995). Sediment samples collected from Caminada Headland beaches have a composite sample mean grain size of 0.164 millimeter (mm) (USACE 2012). Ship Shoal sediments are well sorted, fine to very fine sand with low silt/clay content (Stone *et al.* 2009). The shoal crest has very well-sorted, well-rounded 99 percent quartz sand that coarsens upward, from 0.13 mm (base) to 0.16 mm (top) (Stone *et al.* 2004). The shoal front has moderately sorted and very fine-to-fine sand (0.12 to 0.15 mm), and the back shoal has poorly sorted, very fine sand (0.1 to 0.13 mm) with interbedded layers of silty clay (Stone *et al.* 2004).

Grain size on Ship Shoal generally increases from west to east; this has been attributed to a higher percentage of shell hash on the eastern shoal (Stone *et al.* 2009). Vibracore samples from the South Pelto Block have a composite weighted mean grain size of 0.171 mm (Table 3-2). Initial compatibility analysis determined an overfill ratio of 1.08 (USACE 2012). Comparison of the native and South Pelto samples using the overfill factor (Ra) analysis resulted in a value less than 1.02. Comparative analysis of the sediments using the Renourishment Factor (Rj) resulted in an average value of 1.17. Sediments from the South Pelto block are suitable for beach and dune restoration at Caminada Headland. An overfill ratio of 1.08 is recommended to be used in design volume analysis (USACE 2012).

Table 3-2. Composite Grain Size Summary of Ship Shoal Borrow Area

Core	Weighted Mean Grain Size (mm)	Weighted Percent Coarse (230)*
CHVC-05-15	0.142	93.7%
CHVC-05-16	0.196	98.3%
CHVC-05-17	0.179	98.3%
Average	0.171	96.8%

*****Wentworth Size Class, minimum sand grain size 0.0625 mm, #320 sieve size.

Source: CP&E 2005.

3.1.3 Air Quality

The USEPA, in accordance with the Clean Air Act, set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The Clean Air Act identified two types of NAAQS. Primary standards set limits to protect public health, including the health of *sensitive* populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

NAAQS for six principal pollutants *(criteria pollutants)* set by the USEPA include ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide, and lead. The Code of Federal Regulations requires states to report to the USEPA annual emissions estimates for point sources (major industrial facilities) emitting greater than, or equal to, 100 tons per year of volatile organic compounds, nitrogen dioxide, sulfur dioxide, particulate matter smaller than 10 microns; 1,000 tons per year of carbon monoxide; or 5 tons per year of lead. Ozone is not an emission, it is the result of a photochemical reaction; volatile organic compounds (VOC) lead to the formation of ozone.

Caminada Headland
The Caminada Headland portion of the project is located in Lafourche Parish, Louisiana; this area is currently in attainment of all NAAQS. However, the USEPA's proposed changes to lower the primary (health-based) NAAQS for ozone could place Lafourche Parish out of compliance (USEPA 2011a). Port Fourchon is the site of significant industrial work, and is one of the major sources of local ozone.

Ship Shoal
The Clean Air Act, as amended, delineates jurisdiction of air quality between the USEPA and the BOEM. The BOEM has jurisdiction over OCS air emissions in the Gulf of Mexico west of 87.5ºW (off the coasts of Texas, Louisiana, Mississippi, and Alabama). The USEPA has jurisdiction in all other OCS areas.

OCS sources within 25 miles of the state's boundaries are subject to the same Federal and state requirements that would apply if the source was located onshore. Dredging activities are considered temporary; therefore, they are not considered OCS sources. The air over OCS waters is not classified, but is presumed to be better than the NAAQS for all criteria pollutants. The borrow area is located approximately 46 mi (74 km) south of Terrebonne Parish, Louisiana, an area that is in attainment of all NAAQS.
The influence of OCS activity on the onshore air quality depends on meteorological conditions and air pollution emitted from operational activities. Pertinent meteorological conditions affecting air quality are wind speed and direction; atmospheric stability; and the mixing height (which govern dispersion and transport of emissions). The typical synoptic wind flow for the borrow area is driven by clockwise circulation around the Bermuda High, resulting in a prevailing southeasterly to southerly flow, which is conducive to transporting emissions toward shore. Superimposed on this synoptic circulation are smaller meso-scale wind flow patterns, such as the land/sea breeze phenomenon. In addition, synoptic scale tropical cyclones and mid-

latitude frontal systems occur periodically. Because of these various conditions, winds occur from all directions in the project area.

3.1.4 Water Quality

Caminada Headland

Waters in the project area are used for swimming, SCUBA diving, fishing, boating, and other recreation. The LDEQ assesses four categories for water use under the Louisiana Environmental Regulatory Code (LAC Title 33, Chapter 11) that would apply to the project area:

- *Primary Contact Recreation* includes activities such as swimming, water skiing, tubing, snorkeling, skin diving, and other activities that involve prolonged body contact with water and probable ingestion.

- *Secondary Contact Recreation* includes fishing, wading, recreational boating, and other activities that involve only incidental or accidental body contact and minimal probability of ingesting water.

- *Fish and Wildlife Propagation* includes the use of water by aquatic biota for aquatic habitat, food, resting reproduction, and cover, including indigenous fishes and invertebrates, reptiles, amphibians, and other aquatic biota consumed by humans.

- *Oyster Propagation* includes the use of water to maintain biological systems that support economically important species of oysters, clams, mussels, and other mollusks consumed by humans so that their productivity is preserved and the health of human consumers of these species is protected.

Fish and Wildlife Propagation is impaired in waters of the area due to elevated levels of mercury (LDEQ 2006). One of the suspected causes of this impairment is atmospheric deposition. The Louisiana Department of Health and Hospitals, along with the Louisiana Department of Environmental Quality and the LDWF, issued a fish consumption (March 8, 2006) advisory for king mackerel, cobia, blackfin tuna, and great amberjack caught off the coast of Louisiana (LDWF 2011).

Ship Shoal

The Mississippi and Atchafalaya rivers are the primary sources of fresh water, sediment, and pollutants to the continental shelf west of the Mississippi River (Murray 1997). These rivers drain about two-thirds of the continental United States to the Gulf. Peak and minimum flows occur in April and September to October, respectively; however, river discharge is highly variable from year to year (Nowlin *et al.* 1998). Effects of the Mississippi River on temperature and salinity have been detected as far west as Galveston, Texas (Murray and Donley 1996). River discharges introduce contaminants to the inner shelf, which includes the borrow area. Concentrations of suspended particulate matter in the area range from less than 1 to 10 mg/l. Regulations controlling discharges from land-based point sources limit industrial and municipal waste discharges to the River. Nonpoint source discharges are harder to control, and agricultural and urban runoff carry sediments from exposed soils, nutrients from upriver farms and yards, and car oil and grease from road surfaces to the Gulf's waters.

Each summer, the Gulf hypoxic zone *(Dead Zone)* stretches as a band along the Louisiana-Texas coast and continental shelf. Bottom waters in the hypoxic zone have dissolved oxygen concentrations less than 2 parts per million (ppm). The Gulf hypoxic area is the largest hypoxic area in the world. Hypoxia results from excess nutrients, primarily nitrogen, in the water. Most nitrogen comes from nonpoint sources above the confluence of the Ohio and Mississippi rivers. The hypoxic zone forms in the summer when low-salinity waters from the Atchafalaya and Mississippi rivers spread out over the denser salt water to create a stratified water column. Nutrients in the water stimulate phytoplankton growth. Phytoplankton ultimately die, sink, and decompose, depleting dissolved oxygen in the bottom waters. Hypoxic conditions remain until the water is recirculated by local winds. Hypoxic conditions vary spatially and seasonally depending on the flow of the rivers and physical features such as water circulation patterns, saltwater and freshwater stratification, wind mixing, and tropical storms.

The 2011 Gulf hypoxic zone was 17,520 square kilometers (6,765 square miles). The 2011 zone was larger than average, but below that expected due to the record-breaking flow of the Mississippi River during the spring and summer [Louisiana Universities Marine Consortium (LUMCON) 2011].

The Ship Shoal and South Pelto areas are within the hypoxic zone, which has been observed as far west as Freeport, Texas during some years. Although Ship Shoal is situated in an area prone to hypoxia, estimates of bottom dissolved oxygen concentrations over the entire shoal are generally fairly high and constant in spring, summer, and autumn. Ship Shoal may be a hypoxic refuge for benthic invertebrates sensitive to low dissolved oxygen concentrations. Amphipods were found in very high abundances over Ship Shoal. Because amphipods are known to be affected by low oxygen values (Gaston 1985; Wu and Or 2005), this suggests that Ship Shoal is a hypoxia refuge for benthic species. Shallow depths, wave action, and biogenic activity likely contributed the Ship Shoal's higher dissolved oxygen concentrations. The high density of tubiculous polychaetes (e.g., spionids, representing between 30 percent and 50 percent of polychaete density, as well as *Owenia fusiforms*, or *Onuphis emeriti occulata*) may enhance oxygen influx in sediment surface layer (Jorgansen *et al.* 2005).

Ship Shoal and South Pelto blocks are active oil and gas production areas. Over several decades, drilling materials, such as water-based mud and cuttings, has been released in the region. Mud and cuttings are generally deposited within 1 to 2 km of the discharge location (Neff 1987). Produced (formation) water generated during hydrocarbon production is discharged from wells and rapidly disperses. The produced water may have high salinity, organic content and dissolved metals, and lower dissolved oxygen levels than the receiving water. Discharges are periodically tested and must meet National Pollutant Discharge Elimination System (NPDES) limits set by the USEPA.

3.1.5 Noise

Noise is a localized phenomenon. The Noise Control Act establishes coordination of Federal noise-control activities and provides information to the public regarding noise emissions. Many different noise sources in and near the project area include commercial and recreational boats, automobiles and trucks, and all-terrain vehicles; aircraft; and industry-related noise (such as oil and gas facilities).

Noise levels on the headland are typical of recreational and beach activities. Noise levels fluctuate; the highest levels generally occur during the spring and summer due to increased coastal activities. The project area does not have any noise-sensitive institutions, structures, or facilities. Noise in this area is limited to that generated by oil and gas platforms, service vessels, and other vessels passing through the area. Recreational boaters contribute minimally to the noise in the area.

In recent years, concerns have been raised regarding potential impacts of anthropogenic underwater noise on aquatic organisms. Underwater sounds could hypothetically interrupt or impair communication, foraging, migratory, and other behavior of aquatic organisms. Because of this concern, field investigations characterized underwater sounds typical of bucket, hydraulic cutterhead, and hopper dredging operations (Dickerson *et al.* 2001). Cutterhead dredging operations were relatively quiet compared to other sound sources. Hopper dredges produced more intense sounds similar to those generated by comparable-sized vessels. Bucket dredging created a complex spectrum of sounds, different from cutterhead or hopper dredges. Hopper dredges create two relatively continuous sources of noise: large commercial vessel engine and propeller sounds and draghead sounds when contacting the substrate.

Source levels reported for marine dredging operations ranged from 160 to 180 dB re1uPa @ 1m for 1/3 octave bands with peak intensity between 50 and 500 Hz (Greene and Moore 1995). Underwater sounds produced by each dredge type are influenced by factors including substrate type, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and dredge plant operator skill (Dickerson *et al.* 2001). No conclusive evidence exists to confirm or refute negative impacts of anthropogenic underwater noise on marine mammal populations (DOI-MMS 2007).

3.2 BIO-PHYSICAL ENVIRONMENT

3.2.1 Vegetation Resources

Barrier headland and island shorelines and associated back-barrier marsh areas are dynamic areas with considerable spatial and temporal variation in plant species distribution (USACE 2012). The headland is subject to varying degrees of natural and human disturbance. Vegetation in barrier headland and island shoreline systems is important for trapping and retaining sediments. The vegetative zones or communities on barrier headlands and islands, and the extent of their diversity, are related to elevation, degree of exposure to salt spray, and storm events causing overwash. These vegetative zones often intergrade with each other: beach pioneer zone→frontier zone →dune →barrier grasslands→salt flats→salt marsh →intertidal mud flats (Ritchie *et al.* 1990, 1995; USACE 2012). The presence and abundance of species in each of these zones (Table 3-3) are determined by the availability of propagules, microclimate variation, and individual species adaptations. Initial colonization of a zone is frequently by runners or stolons of species from adjacent zones. Vegetation descriptions in this section are based on a series of vegetation and elevation transects conducted on the Caminada Headland from 1987 to 1990 (Ritchie *et al.* 1995), field observations during the USACE (2012) study, and descriptions from the USFWS (2011a) biological opinion.

3.2.1.1 Vegetative Habitats

The Caminada Headland is located at the southern extreme of the Barataria Basin. There are currently about 1,360 acres of habitats at the headland (USFWS 2011a). The primary factors controlling the distribution of plant species in this area are salinity and elevation. The project area primarily consists of beach, overwash, dune, barrier flats (scrub/shrub and salt flats), mainland and back-barrier saline marsh, intertidal flats, and open water habitats (USFWS 2011a, b).

Beach and Overwash

Active beach areas are located on the Gulf side of barrier headland and island shorelines from the intertidal zone to the toe of the dune. The wave-washed, shell-rich sandy sediments in this area are generally too unstable for vegetation establishment. Plants adapted to harsh backshore conditions (i.e., high salinity, high winds, and rapid sand burial) may become established in front of the dunes. Pioneer beach vegetation can include sea purslane *(Sesuvium portulacastrum)*, marsh hay cordgrass *(Spartina patens)*, slender purslane *(S. maritimum)*, Gulf coast sea rocket *(Cakile constricta)*, and seaside heliotrope *(Heliotropium curassavicum)*. Overwash areas form from storms transporting beach and dune sand landward through low elevation areas within the dunes forming lobate sand deposits that blanket the backbarrier. Overwash may become colonized by grasses (i.e., coastal dropseed *(Sporobolus virginicus)*, saltgrass *(Distichlis spicata)*, and *Paspalum* grasses) as well as morning glory *(Ipomoea* spp.*)* and sea purslane (USFWS 2011a).

Dune

Dunes form from sand transported by wind and trapped by vegetation or other obstructions. Dune height and orientation are a function of prevailing wind direction, velocity, and duration, as well as sand availability and grain size. Typical dune vegetation on Louisiana's barrier islands and headlands includes roseau cane *(Phragmites australis)*, marsh hay cordgrass, bitter panicum *(Panicum amarum)*, and Gulf croton *(Croton punctatus)* (USFWS 2011a).

Barrier Flats and Scrub/shrub

Plants requiring elevation and protection from coastal processes are found behind the dunes on relict overwash platforms. Saltwort *(Batis maritima)*, dwarf glasswort *(Salicornia bigelovii)*, and Virginia glasswort *(S. depressa)* are found in high salinity pockets, often at higher elevations, in infrequently flooded areas. In areas subject to frequent drying, seaside goldenrod (*Solidago sempervirens)* and eastern baccharis *(Baccharis halimifolia)* are occasionally found, as well as

Table 3-3. Vegetation of Project Area
(From USACE 2012; based on site visits and after Ritchie *et al.* (1990, 1995)

Plant Species	Beach Pioneer Area	Frontier Zone	Dune	Barrier Grassland	Salt Flats	Salt Marsh	Intertidal Mud Flats	Spoil Banks
Agalinis maritima (seaside gerardia)				X				
Agalinis purpurea (purple gerardia)				X				
Amaranthus greggii		X						
Atriplex cristata (sea-beach orach)	X							
Atriplex cristata (sea-beach orach)		X				X		
Avicennia germinans (black mangrove)								
Baccharis halimifolia (groundsel bush)				X		X		X
Batis maritima (saltwort)						X		
Borrichia frutescens (sea ox-eye)				X	X	X		
Bostrichia spps						X		
Cakile geniculata (sea rocket)	X	X	X					
Chenopodium album (pigweed, lamb's-quarters)	X	X	X					
Cissus trifoliata (marine-vine)								X
Colocasia esculentum (elephant ear)	X							
Croton punctatus (beach tea)	X	X	X	X				
Cuscuta gronovii (common dodder)						X		
Cuscuta indecora (pretty dodder)						X		
Cynanchum angustifolium (milkweed vine)				X				
Cynodon dactylon (Bermuda grass)		X	X					
Cyperus spp.	X	X	X	X	X			
Distichlis spicata (salt grass)	X	X		X		X		X
Ectocarpus spps						X		
Enteromorpha spps						X		
Eustoma exaltatum (seaside gentian)				X	X			
Fimbristylis castanea (sand rush)				X	X			
Heliotropium curassavicum (seaside heliotrope)	X							X
Heterotheca subaxillaris (camphor weed)			X					
Hydrocotyle bonariensis (sand pennywort)		X	X	X				
Ipomoea pes-caprae (goatsfoot morning glory)		X						
Ipomoea imperati (beach morning glory)		X	X	X				
Iva frutescens (marsh elder)			X	X		X		X
Juncus roemerianus (black needle rush)						X		
Lantana camara (lantana)								X
Limonium carolinianum (sea lavender)				X	X			
Lonicera japonica (Japanese honeysuckle)								X
Morella cerifera (*Myrica cerifera*, wax myrtle)				X				X
Panicum amarum (bitter panicum)		X	X	X				
Panicum repens (dog-tooth grass)	X	X	X	X				
Paspalum vaginatum (seashore paspalum)				X				
Phragmites australis (roseau cane)				X				
Phragmites communis (roseau cane)		X						
Phyla nodiflora (frogfruit)				X				
Polysiphonia spps						X		
Portulaca oleracea (common purslane)	X							
hynchospora colorata (*Dichromena colorata*, white-topped sedge)				X				
Sabatia stellaris (common marsh pink)				X	X			
Salicornia bigelovii (Bigelow glasswort)					X	X		
Salicornia virginica (creeping glasswort)					X			
Schizachyrium littorale (maritime bluestem)			X	X				
choenoplectus americanus (*Scirpus olneyi*, (three-cornered grass)				X				
Uniola paniculata (sea oats)			X					
Sesbania drummondii (rattlebox)		X	X	X				
Sesuvium portulacastrum (sea purslane)	X	X	X		X			
Symphyotrichum tenuifolium (*Aster tenuifolius*, saltmarsh aster)				X				
Solidago sempervirens (seaside goldenrod)		X	X	X		X		X
Spartina alterniflora (smooth cordgrass, oyster grass)		X				X		X
Spartina patens (marsh-hay cordgrass)	X	X	X	X		X		X
Sporobolus virginicus (coastal dropseed)	X	X	X	X	X			
Strophostyles helvula (wild bean)			X	X				

salt-tolerant shrubs, including tree seaside tansy (*Borrichia arborescens)*, and marsh elder *(Iva frutescens)*. Shrubs are occasionally covered by parasitic vines, including scaldweed *(Cuscuta gronovii)* and bigseed alfalfa dodder *(C. indecora)*. These plants may also be found in the high marsh zone (USFWS 2011a).

Saline Marsh

Saline marshes in the project area are behind the headland and on the bay side of barrier islands. Intertidal marshes usually have firm mineral soils and experience moderate to high daily tidal fluctuations. The saline marsh community typically has the lowest plant species diversity of any marsh type. Although many plants can tolerate a periodically flooded substrate, few can tolerate the combined stresses of flooding and high salinity. The dominant species in the area's salt marshes are smooth cordgrass *(Spartina alterniflora)*, a perennial grass that grows from extensive rhizomes. Smooth cordgrass also dominates high marsh areas subject to intermittent flooding, although the highly salt-tolerant salt grass, black needle rush *(Juncus roemerianus)* and glassworts *(Salicornia* spp.*)* are often present. Black mangrove *(Avicennia germinans)* shrubs are found along the flooded marsh edges of the headland and nearby islands, and on the banks of tidal streams, ponds, and bays. Mangroves are extremely important in stabilizing the shoreline and reducing erosion in these areas. Louisiana is the northern natural limit and mangroves periodically experience dieback because of winter freezes. The mangrove population of coastal Louisiana was damaged by severe freezes in 1983 and 1984 (Patterson and Mendelssohn 1991). Recent mild winters have allowed strong regrowth, but most plants are only three to six feet tall (USFWS 2011a).

Intertidal Flats

Intertidal mud flats are typically ephemeral areas of unconsolidated organic and mud deposits that occur in low wave and tidal energy areas. Although mud flats are typically non-vegetated, algal mats may form on them. Benthic microalgae are also found in the top few centimeters of sediment. Where significant wave action occurs along the bayside margin of the barrier headland or island, fine sand may be reworked into small beaches and sandy intertidal flats. Waves keep silts and clays suspended until they eventually settle in deeper water or on protected intertidal mud flats. Sand flats are the preferred habitats of various invertebrates, crustaceans, and mollusks (USFWS 2011a).

Open Water

Major waterbodies associated with the headland include the Gulf of Mexico, Bayou Lafourche, Caminada Bay, Caminada Pass, Bay Champagne, and Bayou Moreau. The back-barrier marsh of the headland is crossed by numerous oil and gas access canals. Turbidity levels over much of the project area are too high for the growth of submerged aquatic vegetation (USFWS 2011a). Turbidity and the soft, highly organic sediments of Louisiana's estuaries and offshore areas limit the widespread distribution of higher salinity seagrass beds (DOI-MMS 2002).

3.2.2 Aquatic Resources and Communities

3.2.2.1 Benthic Resources

Benthic animals are directly or indirectly involved in most of the physical and chemical processes that occur in estuaries (Day *et al.* 1989). Some epibenthic organisms, such as oysters and mussels, provide commercial and recreational fisheries as well as create oyster reef habitats used by many marine and estuarine organisms. The bottom of an estuary regulates or modifies most physical, chemical, geological, and biological processes throughout the entire estuarine system via the *benthic effect*. The benthic habitat is a storehouse of organic matter and inorganic nutrients and a site for vital chemical exchanges and physical interactions. Benthos generally includes the entire bottom community and its immediate physical environment, termed the *benthic boundary layer* (Day *et al.* 1989). Major benthic consumer groups include bacteria and fungi, microalgae, meiofauna, and microfauna (Mitsch and Gosselink 1993).

The benthic community structure is not static; it provides a residence for many sessile, burrowing, crawling, and some swimming organisms (Day *et al.* 1989). The composition and distribution of the macroinfaunal community (relatively large organisms living beneath the sediment surface) in an area is a function of the response of individual species to factors such as sediment characteristics, salinity regime, position in the intertidal zone, and oxygen levels.

Benthic fauna include infauna (animals living in the substrate, including burrowing worms, crustaceans, and mollusks) and epifauna (animals living on or attached to the substrate; mainly crustaceans, as well as echinoderms, mollusks, hydroids, sponges, and soft and hard corals) (DOI-MMS 2002). Shrimp and demersal fishes are closely associated with the benthic community. Substrate is the most important factor in the distribution of benthic fauna. Densities of infaunal organisms increase with sediment particle size (Defenbaugh 1976), although the distribution is also influenced by temperature, salinity, depth, and distance from shore (Defenbaugh 1976). Less important factors include illumination, food availability, currents, tides, and wave shock. The density of offshore infauna is generally greater during the spring and summer than the winter (Brooks 1991).

The density of the macrobenthic fauna was low in the lower portions of the Barataria Basin (Connor and Day 1987). However, there are no clear patterns of benthic abundance in the Barataria system. Peak seasonal and lowest abundances vary according to different salinity regimes and may be correlated to the salinity pattern of an area, or migratory patterns of estuarine-dependent predators (Connor and Day 1987).

Strand biota commonly seen on sandy Gulf of Mexico beaches are not residents, but are transient offshore fauna (Britton and Morton 1989). Three groups of strand biota (bottom dwelling, flotsam dwelling, and *Sargassum*-associated) are carried onto the upper beach by high tides and storm waves. Bottom-dwelling strand biota can include shells, sea whips, sea pens, sand dollars, and worm tubes. The flotsam-attached biota includes gooseneck barnacles *(Lepas anatifera)*, marine wood boring isopods, Portuguese man-o-war *(Physalia physalia)*, jellyfish, mollusks, and crustaceans. *Sargassum*-associated strand biota includes *Sargassum* algae. Sessile biota may remain attached to the algae, whereas motile biota may cling to the algae but can exist independently (Britton and Morton 1989).

Two natural environmental perturbations that occur over the Louisiana continental shelf and threaten Ship Shoal benthic communities are anoxic to hypoxic bottom conditions and tropical cyclones. Conditions change annually from anoxic to hypoxic with inconsistent intensities and ranges (Rabalais *et al.* 1993). On average, a tropical cyclone occurs on the Louisiana Continental Shelf once every four years; these cyclones vary in intensity (Stone 2000). It can take from one to two years for the benthic communities to recover from these events (Baker *et al.* 1981).

Ship Shoal is a high-relief subaqueous shoal composed of fine sand; the diversity of benthic macrofauna is high and the community structure differs from the surrounding deeper and muddier environments (Stone *et al*. 2009). Thus, Ship Shoal could be an important biodiversity hot spot and may serve as a stepping-stone for gene flow (Stone *et al*. 2009). The macrobenthic community on Ship Shoal has high biomass (average of 26.7 g/m^2) and high diversity (161 species) (Dubois *et al.* 2009). Species diversity and total abundance significantly increase with decreasing sediment grain size and increasing bottom water dissolved oxygen. Most species are polychaetes (45 percent; 72 species), dominated by spionids, and crustaceans (28 percent; 46 species), dominated by amphipods. Mole crabs *(Albunea paretti)* and amphioxus *(Branchiostoma floridae)* were present across seasons and contributed most to the biomass. The polychaetes *Neptys simony*, *Neanthes micromma*, *Dispio unicinata*, *Mediomastus californicus*, and *Magelona* sp., the amphipod *Acanthohautorius* sp. and the estuarine longeye shrimp *(Ogyrides alphaerostris)* were seasonally abundant (Dubois *et al.* 2009).

Ship Shoal is a distinct faunal habitat for macroinvertebrates in a transition zone between inshore and offshore habitats (Stone *et al*. 2009). Macroinfauna are a unique combination of sandy beach swash zone communities associated with the Mississippi River and the northwest seashore; from shallow enclosed bays of the northern Gulf; and/or from muddy offshore environments. Half of the polychaete species on Ship Shoal were previously reported only from continental shelves of Florida or Texas and Florida. Ship Shoal and other sandy shoals in Louisiana could be important in the dispersal and gene flow of benthic species over the Gulf continental shelf (Stone *et al*. 2009). Ship Shoal may be a source pool for recruitment of benthic invertebrates to surrounding areas affected by seasonal hypoxia (Stone *et al*. 2009).

The benthic community of Ship Shoal differed from other Louisiana continental shelf areas in a study by Baker *et al.* (1981) (Table 3-4). Macroepifauna on Ship Shoal were primarily Osteichthyes (69.3 percent) and decapod crustaceans (30.7 percent) (Table 3-4). Ship Shoal decapods were similar in taxonomic composition, but lower in diversity, than Louisiana continental shelf decapods (Baker *et al.* 1981).

3.2.2.2 Plankton Resources

The three types of plankton are bacterioplankton, phytoplankton, and zooplankton (Knox 2001). Bacterioplankton are the bacterial component of plankton and carry out a broad array of essential chemical transformations critical to the ecological function of aquatic systems. Bacteria are the most important decomposers of organic matter. Bacteria can fix nitrogen from dinitrogen gas and are the only organisms capable of converting it to the inert dinitrogen form (i.e., denitrification). Bacteria also transform sulfur, iron, manganese, mercury and many other elements in aquatic systems.

Table 3-4. Percent Taxonomic Composition of Meiofauna, Macroinfauna and Macroepifauna for the Baker *et al.* (1981) study

Category and Taxa	Ship Shoal (Percent)	Louisiana Continental Shelf (Percent)
Meiofauna		
Foraminifera	0.2	55.3
Nematoda	97.0	34.7
Macroinfauna		
Polychaeta	62.6	69.0
Macroepifauna		
Osteichthyes	69.3	32.8
Decapoda	30.7	25.7

Phytoplankton are single-cell algae that drift with the motion of water. Diatoms and dinoflagellates are the dominant groups of phytoplankton; other important groups include cryptophytes (unicellular algae), chlorophytes (green algae), and chrysophytes (golden algae). The species composition of a given phytoplankton community is a function of various environmental factors including salinity, turbidity, nutrients, turbulence, and depth (Day *et al.* 1989).

Phytoplankton provide a major, direct food source for animals in the water column and sediments; are responsible for at least 40 percent of photosynthesis; and have an important role in nutrient cycling (Day *et al.* 1989). Phytoplankton productivity is a major source of primary food energy for estuarine systems throughout the world and the major source of autochthonous organic matter in most estuarine ecosystems (Day *et al.* 1989). There is also a public health concern with blooms of toxin-producing phytoplankton (red and brown tides), large-scale blooms can lead to hypoxia and cause fish kills.

Zooplankton are faunal components of the plankton, and include small crustaceans such as copepods, ostracods, euphausiids, and amphipods; jellyfishes and siphonophores; worms; mollusks such as pteropods and heteropods; and egg and larval stages of most benthic and nektonic animals (Rounsefell 1975). Zooplankton consist of two broad categories, holoplankton, (planktonic species as adults) and meroplankton (organisms occurring in the plankton during early life stages before becoming benthic or nektonic). Zooplankton are eaten by a variety of estuarine consumers and have an important role in nutrient cycling. In most estuaries, zooplankton feed on phytoplankton and/or ingest detritus (Conner and Day 1987). Most zooplankton are filter feeders and the suspended detritus particulate material in the waters of the Barataria Basin are likely a major food source. Zooplankton provide the trophic link between phytoplankton and intermediate-level consumers such as aquatic invertebrates, larval fishes, and smaller forage fishes (Day *et al.* 1989). Most fish and other nekton are only part of the planktonic community during early stages of their life cycles (Thompson and Forman 1987).

In the Barataria Basin, the zooplankton community is dominated by copepods of the genus *Acartia* (Gillespie 1971, 1978; Bouchard and Turner 1976; Conner and Day 1987). The copepod *Acartia tonsa* is the dominant member of the zooplankton community throughout Louisiana (Perret *et al.* 1971). Zoeae (a larval stage of some crustaceans) can be a large component of the meroplankton. Fish eggs and larvae from Gulf menhaden (*Brevoortia patronus),* bay anchovy (*Anchoa mitchilli),* inland silverside *(Menidia beryllina)*, and striped mullet *(Mugil cephalus*) are found throughout the Barataria Basin (Conner and Day 1987). In some Louisiana waters, zooplankton are dominated by Harris mud crab *(Rhithropanopeus harrisii)* zoea.

Biological factors affecting zooplankton densities include predation by nekton and ctenophores, meroplankton larval stage duration, and changes in the aquatic environment caused by zooplankton populations (Bouchard and Turner 1976; Conner and Day 1987). Physical factors affecting zooplankton populations include tidal flushing, inflow of fresh water carrying organic detritus, river discharge, water depth, tidal changes, turbidity, and dissolved oxygen (Conner and Day 1987). The distribution of zooplankton is mainly influenced by salinity (Bouchard and Turner 1976). Some zooplankton are euryhaline, others have distinct salinity preferences. Salinity may primarily control the number of species, whereas temperature, competition, and predation may control the number of individuals (Perret *et al.* 1971). Spring zooplankton peaks appeared to be related to temperature in at least one study (Gillespie 1978).

The pelagic offshore plankton contain primary producers (phytoplankton and bacteria; 90 percent of the phytoplankton in the northern Gulf are diatoms) and secondary producers (zooplankton). Offshore zooplankton consists of holoplankton (including protozoans, gelatinous zooplankton, copepods, chaetognaths, polychaetes, and euphausids) and meroplankton (including polychaetes, echinoderms, gastropods, bivalves, and fish larvae and eggs) (DOI-MMS 2002).

Temperature, salinity, and nutrient availability limit the geographical and vertical ranges of plankton and consumers. The species diversity, standing crop, and primary productivity of offshore phytoplankton fluctuate less than coastal phytoplankton because salinity, nutrient availability, vertical mixing, and zooplankton predation change less frequently in offshore waters (DOI-MMS 2002). In general, diversity of pelagic plankton generally decreases with decreased salinity, and biomass decreases with distance from shore. Shelf phytoplankton and zooplankton are more abundant, more productive, and seasonally more variable than deep Gulf plankton. The difference is related to salinity changes, greater nutrient availability, increased vertical mixing, and differences in zooplankton predation in the shelf environment (DOI-MMS 2002).

The neuston, composed of organisms living at the air-seawater interface is also essential to the offshore environment (DOI-MMS 2002). Abundant neuston includes copepods, floating *Sargassum*, and *Sargassum*-associated organisms. As many as 100 different animal species can be found in the Gulf *Sargassum*, primarily hydroids and copepods, but also fishes, crabs, gastropods, polychaetes, bryozoans, anemones, and sea spiders. *Sargassum* rafts are also long-term havens for young sea turtles, which can drift with the algae as they feed, possibly for several years (DOI-MMS 2002).

The average algal biomass over Ship Shoal varies seasonally. Sediment algal biomass was highest in spring and summer when it exceeded that of the overlying water column over much of Ship Shoal (Stone *et al*. 2009). Light reaches the seafloor on Ship Shoal to stimulate the growth of benthic algae year round (Stone *et al*. 2009). The bottom benthic algae biomass is high and the high proportion of diatoms (compared to settled phytoplankton) suggests that the benthic primary production may comprise most of the primary production on Ship Shoal (Stone *et al*. 2009).

3.2.2.3 Fish and Macroinvertebrates

Caminada Headland

The Caminada Headland has a variety of aquatic habitats, including large expanses of shallow open water. These saline areas typically do not contain submerged aquatic vegetation. The moderate- to high-salinity marine and estuarine waters and shoreline habitat in the project area provide nursery, spawning, and foraging habitat for many estuarine-dependent commercially and recreationally important finfish and shellfish species. Most of the economically important saltwater fishes and crustaceans harvested in Louisiana spawn offshore and then use estuarine areas for a nursery habitat (Herke 1971). Populations of most major commercially important fish and invertebrate species have been declining throughout the project area, only Spanish mackerel *(Scomberomorus maculatus)* populations have increased (LCWCRTF and WCRA 1998; Saucier and Baltz 1993; Zimmerman and Minello 1984; Rozas and Odum 1987; Hettler 1989; Kneib 1991; Rozas 1992; Rozas and Reed 1993).

Barataria Bay’s headland and shoreline habitats provide unique nursery, foraging, predator refugia, and spawning habitat for many economically important transient marine and estuarine species that prefer, or are dependent on, these transitional habitats during portions of their life history. Barrier headlands and islands provide three primary habitats for shellfish and finfish that can have quite different fish fauna. These habitats include the surf zone beach; back island low-energy zones that are sand and mud flats or marsh; and intra-island ponds, lagoons, and meanders.

The surf zone is temporarily used by larvae and juveniles before they are carried by currents to back-barrier, bay, or mainland habitats (Williams 1998). Common surf zone species in the area include bay anchovy, Gulf menhaden, inland silverside, striped anchovy *(A. hepsetus)*, Florida pompano *(Trachinotus carolinus)*, scaled sardine *(Harengula jaguana)*, and rough silverside *(Membras martinica)*. Barrier headland and island sandflats are typically used by Gulf menhaden, inland silverside, grass shrimp (*Palaemonetes* sp.), white mullet *(Mugil curema)*, longnose killifish *(Fundulus similis)*, striped mullet, spot *(Leiostomus xanthurus)*, and darter goby *(Ctenogobius boleosoma)* (Williams 1998). The surf zone is also important foraging habitat for larger predators, including red drum (*Sciaenops ocellatus*), Spanish mackerel, spotted seatrout (*Cynoscion nebulosus*), flounder, and coastal sharks.

Marsh edge habitats in the area are used by brown shrimp *(Farfantepenaeus aztecus),* white shrimp *(Litopenaeus setiferus),* Atlantic croaker (*Micropogonias undulatus*), spotted seatrout, sheepshead minnow *(Cyprinodon variegatus)*, longnose killifish, sand seatrout *(C. arenarius)*, bay anchovy, striped mullet, blue crab (*Callinectes sapidus),* white mullet, striped anchovy, grass shrimp, inland silverside, spot, longnose killifish, Gulf menhaden, thin striped hermit crab (*Clibanarius vittatus)*, lesser blue crab (*C. similis)*, darter goby, skilletfish (*Gobiesox strumosus)*, longwristed hermit crab (*Pagurus longicarpus)*, xanthid mud crab, oystershell mud crab (*Panopeus simpsoni),* and snapping shrimp (*Alpheus* sp.) (Foreman 1968; Zimmerman 1988; Williams 1998; Roth 2009).

The headland's coastal wetlands provide nursery and foraging habitats that support economically important marine fishery species, such as Atlantic croaker, red drum, black drum (*Pogonias cromis*), bay anchovy, spotted seatrout, Gulf menhaden, striped mullet, tarpon (*Megalops atlanticus*), and southern flounder (*Paralichthys lethostigma*). Commercial and recreational shellfish species include blue crab, white shrimp, brown shrimp, Eastern oyster *(Crassostrea virginica)*, and Gulf stone crab *(Menippe adina).* Many of these species are prey for other Federally managed fishery species such as mackerels, snappers, groupers, billfishes, and sharks.

Common tidal creek species in the area include bay anchovy, hardhead catfish *(Ariopsis felis)*, Gulf menhaden, Atlantic croaker, inland silverside, brown shrimp, white shrimp, spotted seatrout, sheepshead minnow, longnose killifish, and sand seatrout (Fox and Mock 1968; Foreman 1968; Zimmerman 1988). Young-of-the-year red drum and mangrove snapper *(Lutjanus griseus)* are common in intra-island creeks and ponds during postlarval early juvenile stages (Thompson 1988).

Other finfish and crustaceans found in the project area waters include: gafftopsail catfish *(Bagre marinus)*, Spanish mackerel, bull shark *(Carcharhinus leucas)*, ladyfish *(Elops saurus)*, Atlantic needlefish *(Strongylura marina)*, Gulf killifish *(Fundulus grandis)*, fat sleeper *(Dormitator maculatus)*, gobies, speckled worm eel *(Myrophis punctatus)*, least puffer *(Sphoeroides parvus)*, Gulf pipefish *(Syngnathus scovelli)*, Atlantic spadefish (*Chaetodipterus faber*), alligator gar (*Atractosteus spatula*), pink shrimp (*Farfantepenaeus duorarum)*, seabob *(Xiphopenaeus kroyeri)*, roughneck shrimp *(Rimapenaeus constrictus)*, and mysid shrimp. Other invertebrates in the project area include *Rangia* clams, jellyfish, and ctenophores (USFWS 2011a).

Ship Shoal

Fish species in the Gulf of Mexico are generally temperate, with incursions of subtropical Caribbean fauna (DOI-MMS 2002). Seasonal distribution and abundance fluctuations of Gulf fishes are generally related to oceanographic conditions. Small changes in habitat quality can affect juvenile fish growth and survival and have large impacts on the number of fish produced by a specific habitat (Diaz *et al.* 2003).

Bottom substrate can affect community structure of fish and macroinvertebrates. Fish usage can be connected with bedform size and density of biogenic structures such as polychaete tubes, megafauna, pits, or fecal mounds (Diaz *et al.* 2003). Large bedforms with some biogenic structure had the highest occurrence of fishes; reductions in physical relief (from large to small bedforms) resulted in a significant decline in fish occurrence. Shoals with a steeper grade also had greater abundance; however, flat-bottom habitats had greater abundance, species richness, and species diversity than shoal habitats (Slacum *et al.* 2010). This may have been due to the availability of benthic forage in flat-bottom habitats. In the western Gulf, Brooks *et al.* (2003) concluded that the sand bank, in particular, the interior of the sand bank is important habitat for demersal fish.

Ship Shoal supports estuarine-dependent species such as white and brown shrimp and spotted seatrout fisheries as well as Federally managed species such as mackerels, snappers, groupers, billfishes, and sharks. These species are major components of the Ship Shoal ecosystem. Shrimp and Atlantic croaker on Ship Shoal were typically found in lower numbers than at offshore stations. Ship Shoal is an extremely productive ground for demersal fishes (Baker *et al.* 1981). The biomass of demersal fishes on Ship Shoal was much higher [151.8 lbs/hr (68.7 kg/hr)] than the biomass on the Louisiana continental shelf, on average [43.3 lbs/hr (19.6 kg/hr)] (Baker *et al.* 1981).

From at least April through October, Ship Shoal and much of the surrounding area form an important offshore spawing/hatching/ foraging ground for a large segment of the Gulf of Mexico blue crab fishery (Condrey and Gelpi 2010). Persistent concentrations of spawning, hatching, and foraging female blue crabs have been observed on Ship Shoal (Condrey and Gelpi 2010). During April-October, mature female crabs may spawn continuously, producing new broods approximately every 21 days while actively foraging. Ship and Trinity Shoals appear to be the most important spawning/hatching/foraging grounds for blue crab, especially in August (Stone *et al*. 2009).

3.2.2.4 Invasive Species

Invasive Vegetation

Chinese tallow and other invasive plant species have been observed occasionally, but no problems caused by encroachment of invasive plant species have been reported on Louisiana's headlands and barrier islands. Extreme environmental conditions, such as higher salinities, shifting substrates, and frequent storm disturbance may limit suitability of the habitat for colonization (USFWS 2011a).

Invasive Fish and Invertebrate Species

The Australian spotted jellyfish *(Phyllorhiza punctata),* indigenous to the tropical western Pacific Ocean, is the most likely invasive species to be found in Gulf waters adjacent to the Caminada Headland and over Ship Shoal. Populations of this jellyfish are established in the area and have been collected near the project area in Terrebonne Bay, Lake Pelto, Isles Dernieres, and Grand Isle near Barataria Pass from 1998 through 2005 (USGS 2011). Small numbers of several other invasive species were collected near the project area. The Asian tiger shrimp *(Penaeus* *monodon)* was collected in Bayou Terrebonne near Seabreeze Pass and off Grand Isle (USGS 2011). The titan acorn barnacle *(Megabalanus coccopoma)* was found at the eastern tip of Grand Isle (USGS 2011).

3.2.3 Wildlife Resources

3.2.3.1 Amphibians, Reptiles, Terrestrial Mammals, and Invasive Wildlife Species

Reptiles and Amphibians

Terrestrial reptiles in saline marshes are limited primarily to the Gulf salt marsh snake (*Nerodia clarkii*) and diamond-backed terrapin (*Malaclemys terrapin*) (USFWS 2011a, b). Five sea turtles species are found in the Gulf of Mexico, the leatherback *(Dermochelys coriacea)*, hawksbill *(Eretmochelys imbricate)*, green *(Chelonia mydas)*, loggerhead *(Caretta caretta)*, and Kemp's ridley *(Lepidochelys kempii)*. Sea turtles are discussed in more detail in Section 3.3.2.2.

Amphibians have permeable skin and need to osmoregulate, and are generally restricted to the less-saline, upper portions of the Barataria Basin (USFWS 2011a, b). The only species typically found in the salt marsh is the Gulf coast toad *(Incilius valliceps)*. Little information is available on their distribution on the headland and barrier islands (Mabie 1976). The eastern narrow-mouthed toad *(Gastrophryne carolinensis)* has been found on Gulf beaches in southeastern Louisiana and a salt marsh in Cameron Parish (Dundee and Rossman 1989; USFWS 2011a, b).

Terrestrial Mammals

Because of their life history requirements, most mammals are unlikely to occur in the project area (USFWS 2011a, b). The swamp rabbit *(Sylvilagus aquaticus)* is found on the Caminada Headland. Raccoons *(Procyon lotor)* and coyotes *(Canis latrans)* are the most likely mammals to occur on the headland. There has been an apparent overall decline in furbearers that were historically present in the project area over the past 10 to 20 years (LCWCRTF and WCRA 1999).

Invasive Wildlife Species

Nutria *(Myocaster coypus)* and feral hogs *(Sus scrofa)* are typically found in freshwater swamps and marshes and are the primary invasive mammalian species throughout the Barataria Basin (Condrey *et al.* 1995; USFWS 2011a, b). Invasive avian species in the Barataria Basin include the monk parakeet, Eurasian collared-dove, European starling, English sparrow, and cattle egret. However, these birds are not likely to occur in the project area (USFWS 2011a, b).

3.2.3.2 Marine Mammals

The marine mammals of the Gulf of Mexico include members of the order Cetacea, which is divided into the suborders Mysticeti (i.e., baleen whales) and Odontoceti (i.e., toothed whales), as well as the order Sirenia (manatees). There are 28 species of cetaceans (7 mysticete and 21 odontocete species) and 1 sirenian species, the Florida manatee (*Trichechus manatus latirostris*) in the Gulf (Jefferson *et al.* 1992; Davis *et al.* 2000).

Bottlenose dolphins (*Tursiops truncatus)* and Atlantic spotted dolphins (*Stenella frontalis*) are common in shallow Gulf waters, up to 656 feet (200 m) deep. Bottlenose dolphins are common over the continental shelf and upper slope waters of the northern Gulf and feed on a wide variety of fishes, cephalopods, and shrimp (Davis and Fargion 1996; Jefferson and Schiro 1997; Wells and Scott 1999). There appears to be two bottlenose dolphin ecotypes, a coastal form and an offshore form (Hersh and Duffield 1990; Mead and Potter 1990). Inshore stocks are further divided into 32 separate provisionally delineated northern Gulf bay, sound, and estuarine stocks (Waring *et al*. 2010). The bottlenose dolphin is the primary marine mammal commonly observed in estuarine/marine open water portions of the project area (USFWS 2011a, b). Various whale species have been documented in nearby offshore waters (USFWS 2011a, b). The Atlantic spotted dolphin is endemic to tropical to temperate waters (Perrin *et al.* 1987, 1994a) and feeds on a wide variety of fishes, cephalopods, and benthic invertebrates (Leatherwood and Reeves 1983; Jefferson *et al.* 1993; Perrin *et al.* 1994a). In the Gulf, Atlantic spotted dolphins are commonly observed in continental shelf waters less than 6,556.2 feet (200 m) deep.

The sperm whale is common in oceanic waters of the northern Gulf and may be a resident species, whereas the baleen whales are considered rare or extralimital in the Gulf (Würsig *et al.* 2000).

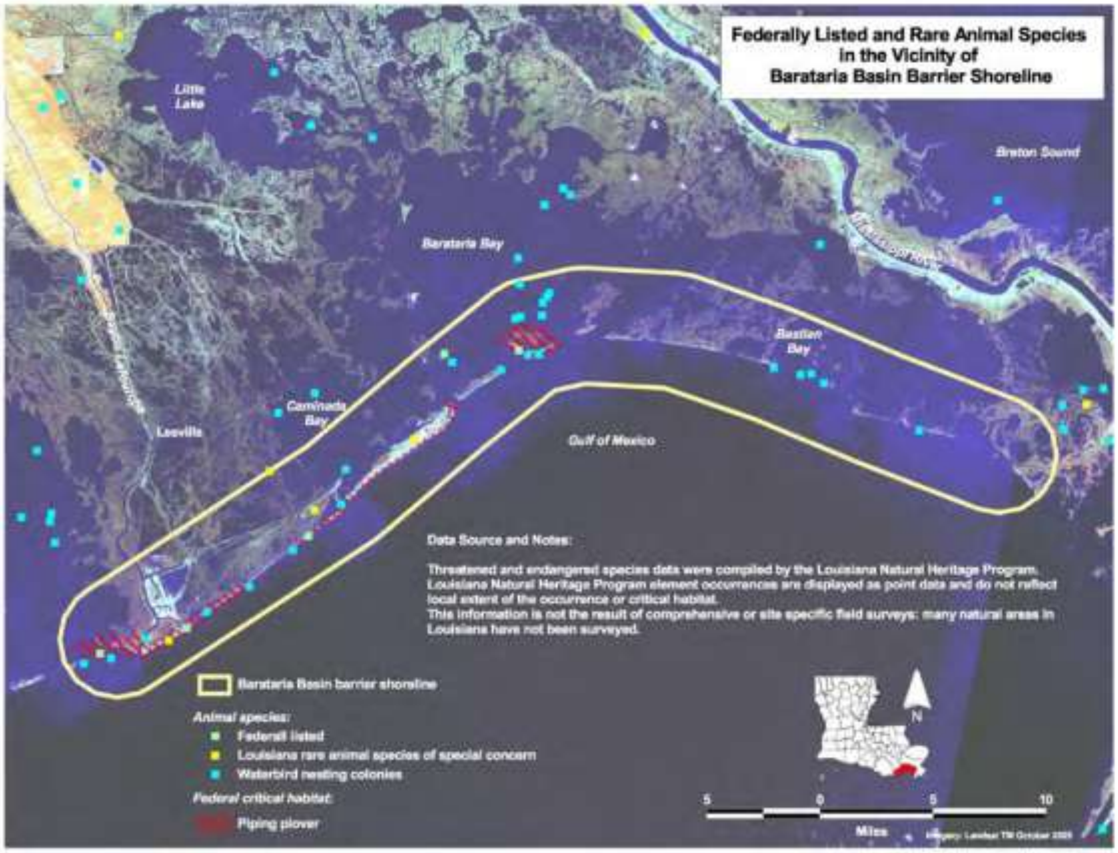
3.2.4 Avian Communities

Federal protection of birds may fall under the Migratory Bird Treaty Act (MBTA) and/or the U.S. Endangered Species Act (ESA). The offshore waters, coastal beaches, and contiguous wetlands of the northeastern Gulf are populated by resident and migratory coastal and marine birds. Avian use of wetlands near the project area varies, depending upon seasonal and environmental conditions (USFWS 2011a,b). Major groups of birds in the area include songbirds, shorebirds, waterfowl, diving birds, marsh and wading birds, seabirds, and raptors. Waterbird nesting colonies in and near the project area are shown in Figure 3-4 (the Caminada Headland is in the lower left portion of the figure). Bird nesting colonies are present within one mile of this proposed project (Kyle F. Balkum, LDWF, pers. comm., Nov. 15, 2011).

Bird species observed over Ship Shoal are predominantly trans-migrant shorebirds, wading birds, and waterfowl that briefly occupy the project area. Many bird species are pelagic and rarely sighted nearshore. Fidelity of birds to nesting sites varies from year to year along the Gulf Coast (Martin and Lester 1991).

Migratory Birds

Migrant birds often concentrate along shorelines, the ends of peninsulas, and offshore islands to rest and feed before and after crossing waters (Askins 2002). Trans-Gulf migrants use the Caminada Headland and surrounding areas as a staging area and as a final departure area for their fall migration as well as the first landfall during spring migration. The Barataria Basin is the terminus of the Mississippi Flyway, the largest waterfowl migration route in North America (Bahr and Hebrard 1976).



Source: USACE 2012; Louisiana Natural Heritage Program.

Figure 3-4. Important Bird Areas in the Lower Barataria Basin

Songbirds

The Caminada Headland provides important stopover habitat for migrating Neotropical birds (USFWS 2011b). Because of their life history requirements, few other bird species are expected to inhabit the surrounding marshes and open water areas of the project area except as temporary staging areas before and after trans-Gulf migrations (USFWS 2011a). The seaside sparrow *(Ammodramus maritimus)* is associated with pounding surf and densely matted grasses and sedges along the shorelines of Louisiana beaches; nests are often constructed a foot or so high in mangrove bushes (Lowery 1974). Songbird populations in the project area have generally been steady in the marsh and open water areas surrounding the Caminada Headland (LCWCRTF and WCRA 1999).

Shorebirds

The five families of Gulf of Mexico shorebirds include: jacanas (*Jacanidae* sp.), oystercatchers *(Haematopus ostralegus*), stilts (*Himantopus himantopus*) and avocets (*Recurvirostr*a sp.), plovers (*Charadrius* sp.), and sandpipers (*Tringa* sp.), and snipes (*Gallinago* sp.) (Hayman *et al.* 1986). Shorebirds in the area include the piping plover (*Charadrius melodus*), semipalmated sandpiper (*Calidris pusilla*), western sandpiper (*Calidris mauri*), curlew (*Numenius arquata*), ruddy turnstone (*Arenaria interpes*), American avocet (*Recurvirostra americana*), oystercatcher (*Haematopus ostralegus*), greater yellowlegs (*Tringa melanoleuca*), common snipe (*Gallinago gallinago*), and killdeer (*Charadrius vociferous*) (USFWS 2011a). Coastal Gulf islands, including the nearby Isles Denieres, are important areas for many bird species of conservation concern, including the snowy plover (*Charadrius alexandrines*), Wilson's plover (*C. wilsonia*), piping plover, American oystercatcher (*Haematopus palliates*), gull-billed tern (*Gelochelidon nilotica*), Caspian tern (*Hydroprogne caspia*), royal tern (*Thalasseus maxima*), Sandwich tern (*T. sanvicensis*), common tern (*Sterna hirundo*), Forster's tern (*S. forsteri*), least tern (*Sternula antillarum*), and black skimmer (*Rynchops niger)*. The least tern and willet are among the most common breeding species on nearby Trinity Island (Leumas 2010). Shorebird populations have been steady in the Caminada Headland area for the past 10 to 20 years (LCWCRTF and WCRA 1999).

Shorebirds inhabit saline marsh, and shallow water/mud flat habitats of barrier shorelines and the surrounding estuary. Roosting habitats include beaches, sandbars, spits, or flats above high tide and shallowly flooded areas or islands free of vegetation (Helmers 1992). Nearly all shorebird species migrate; some shorebirds migrate from nesting places in the far north to the southern part of South America (Terres 1991). Many shorebird species are regular to accidental migrants, although some species are common residents throughout the project area.

The piping plover inhabits coastal sandy beaches and mudflats and is the only threatened bird that may occur in the project area. The Caminada Headland has been designated critical habitat for the piping plover (USFWS 2010) (see Section 3.3.2.3).

Waterfowl

At least 27 species of waterfowl (swans, geese, and ducks) are regularly reported along the north-central and western Gulf Coast. Many waterfowl species migrate from wintering grounds along the Gulf Coast to summer nesting grounds in the northern U.S. (DOI-MMS 2004). However, waterfowl are not historically present on barrier shorelines (USFWS 2011a).

Diving Birds

The three main groups of diving birds are cormorants and anhingas, loons, and grebes. Diving birds inhabit fresh and saltwater environments. They have webbed feet and dive into the water to feed on fish and other aquatic species.

Wading Birds

Wading birds live in marshes and shallow water, feeding on fish, frogs, aquatic insects, crustaceans, and other prey (Terres 1991). Wading bird families in the northern Gulf include herons, bitterns, egrets, storks, ibises and spoonbills, and cranes (USACE 2012). Most wading bird colonies (herons and egrets) are found in swamps, although many species also nest on barrier islands and in fresh-to-saline marshes with shrubs and mangroves (Condrey *et al.* 1995).

Since 1985, wading bird population trends in the Caminada Headland salt marsh and barrier beaches have been steady (LCWCRTF and WCRA 1999).

Seabirds

All birds reported in Gulf studies are protected under the MBTA, including members of the seabird guild, which represents a wide range of species dependent on the resources of the Gulf pelagic zone. Seabirds spend much of the time in or over water and are capable of staying far from land for long periods. Most of these birds have adaptive salt glands that allow them to regulate the salt content in their blood (Ehrlich *et al.* 1998). Most seabird species are colonial nesters that leave the nest to venture far from natal areas. Seabirds in the project area include the magnificent frigatebird (*Fregata magnificens*), greater shearwater (*Puffinus gravis*), sooty shearwater (*P. grisseus*), Audubon's shearwater (*P. lherminieri*), manx shearwater (*P. puffiinus*), masked booby (*Sula dactylatra*), northern gannet (*Morus bassanus*), Wilson's storm-petrel (*Oceanites oceanicus*), and band-rumped storm-petrel (*Oceanodrama castro*). Gulls and terns, pelicans, and cormorants divide their time more or less equally between offshore and coastal waters (Ehrlich *et al.* 1988) and can occur in the project area.

The four ecological groups of seabirds that have been documented over deepwater areas of the Gulf are summer migrants (e.g., shearwaters, storm petrels, and boobies); summer residents that breed in the Gulf (e.g., sooty, least, and sandwich terns, and frigate birds); winter residents (e.g., gannets, gulls, and jaegers); and permanent resident species (e.g., laughing gulls and royal and bridled terns) (Hess and Ribic 2000; DOI-MMS 2001). Most seabird species nest on islands that are remote and lack predators. Non-island breeding sites are more frequently abandoned by seabird species than barrier island sites, which are normally used for 10 or more years (USFWS 2011a). Coastal Louisiana has the largest concentration of colonial wading birds and seabirds in the U.S. During a 2001 survey, 197 colonies of wading birds and seabirds (representing 215,249 pairs of nesting birds) were observed (Michot *et al.* 2003). Seabird populations in the salt marshes and open water areas near the Caminada Headland have been steady (LCWCRTF and WCRA 1999).

More than 70 species of birds have been observed in the Gulf of Mexico from 1996 to 2005 (Davis and Fargion 1996; Davis *et al.* 2000; Avent 2004; Russell 2005). The status and movements of pelagic bird species are difficult to monitor because surveys are conducted offshore under marine field conditions and bird movement is weather dependent. Few surveys dedicated to bird behavior and populations have been done in the Gulf of Mexico. Many marine mammal surveys contain ancillary pelagic and migratory bird observations. Marine mammal movements and pelagic bird species in the Gulf are often associated with the increased primary productivity of the Loop eddies and cold core currents (Ribic *et al.* 1997; Wursig *et al.* 2000; Russell 2005).

The brown pelican (*Pelicanus occidentalis*) is a coastal seabird. Brown pelicans forage in shallow estuarine waters and use sand spits and offshore sand bars as resting and roosting areas. There has been an overall increasing trend of pelicans in the project area since 1985 (USFWS 2010). Pelicans inhabit coastal areas and nests have been observed on Queen Bess Island northeast of the Caminada Headland. However, no known brown pelican nesting sites are within the project area.

Colonial Nesting Birds
Colonial nesting birds have been reported within one mile of the proposed project (Kyle Balkum, LDWF, pers. comm. Sept.21, 2011). Colonies can contain numerous species of birds, including gulls, terns, skimmers, wading birds, and brown pelicans.

Raptors
The northern harrier is the most important raptor over Louisiana coastal marshes (USFWS 2011a). The sharpshinned hawk, Cooper's hawk, peregrine falcon, and bald eagle may occur over marshes when perches and suitable nesting trees are available. These species prey on shorebirds and waterfowl in marshes. The bald eagle is protected under the Bald and Golden Eagle Protection Act. The osprey nests near the water and preys on fish (USFWS 2011a). Suitable nesting or roosting trees are not present on the Caminada Headland.

3.3 CRITICAL BIOLOGICAL RESOURCES

3.3.1 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-267), requires Federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat (EFH). EFH is defined as *those waters and substrate necessary to fish for spawning, breeding, or growth to maturity*.

EFH habitats designated in and near the project area include estuarine emergent wetlands; mud, sand, and shell substrates; and estuarine and marine water column. Wetlands near the project area are tidally influenced saline marsh and beachfront vegetated primarily with smooth cordgrass, with patches of saltgrass and black mangroves. EFH categories in the proposed borrow area include the marine water column and non-vegetated bottoms. The primary categories of EFH that would be affected by project implementation are estuarine emergent wetlands and sand substrates (Virginia M. Fay, NMFS, pers. comm., Nov. 18, 2011). No Habitat Areas of Particular Concern (HAPCs) are located within or near the project site

Aquatic and tidally influenced wetland habitats in the project area, including the offshore borrow site, are EFH for various life stages of 12 Federally managed species (Table 3-5; Virginia M. Fay, NMFS, pers. comm., Nov. 18, 2011). These species are from the Shrimp, Red Drum, Reef Fish, Coastal Migratory, and Highly Migratory Fishery Management Plans.

Wetlands and water bottoms in and near the project area also provide nursery and foraging habitats for species including Atlantic croaker, Gulf menhaden, striped mullet, sand seatrout, spotted seatrout, southern flounder, black drum, and blue crab. Some of these species serve as prey for other Federally managed fishery species such as mackerels, snappers, groupers, billfishes, and sharks. Wetlands in the project area also produce nutrients and detritus, which contribute to overall productivity of the nearshore Gulf (Virginia M. Fay, NMFS, pers. comm., Nov. 18, 2011).

Table 3-5. EFH for the Species and Life Stages Listed in the Project Area (M – Marine; E-Estuarine)

Species	Life Stage	System	EFH
Shrimp Fishery Management Plan			
Brown shrimp *(Farfantepenaeus aztecus)*	eggs	M	<18-110 m; sand/shell/soft bottom
	larvae/postlarvae	M /E	<82 m; planktonic, sand/shell/soft bottom, SAV, emergent marsh, oyster reef
	juveniles	E	<18 m; SAV, sand/shell/soft bottom, emergent marsh, oyster reef
	adults	M	14-110 m; sand/shell/soft substrate
White shrimp *(Litopenaeus setiferus)*	eggs	M	<9-34 m; sand/shell/soft bottom
	larvae/postlarvae	M/E	<82 m; planktonic, soft bottom, emergent marsh
	juveniles	E	<30 m; soft bottom; emergent marsh
	adults	M	9-34 m; soft bottom
Red Drum Fishery Management Plan			
Red drum *(Sciaenops ocellatus)*	eggs	M	Gulf of Mexico (GOM) < 46 m
	larvae/postlarvae	E	all estuaries planktonic, SAV, sand/shell/soft bottom, emergent marsh
	juvenile	M/E	GOM <5 m, all estuaries, SAV, sand/shell/soft/hard bottom, emergent marsh
	adults	M/E	GOM, 1-46 m, all estuaries SAV, pelagic, sand/shell/soft/hard bottom, emergent marsh
Reef Fish Fishery Management Plan			
Red snapper *(Lutjanus campechanus)*	adults	M	7-146 m; reefs, hard/sand/shell bottom
Lane snapper *(Lutjanus synagris)*	eggs	M	4-132 m: pelagic
	larvae	M/E	4-132 m; reefs, SAV
	juvenile	M/E	<20 m; SAV, mangrove, reefs, sand/shell/soft bottom
Dog snapper *(Lutjanus jocu)*	juvenile	M/E	SAV, mangrove, emergent marsh
Greater amberjack *(Seriola dumerili)*	eggs	M	1-183 m; pelagic
	larvae	M	1-183 m; pelagic
	juvenile	M	1-183 m
Lesser amberjack *(Seriola fasciata)*	eggs	M	pelagic
	larvae	M	pelagic
Gray triggerfish *(Balistes capriscus)*	eggs	M	10-100 m; reefs
	postlarvae/juvenile	M	10-100 m

Table 3-5 (cont'd). EFH for the Species and Life Stages Listed in the Project Area (M – Marine; E-Estuarine)

Coastal Migratory Pelagics Fishery Management Plan			
Cobia *(Rachycentron canadum)*	eggs	M	pelagic
	larvae	M	11-53 m; pelagic
	juvenile	M	5-183 m; pelagic
King mackerel *(Scomberomorus cavalla)*	larvae	M	9-180 m; pelagic
	juvenile	M	<9 m; pelagic
Highly Migratory Pelagics Fishery Management Plan			
Bonnethead shark *(Sphyrna tiburo)*	juvenile	E	<25 m; inlets, estuaries, coastal waters,
	adult	M	<25 m

3.3.2 Threatened and Endangered Species

This section describes the biology of protected species potentially affected by the project. The species listed in Table 3-6 may be present in the area and may be affected by the project.

Table 3-6. Listed Species that could be Affected by the Proposed Project (E=endangered, T=threatened)

Species	Scientific Name	Federal Status
FISHES		
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	**T**
Smalltooth sawfish	*Pristis pectinata*	**E**
SEA TURTLES		
Green turtle	*Chelonia mydas*	**T**
Hawksbill	*Eretmochelys imbricate*	**E**
Kemp's ridley	*Lepidochelys kempii*	**E**
Leatherback	*Dermochelys coriacea*	**E**
Loggerhead	*Caretta caretta*	**T**
BIRDS		
Piping plover	*Charadrius melodus*	**E**
MARINE MAMMALS		
Florida manatee	*Trichechus manatus latirostris*	**E**
Sperm whale	*Physeter macrocephalus*	**E**
Sei whale	*Balaenoptera borealis*	**E**
Humpback whale	*Megaptera novaeangliae*	**E**
Fin (Finback) whale	*Balaenoptera physalus*	**E**
Blue whale	*Balaenoptera musculus*	**E**
Northern right whale	*Eubalaena glacialis*	**E**

Biological opinions affecting this project include: Louisiana Coastal Area Barataria Basin Shoreline Restoration Project, Jefferson, Lafourche, and Plaquemines Parishes, Louisiana (March 28, 2011); and Hopper and Hydraulic Cutterhead Dredging Associated with Sand Mining for Coastal Restoration Projects Along the Coast of Louisiana Using Sand from Ship Shoal in the Gulf of Mexico Central Planning Area, South Pelto Blocks 12, 13, and 19, and Ship Shoal Block 88 (September 19, 2005). The USFWS determined that since this project is a subset of the larger BBBS Project, the biological opinion for the BBBS Project would also cover this project (Jeffrey D. Weller, USFWS, pers. comm., Feb. 28, 2012). The NMFS determined that the Ship Shoal biological opinion that covers hopper dredging associated with sand mining at Ship Shoal for restoration projects along the Louisiana Coast, and analyzes and accounts for the effects of sand mining on ESA-listed species would also cover this project (David Bernhard, NMFS, pers. comm., Jan. 20, 2012)

Historically, smalltooth sawfish were relatively common in the shallow Gulf waters and along the east coast as far north as North Carolina. The current distribution of smalltooth sawfish is likely centered near the southern tip of the Florida peninsula. Recent sawfish observations are limited to Georgia, Florida, and Texas. However, the Texas sighting was unverified and may have been a largetooth sawfish (*P. perotteti*); both species are rare throughout the western Gulf. No known sawfish breeding or juvenile habitats are adjacent to, or associated with, the project area (USFWS 2011a). Smalltooth sawfish are rare in the action area, the likelihood of their entrainment is very low, and the chances of the proposed action affecting them are discountable (NMFS 2005).

Other threatened and endangered species [and Federal status] under the jurisdiction of the NOAA Fisheries Service that can be found in the Gulf of Mexico include elkhorn coral *(Acropora palmate)* [T] and staghorn coral *(A. cervicornis)* [T]. However, these species are not likely to be found in the project area.

3.3.2.1 Gulf Sturgeon

The Gulf sturgeon is a geographically distinct subspecies of the Atlantic sturgeon (*Acipenser oxyrinchus)* and is Federally listed as a threatened species. Gulf sturgeon are anadromous, inhabiting coastal rivers from Louisiana to Florida in cooler months and the Gulf of Mexico, bays, and estuaries during warm months. Mud and sand bottoms and seagrass areas appear to be important habitats. Subadults and adults spend approximately eight to nine months each year in rivers and three to four months during the winter in estuaries or the Gulf of Mexico. Sturgeon less than two years old may remain in rivers and estuaries year-round and not enter the Gulf (USFWS and GSMFC 1995).

Gulf sturgeon may not sexually mature for 8 or 12 years for females and 7 to 9 years for males. Sturgeon spawn in coastal rivers between late winter and early spring (i.e., March to May) and may only spawn in specific rivers. Sturgeon migrate to marine and estuarine waters in the fall. Sturgeon are bottom feeders, feeding on macroinvertebrates, including brachiopods, mollusks, worms, and crustaceans. Sturgeon feed in estuaries and the Gulf of Mexico and do not appear to forage in rivers (NOAA Fisheries 2010).

In Louisiana, Gulf sturgeon have been reported at Rigolets Pass, rivers and lakes of the Lake Pontchartrain Basin, and adjacent estuarine areas. Gulf sturgeon critical habitat is located between the eastern portion of Lake Pontchartrain in Louisiana and Suwannee Sound in Florida. The Gulf sturgeon is unlikely to be present in the project area (NMFS 2005).

3.3.2.2 Sea Turtles

Five sea turtle species are found in the Gulf of Mexico and Caribbean, green, Kemp's ridley, hawksbill, loggerhead, and leatherback. Loggerheads and leatherbacks are Federally listed as threatened; the other three species are endangered. All five species have been observed in Louisiana's coastal waters. These species, in decreasing order of abundance, were Kemp's ridley, loggerhead, green turtle, leatherback, and hawksbill (Fuller *et al.*1987). Sea turtles are not currently known to nest in Louisiana (USFWS 2011a).

Since March 15, 2011, sea turtle strandings have notably increased in the northern Gulf, primarily in Mississippi (NOAA Fisheries 2011c). In 2011, 525 sea turtles stranded along the coasts of Louisiana (148), Mississippi (283), and Alabama (94) (NOAA Fisheries 2011c). Most of the 2011 strandings occurred between March and June. In 2011 (through April 29), 206 sea turtles stranded along the coasts of Louisiana (74), Mississippi (105), and Alabama (27) (NOAA Fisheries 2011c).

Kemp's Ridley
Kemp's ridleys are found in shallow nearshore and inshore waters of the northern Gulf, particularly in Louisiana. In the northwestern Atlantic Ocean, Kemp's ridleys feed in coastal waters as far north as New England during the summer, migrating south during the winter (NMFS and USFWS 1992). Kemp's ridleys have been observed in Louisiana year-round; most of the turtles observed have been juveniles (Fuller *et al.* 1987). The Kemp's ridley is the most abundant sea turtle off the Louisiana coast (Viosca 1961; Gunter 1981) accounting for 67 percent of Louisiana turtles (Fuller *et al.* 1987). In 2011, Kemp's ridley strandings were documented in Louisiana (204), Mississippi (265), and Alabama (66) (NOAA Fisheries 2011c). In 2012 (through April 29), Kemp's ridley strandings were documented in Louisiana (62), Mississippi (99), and Alabama (23) (NOAA Fisheries 2011c). Sea turtles may seasonally use the bays and saline marshes adjacent to, and including, Gulf and barrier island beaches (USFWS 2011a). Kemp's ridleys are observed inshore more frequently than any other sea turtle species (Fuller *et al.* 1987) and are often found in salt marsh waterbodies. In the northern Gulf, Kemp's ridleys may move to deeper water during the winter. No critical habitat for Kemp's ridleys has been designated.

Neonatal Kemp's ridleys feed on *Sargassum*, infauna, and other epipelagic species. Post-pelagic turtles are benthic feeders over sand and mud bottoms, primarily consuming crabs (particularly portunids) and other crustaceans. Hatchlings may become entrained in Gulf eddies, are dispersed by oceanic surface currents, then enter shallow coastal habitats when they reach about

20 cm in length. Low salinity, high turbidity, and high organic content waters, and areas with abundant shrimp appear to be preferred by Kemp's ridleys (Zwinenberg 1977; Hughes 1972). Important feeding grounds for adults and sub-adults include the highly productive white shrimp and Portunid crab beds of Louisiana from Marsh Island to the Mississippi Delta (Hildebrand 1981).

Kemp's ridleys generally nest on beaches or large open waterbodies with seasonal narrow connections to the ocean. Nesting primarily occurs on beaches of the western Gulf from April to July. During the nesting season, females may remain in nearshore waters or may move up to 10 km along the beach before returning to the nesting beach.

Loggerhead

Loggerheads are widely distributed throughout temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans. Loggerheads were the second most abundant sea turtle reported in Louisiana; most of the turtles observed were juveniles (Fuller *et al.* 1987). Their range likely includes all of coastal Louisiana. However, loggerheads have only been reported from Chandeleur Sound, Barataria Bay, and Cameron Parish (Dundee and Rossman 1989), and most were observed east of the Vermilion River (Fuller *et al.* 1987). In 2011, loggerhead strandings were documented in Louisiana (19), Mississippi (10), and Alabama (4) (NOAA Fisheries 2011c). In 2012 (through April 29), loggerhead strandings were documented in Louisiana (2), Mississippi (2), and Alabama (2) (NOAA Fisheries 2011c). No critical habitat has been designated for the loggerhead.

Loggerheads have been seen hundreds of miles offshore or inshore in bays, coastal lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers (USFWS 2010). They remain dormant in the winter, remaining buried in the mud at the bottom of sounds, bays, and estuaries. Loggerheads mainly feed on marine invertebrates including mollusks, shrimp, crabs, sponges, jellyfish, squid, sea urchins, and basket stars (Caldwell *et al.* 1955; Hendrickson 1980; Nelson 1986) and discarded bycatch from shrimp trawling. Feeding areas often include coral reefs, rocky areas, and shipwrecks. Loggerheads may migrate long distances between foraging areas and nesting beaches. Adults typically feed in waters less than 50 meters deep; primary foraging areas for juveniles appear to be estuaries and bays (Nelson 1986; Rabalais and Rabalais 1980).

In the continental U.S., loggerheads nest from Texas to Virginia. Many loggerheads nest from Florida to North Carolina and most (90 percent) nesting occurs on the south-cental Florida Gulf Coast (Hildebrand 1981). Only minor and solitary nesting has historically been observed in Louisiana; nests were seen on the Chandeleur Islands in 1962 and Grand Isle in the 1930s. It is unknown whether loggerheads currently nest in Louisiana. Over the past decade, nesting is estimated to be between 47,000 and 90,000 annually in the U.S. (NMFS and USFWS 2008). Loggerheads nest between late April and early September. During the nesting season, adults remain in nearshore and estuarine waters near nesting beaches. Females generally return to natal beaches to nest. Loggerheads typically nest above the high-tide mark on open beaches or along narrow bays with suitable sand. They may prefer steeply sloped beaches with gradually sloped offshore approaches. Females lay 3 to 5 or more nests during a single nesting season; eggs incubate about two months later. Hatchlings are pelagic, moving to convergence zones (downwelling areas) where seagrass and debris accumulates. Juveniles may remain among *Sargassum* for years; larger juveniles feed in coastal areas. Loggerheads sexually mature at about 35 years.

Green Turtle

Green turtles are found in tropical and sub-tropical waters around the world. In U.S. Atlantic waters, green turtles are found from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico. Distribution is correlated to grassbed distribution, the location of nesting beaches, and associated ocean currents (Hirth 1971; Perrine 2003; Spotila 2004). Green turtles likely occur throughout coastal Louisiana and may nest on the Chandeleur Islands (Dundee and Rossman 1989). The green turtle was the third most abundant sea turtle reported in Louisiana; most turtles observed were juveniles and were primarily in southeastern Louisiana (Fuller *et al.* 1987). During the nesting season, adults remain in nearshore and estuarine waters near nesting beaches. In 2011, green turtle strandings were documented in Louisiana (6), Mississippi (7), and Alabama (4) (NOAA Fisheries 2011c). In 2012 (through April 29), green turtle strandings were documented in Louisiana (3) and Mississippi (1) (NOAA Fisheries 2011c). Critical habitat for green turtles consists of waters surrounding Culebra Island, Puerto Rico.

Long migrations are often made between feeding and nesting grounds (Carr and Hirth 1962). Green turtles are generally found over shallow flats, seagrass and algae areas inside bays and inlets. Resting areas include rocky bottoms and oyster, worm, and coral reefs. Post-hatchling pelagic turtles may be omnivorous. During the first year, green turtles are primarily carnivorous, feeding mainly on invertebrates; adult turtles are herbivorus. Green turtles are the only sea turtles that consume large amounts of plants, feeding in shallow water areas with abundant seagrass or algae (Fritts *et al.* 1983; Spotila 2004).

Green turtles often nest on open high-energy beaches with a sloping platform and minimal disturbance; nests are dug above the high-water line. In Florida, nesting occurs from June to late September. Hatchlings swim to convergence zones and may remain in *Sargassum* rafts. Older turtles leave the pelagic habitat to feed benthically.

Hawksbill

Hawksbills are found in tropical and subtropical seas of the Atlantic, Pacific, and Indian oceans. In the continental U.S., hawksbills have been observed along the Gulf Coast. Although hawksbills have been seen along the east coast as far north as Massachusetts, they are rare north of Florida. Hawksbills are scarce in Louisiana; only one turtle was reported by Fuller *et al.* (1987) off Cameron Parish, Louisiana. A few juvenile (1 to 2 years old) hawksbills have been observed in Texas. No hawksbill strandings were documented in 2011 or 2012 (through April 29) in Alabama, Louisiana, or Mississippi (NOAA Fisheries 2011c).

Hawksbills are frequently found along rocky areas, coral reefs, shallow coastal areas, lagoons, oceanic islands, narrow creeks, and passes. They typically inhabit waters less than 70 feet. Post-hatchlings are pelagic and occupy convergence zones, floating among *Sargassum* and debris (NMFS and USFWS 1993). Juveniles may eat fish eggs, *Sargassum*, and debris; feeding primarily on certain species of sponges once they become benthic. Critical habitat for hawksbills has been designated at Isla Mona, Culebra Island, Cayo Norte, and Island Culebrita, Puerto Rico.

In the continental U.S., hawksbills only nest along the southeastern coast of Florida and the Florida Keys. Hawksbills nest on low- and high-energy beaches, on various types of substrates, and may nest under vegetation. Nesting densities are generally low, ranging from a few dozen to a few hundred females. Hawksbills nest on scattered undisturbed small, deep-sand beaches, except for long expanses of beach on the Gulf and Caribbean coasts of the Yucatán Peninsula, Mexico. Hawksbills nest between April and November in most areas. Females frequently return to the same beach to nest.

Since hawksbills are scarce in Louisiana, there is a very low likelihood that they will be affected by this project.

Leatherback

Leatherbacks are highly migratory and pelagic. Only two leatherbacks were reported in Louisiana in the Fuller *et al.* (1987) study; both were spotted offshore by pilots. No leatherback strandings were documented in 2011 or 2012 (through April 29) in Alabama, Louisiana, or Mississippi (NOAA Fisheries 2011c). Critical habitat for leatherbacks is in the U.S. Virgin Islands.

Leatherbacks are able to regulate their core body temperature and have been found in deeper water than other species and in cold waters, including Alaska. They may occasionally feed on aggregations of jellyfish in shallower waters. Leatherbacks primarily feed on jellyfish, but also consume sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. In the Gulf, leatherbacks are frequently associated with cabbage head *Stomolophus* and *Aurelia* jellyfish. The distribution and food habits of post-hatchling and juvenile leatherbacks are unknown, although they may be pelagic and associate with *Sargassum*.

Females nest in the U.S. from March to July. The Pacific coast of Mexico has the largest known concentration of nesting leatherbacks. Preferred nesting sites are well-sloped high-energy sand beaches backed with vegetation near deep water and generally rough seas. Nesting surveys likely underestimate the number of leatherbacks because leatherbacks nest as early as late February and surveys generally do not begin until May. Although many females return to the same beaches to nest, some nest on beaches up to 100 km apart in a single season.

The improbability of a leatherback being present nearshore and their non-benthic feeding habits combine to produce a very low likelihood of hopper dredge entrainment (NMFS 2005).

3.3.2.3 Piping Plover

The piping plover is a migratory shorebird that winters on coastal sandy beaches and mudflats in the Caminada Headland area. The piping plover breeds during the late spring and summer in three discrete areas of North America: the Northern Great Plains, the Great Lakes, and the Atlantic Coast. Plover winter in the coastal U.S. from North Carolina to Texas. The density of wintering Great Lakes plover was highest between St. Catherine's Island, Georgia, and Jacksonville, Florida, and the Florida Gulf coast, particularly around Tampa Bay (Stucker and Cuthbert 2006).

Piping plover arrive in Louisiana as early as late July and remain until late March or April. Most plover may migrate non-stop from interior breeding areas to wintering grounds. Individual plover tend to return to the same wintering sites year after year (Nicholls and Baldassarre 1990). In late February, piping plover begin to migrate from wintering grounds to breeding sites. Northward migration peaks in late March, and most birds have left the wintering grounds by late May (Eubanks 1994).

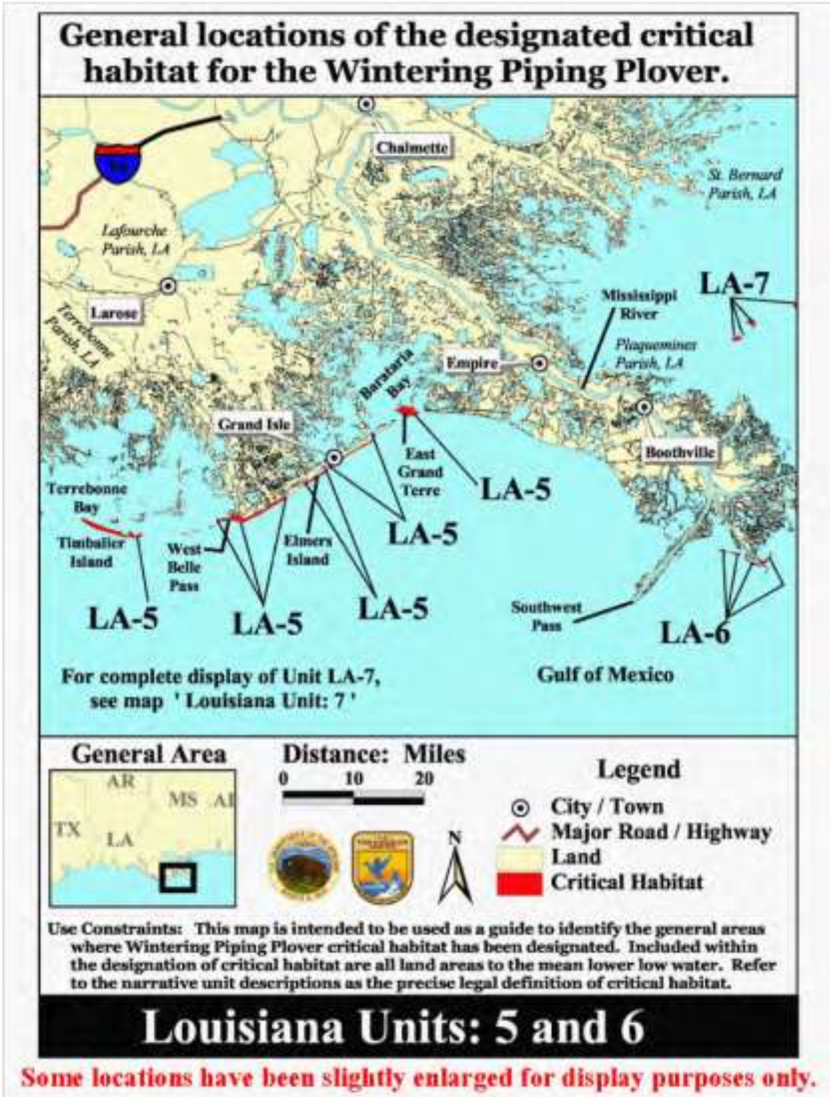
Winter feeding areas include beaches, mud flats, sand flats, algal flats, and washover passes with no or very sparse emergent vegetation (Doonan *et al.* 2006). Piping plovers are frequently observed at the accreting ends of barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996). Wintering piping plovers spend most of their time foraging (Nicholls and Baldassarre 1990). Primary prey for wintering plover includes polychaetes, various crustaceans, insects, and occasionally bivalves (Nicholls 1989). Roosting areas are sparsely vegetated or unvegetated, generally with debris, detritus, or micro-topographic relief, which provide refuge from high winds and cold temperatures. Wintering piping plover use a variety of sites as environmental conditions change. They are patchily distributed along the coast, correlated with the availability of suitable, open habitat. The population of piping plover declines with the loss and degradation of their habitat.

The piping plover is currently in decline and is listed as endangered in the Great Lakes area and threatened elsewhere in its range. The USFWS designated 142 critical habitat units along the Gulf and Atlantic coasts for wintering piping plover. Critical Habitat Unit LA-5 (Figure 3-5) includes portions of the Louisiana shoreline from Timbalier Island to East Grand Terre Island, which includes the project area. When it was designated Unit LA-5 consisted of approximately 5,735 acres. Critical habitat includes components that support foraging, roosting, and sheltering, and the physical features necessary for maintaining the natural processes that support those habitat components. The designated critical habitat identifies specific areas essential to the conservation of the species.

The proposed project has the potential to adversely affect wintering piping plover and their habitat, including designated critical habitat in Unit LA-5, within the action area.

3.3.2.4 Florida Manatee

The Florida manatee, a subspecies of the West Indian manatee (*Trichechus manatus*), is found throughout the southeastern United States, including the Louisiana coast. During warm months, manatees travel great distances, as far as Massachusetts and Texas (USFWS 2007). Federally listed as endangered, Florida manatees occasionally enter Lakes Pontchartrain and Maurepas, and associated coastal waters and streams during the summer (June through September). Manatee sightings in Louisiana may be increasing, and they are regularly reported in the Amite, Blind, Tchefuncte, and Tickfaw rivers, and canals in the adjacent coastal marshes. Manatees have been documented occasionally in nearby Bayou Lafourche (USFWS 2011b**)**.



Source: http://www.fws.gov/plover/finalchmaps/Plover_LA_5_to_6.jpg.

Figure 3-5. Wintering Piping Plover Critical Habitat

Manatees are a sub-tropical species and are cold intolerant, preferring warm water areas in Florida during the winter, leaving only to feed during warming trends. When temperatures drop, manatees congregate near warm water sites, such as natural springs, power plants, and deep canals. Manatees inhabit freshwater, brackish, and marine environments, including tidal rivers and streams, mangrove swamps, salt marshes, freshwater springs, and vegetated bottoms. Manatees are herbivores, feeding on aquatic vegetation. Shallow grass beds near deep channels appear to be preferred feeding areas in coastal and riverine habitats (USFWS 2007).

The proposed project is not likely to adversely affect the Florida manatee because the project area does not contain suitable foraging habitat for this species, and the CPRA would implement, as part of the project construction plan, standard conditions for in-water work in the presence of manatees (USFWS 2011a).

3.3.2.5 Whales

Sperm whales *(Physeter macrocephalus)* occur in the Gulf of Mexico but are rare inshore (NMFS 2005). Other endangered whales, including North Atlantic right whales *(Eubalaena glacialis)* and humpback whales *(Megaptera novaeangliae)* have been occasionally observed in the Gulf of Mexico. Various species of whales have been documented in the offshore waters of the study area (USFWS 2011b). These were likely inexperienced juveniles straying from the normal range of these stocks (NMFS 2005).

There has never been a report of a whale taken by a hopper dredge and based on the improbability of their presence, feeding habits, and very low likelihood of hopper dredge interaction, and the chances of the proposed action affecting them is extremely unlikely (NMFS 2005).

3.4 CULTURAL RESOURCES

Cultural resources include historic properties, which are defined under the National Historic Preservation Act (NHPA) of 1966, as amended (36 CFR 800), as pre- or post-contact period sites, districts, structures, buildings, objects, or features that are made or modified in the course of human activities. Their discovery, assessment, and management are mandated through Section 106 of the NHPA, which requires Federal agencies to take into account the effect of their undertakings (e.g., projects requiring Federal review and permitting) on properties listed in or eligible for listing in the National Register of Historic Places (NRHP) and to afford the Advisory Council on Historic Preservation (ACHP) as well as other Federal agencies, Tribes, State and local agencies and other interested parties an opportunity to comment on the proposed undertaking. For onshore, nearshore, and offshore components of this proposed project, the BOEM, the USACE, the State Historic Preservation Offices (SHPO) which in Louisiana operates within the Louisiana Department of Culture, Recreation & Tourism's (CRT) Office of Cultural Development's Division of Archaeology (LADOA) and Division of Historic Preservation (DOHP), as well as the Federally-recognized Chitimacha Tribe, Lafourche Parish, the Wisner Foundation, and other interested parties, have been consulted to assist in the determination of NRHP eligibility of cultural resources and provide guidance and recommendations concerning the treatment of any identified historic properties on land and underwater. Other pertinent authorities and guidelines applicable to cultural resources are the Archeological Resources Protection Act, the Native American Graves Protection and Repatriation Act, the Archeological and Historic Preservation Act, the Abandoned Shipwreck Act of 1987.

Terrestrial, intertidal and underwater archaeological assessments of the Caminada Headland restoration fill template, three conceptual Caminada Headland dredged material conveyance corridor and pump-out areas (state waters), and the Ship Shoal Borrow Area and Expansion Area (Federal waters) were completed in consultation with the SHPO/LADOA, BOEM, and the

Chitimacha Tribe in 2011 as part of the project's environmental review and planning processes. Copies of agency correspondence documenting this consultation are included in Appendix A. These investigations are summarized below comprehensive detailed descriptions of the methods and results of each investigation are included in their respective technical reports that were prepared by the project's archaeological and marine survey consultants and are included in the appendices at the back of this document

3.4.1 Caminada Headland Restoration Fill Template

3.4.1.1 Previously Recorded Archeological Sites

The larger area containing the Caminada Headland Beach and Dune Restoration Fill Template has been subjected to archeological investigations dating back to the 1950s (McIntire 1958). In fact, two archeological sites, 16LF08 and 16LF09, were recorded in the immediate vicinity of the current project area by McIntire as early as 1952. Both of those sites, which were recorded on *terre firme*, were revisited by Weinstein and Burden in 1976 (Gagliano et al. 1976) and by Beavers and Lamb in 1979. These two sites originally were described as *shell midden beach deposits* containing late prehistoric pottery sherds. As shown in Figure 3-6, the areas that contained these sites now are located well offshore, and they have been submerged and destroyed by wave wash, erosion, and shoreline retreat. In 1976, Weinstein and Burden (Gagliano et al. 1976) failed to relocate 16LF09, noting that the site had been destroyed, and that no archeological materials were found during their visit. Similarly, those authors (Gagliano et al. 1976) noted that Site 16LF08 had suffered wave action and shoreline retreat. Neither of those sites was recommended as eligible for listing on the National Register of Historic Places, and no further work was recommended. Because the former locations of these sites have been drowned, and due to the prior record of their lack of *in situ* deposits, neither of these sites possesses those qualities of significance and integrity defined by the National Register of Historic Places Criteria for Evaluation (36 CFR 60.4 [a-d]).

A third archeological site, originally designated 16LF288, was recorded within the Caminada Headland Restoration Fill Template by Stephanie Postlewaite in 2010 (Postlewaite 2010) as part of survey efforts associated with the Deepwater Horizon oil spill (Figure 3-6). Postlewaite encountered two surface concentrations of prehistoric ceramic sherds mixed with oyster shells in the lower tidal zone. She noted that the site was submerged at high tide and that it had been undergoing active erosion due to wave wash and shoreline retreat. Because of its lack of archeological context and integrity, Postlewaite (2010) noted that this site lacks those qualities of significance and integrity defined by the National Register of Historic Places Criteria for Evaluation (36 CFR 60.4 [a-d]). No further work was recommended. Site 16LF288 subsequently was redesignated as part of Site 16LF282, which was determined not eligible for listing on the National Register of Historic Places by the Louisiana Department of Culture, Recreation & Tourism, Office of Cultural Development (Letter from Pam Breaux, Louisiana SHPO, to Elizabeth Davoli, 15 May 2012) (Appendix A).

Figure 3-6. Archaeological Sites and Survey Areas for the Caminada Headland Beach and Dune Restoration Project Fill Template

All three of these previously recorded sites--16LF08, 16LF09, and the subject portion of 16LF282--were noted either as destroyed by wave action and shoreline retreat or, in the case of 16LF08, as undergoing such destructive processes and in imminent danger of loss as of 1976. None of these sites possessed integrity or significance pursuant to Criterion D (36 CFR 60.4), and none were considered eligible for listing on the National Register of Historic Places. Therefore, these three sites (16LF08, 16LF09, and the subject portion of16LF282) do not constitute *historic properties* as defined by Federal regulations (36 CFR Part 800.15(l)(1).

3.4.1.2 Cultural Resources Identification and Evaluation

As part of planning for the Caminada Headland Beach and Dune Restoration Project Fill Template, consultation was undertaken with the Louisiana Department of Culture, Recreation & Tourism, Office of Cultural Development, Division of Archaeology (LA SHPO) and with the Federally-Recognized Chitimacha Tribe of Louisiana. Those consultations resulted in a request for archeological survey of the only remaining portion of the Caminada Headland Restoration Fill Template that had not been surveyed intensively for cultural resources as part of the comprehensive survey efforts applied following the Deepwater Horizon oil spill. Archeological survey of that 36 hectare (89 acre) area produced only negative results: excavation of 112 shovel tests failed to identify any cultural materials or archeological sites, and no evidence of intact deposits were found. A negative findings report (Coughlin 2012; Louisiana Division of Archaeology Report No. 22-3966) was reviewed by the Louisiana Division of Archaeology in February 2012, which concurred that no historic properties will be impacted by the project in this survey area (Letter from Pam Breaux, Louisiana SHPO, 28 February 2012) (Appendix A).

In addition, and at the request of both the Louisiana Division of Archaeology and the Chitimacha Tribe of Louisiana, a work plan was developed to test and evaluate the eligibility of the Cathy 1 site, originally designated 16LF283, for listing on the National Register of Historic Places. That site, also recorded by Stephanie Postlewaite in October 2010, was observed to contain prehistoric ceramic sherds, oyster shells, animal bones, and human remains at the time it was recorded. Formal evaluation (Phase II testing) applying the National Register of Historic Places Criteria for Evaluation (36 CFR 60.4 [a-d]) was undertaken of the Cathy I site in January and February 2012 by R. Christopher Goodwin & Associates, Inc. for the Coastal Protection and Restoration Authority (CPRA). Testing on the beach within the Caminada Headland Beach and Dune Restoration project area included controlled surface collection, shovel testing, hand auger testing, and power auger testing. Auger tests were extended into the submerged near shore zone. In addition, because of the likelihood that cultural remains recorded on the beach at the location of the Cathy I site had been redeposited by wave action, a sampling regime of vibracores was implemented offshore to examine delta plain and drowned natural levee deposits to determine whether or not archeological remains in the offshore environment could retain integrity, and to search for the possible source of the archeological remains that had washed onto the beach. The location of the Cathy 1 site is shown in Figure 3-6.

Archeological testing onshore demonstrated that no intact archeological deposits are present at the Cathy I site, originally designated 16LF283. Vibracoring and subsequent sediment analyses recorded Lafourche Delta Complex deposits but showed that any shallow archeological deposits in the near shore zone, i.e., at the sediment – water interface, were quickly eroded by high energy waves and long shore currents. Because of a lack of integrity and hence of substantive research potential, the redeposited Cathy I site lacks those qualities of significance and integrity defined by the National Register of Historic Places Criteria for Evaluation (36 CFR 60.4 [a-d]). No further work was recommended. The Cathy I site does not constitute an historic property as defined in 36 CFR 800.15(l)(1). A letter of concurrence with this recommendation was received from the Louisiana Department of Culture, Recreation & Tourism, Office of Cultural Development on 15 May 2012 (Letter from Pam Breaux, Louisiana SHPO, to Elizabeth Davoli, 15 May 2012). That letter also indicated that the Cathy I site (originally designated 16LF283) subsequently was redesignated as part of Site 16LF282, which was determined not eligible for listing on the National Register of Historic Places by that office (Letter from Pam Breaux, Louisiana SHPO, to Elizabeth Davoli, 15 May 2012) (Appendix A).

No historic properties are located within the area of potential effect (APE) for the Caminada Beach and Dune Restoration Project Area Fill Template. Therefore, the planned undertaking will have no effect on historic properties (36 CFR Part 800.4(d)(1).

3.4.3 Caminada Headland Dredged Materials Conveyance Corridors and Pump-Out Areas

The conceptual dredged materials conveyance corridors and pump-out areas (Upper and Lower Belle Pass, Pass Fourchon, and Offshore West and East) were assessed in consultation with the SHPO/LADOA and the Chitimacha Tribe in 2011 for presence/absence of National Register listed or eligible historic properties within each of their individual APEs.

Upper and Lower Belle Pass Pump-Out Areas

The shoreline adjacent to the Upper and Lower Belle Pass Pump-Out Areas and the area immediately surrounding it have been subjected to four previous cultural resource management archaeological investigations since 1976 (Gagliano *et al.* 1976; Beavers and Lamb 1980; Weinstein 1994; and Nowak *et al.* 2010). These investigations resulted in the confirmation and identification of five Mississippian culture ancient Native American archaeological sites within one mile of the proposed Belle Pass Pump-Out Areas. All five of these sites were assessed at the time of their identification as badly/very disturbed or destroyed with compromised integrity of location due to natural and anthropogenic impacts from erosion, dredging, canal expansion and artificial levee construction. Furthermore, archaeological sensitivity of the coastal area encompassing the alternative was assessed by Nowak *et al.* in 2010 as low for pre- and post-contact sites on shore, and of variable sensitivity for shipwrecks.

Background research, and the review of the previous archaeological investigations noted above, as well as the review of environmental/hydrographic survey data that was acquired for the project in the Upper and Lower Belle Pass Pump-Out Areas in 2011 (Picciola 2011), resulted in the assessment that the Upper and Lower Belle Pass Pump-Out Areas have low marine archaeological sensitivity (Fathom 2012). Consequently, no additional investigation was recommended. Implementation of an unanticipated discovery plan (UDP) prepared for the project and included in Appendix B, however, is recommended. This UDP provides the necessary guidance and recommendations concerning formal cultural resource awareness training for project construction and administrative staff prior to the project's implementation to inform and sensitize them about the importance of historic preservation, the types of features and artifacts that could be encountered while working on the project, and the appropriate protocols and communication chain to follow in the event that an unanticipated discovery of an archaeological deposit or human remains occurs.

Pass Fourchon Pump-Out Area

The shoreline adjacent to the Pass Fourchon Pump-Out Area has been subjected to three previous cultural resource management archaeological investigations since 1976 (Gagliano *et al.* 1976; Weinstein and Burden 1979; and Beavers and Lamb 1980). These investigations resulted in the confirmation and identification of three archaeological sites within one mile of the Pass Fourchon Pump-Out Area. All of the identified Mississippian culture ancient Native American archaeological sites were assessed to be *badly/very disturbed* or *destroyed* with compromised integrity of location due to natural and anthropogenic impacts from erosion, dredging, canal expansion and artificial levee construction. Based on the results of background research and a review of the previous archaeological investigations noted above, and a review of environmental/hydrographic survey data acquired in the Pass Fourchon Pump-Out Area for the project in 2011 (Picciola 2011), the Pass Fourchon Pump-Out Area was assessed as having low marine archaeological sensitivity (Fathom 2012). Consequently, no additional investigation was recommended; however, implementation of the UDP prepared for the project and included in Appendix B is recommended.

Offshore West and East Pump-Out Areas

The adjacent shoreline and areas encompassing portions of the Offshore West and East Pump-Out Areas have been subjected to three previous cultural resource management archaeological investigations since 2006 (Braud 2006; Nowak *et al.* 2008; and HDR 2010 [report pending on field investigations completed in 2010 as part of the B.P./MC252 oil spill clean-up effort]). These investigations resulted in the identification of nine Mississippian culture ancient Native American archaeological sites on the headland's beachface and intertidal zone within one mile of the landfall of the proposed Offshore Pump-Out Areas (see discussion in the Caminada Headland Restoration Fill Template section above). No underwater archaeological sites are inventoried in the SHPO/LADOA sites files in the waters within one mile of the proposed Offshore West and East Pump-Out Areas; however, several shipwrecks are charted and reported in available databases for the vicinity of the Offshore West and East Pump-Out Areas.

Consultation with the SHPO and the Chitimacha Tribe regarding the results of the HDR 2010 investigation and the archaeological assessment of Caminada Headland Dredged Materials Conveyance Corridor and Pump-Out Areas that was completed for the project (i.e., Fathom 2012) identified concerns that the cultural materials and human remains comprising the intertidal Cathy 1 Site (16LF283) might derive from eroded elements of the now-inundated and buried natural levees of a meander in Bayou Moreau that is submerged in the nearshore waters of the

Gulf of Mexico and oriented parallel to the headland's present shoreline, adjacent to the Cathy 1 Site (16LF283), and proximal to the Offshore West and East Pump-Out Areas (see copies of agency correspondence in Appendix A).
Based on background research, the review of the previous archaeological investigations noted above, the review of environmental/hydrographic survey data acquired for the project in 2011 (Picciola 2011) within the Offshore West Pump-Out Area, and the results of CPRA's consultation with the SHPO/LADOA, the Offshore Pump-Out Area was assessed as having variable sensitivity and additional investigation of its terrestrial, intertidal and underwater elements was recommended (Fathom 2012).

For the underwater portion of the Offshore Pump-Out Area (the terrestrial and intertidal areas are discussed above), this additional investigation consisted of: (1) a review of existing seismic data acquired during an earlier phase of the overall project in 2010 (OSI 2010) along a series of parallel transects (oriented perpendicular to the shore) extending the length of the headland to determine presence/absence of preserved elements of the inundated and buried meander of Bayou Moreau, and; (2) a marine geophysical/remote sensing archaeological field survey of the study area of the Offshore West and East Pump-Out Areas to determine presence/absence of submerged cultural resources (i.e., shipwrecks and paleosols associated with inundated pre-contact period archaeological deposits).

Review of the existing seismic data acquired along seven transects surveyed in the area corresponding to the projected location of the inundated and buried meander of Bayou Moreau identified acoustic reflectors indicative of discontinuous deposits of coarser materials (OSI 2010). These deposits were interpreted by the project's geological consultants as deriving from the bottom and lower portions of the bayou channel, rather than the archaeologically sensitive natural levees that once straddled the banks of Bayou Moreau. The seismic data suggests that the bayou's natural levees were truncated by erosional processes associated with the marine transgression of the area, which reworked the levees' sediment matrix and transported and redeposited it and displaced artifacts once contained within it along the adjacent Headland's intertidal zone where they were found during HDR's 2010 archaeological field survey. The absence of seismic data evidence for intact natural levee features associated with the inundated and buried Bayou Moreau meander correlated with the 2010 findings of HDR's archaeologists, who assessed all but the Cathy I Site (16LF283) as, *eroded and subsequently redeposited resources…[that] lack context and integrity*. As a result of these findings, no additional archaeological investigations to further characterize the submerged remains of the Bayou Moreau geological channel feature were recommended.

Marine geophysical/remote sensing field survey of the Offshore West and East Pump-Out Areas pump-out and conveyance corridor option was completed for the project by OSI late in 2011 and reported on in 2012 (see OSI 2012 in Appendix B). Primary survey tracklines for the geophysical/remote sensing survey were spaced 98 ft (30 m) apart with secondary survey tie-lines oriented perpendicular to the primary lines spaced 500 ft (152.5 m) and 1,000 ft (305 m) apart in the conveyance corridors and pump-out areas, respectively. Due to the presence of a pipeline detected in the Offshore West Pump-Out Area, survey coverage was expanded and the proposed Offshore West Pump-Out Area was shifted closer to shore - approximately 2,200 ft (670.5 m) to the northwest (see Figure 2 in OSI 2012).

Equipment utilized during the 2011 OSI geophysical/remote survey of the Offshore West and East Pump-Out Areas and conveyance corridors consisted of:

- HYPACK navigation and data logging computer system
- Trimble 212 differential global positioning system (DGPS)
- Odom Echotrac single frequency depth sounder
- Klein 3000 100/500 kHz dual-frequency digital side scan sonar system
- Geometrics G881 cesium marine magnetometer (towed at an altitude of less than 20 ft [6 m] above the sea floor)
- EdgeTech Xstar CHIRP subbottom profiling system equipped with an SB216 tow vehicle.

Analysis of hydrographic data recorded water depths in the Offshore West and East Pump-Out Areas ranging from approximately 9 to 34 ft (3 to 10 m) below NAVD88, and gradually sloping, relatively featureless, seafloor with no bathymetric targets suggestive of an intact shipwreck or scattered shipwreck materials extending above the seafloor visible in the plot (see OSI 2012 in Appendix B).

Analysis of the magnetometer data identified a total of 239 magnetic anomalies in the Offshore West Pump-Out Area and 88 magnetic anomalies in the Offshore East Pump-Out Area (see tables and drawings in OSI 2012, included in Appendix B). In the Offshore West Pump-Out Area, recorded magnetic anomalies ranged from 1.5 to 3,253 gammas in amplitude and approximately nine to 589 ft (3 to 195 m) in duration (OSI 2012). A linear alignment of anomalies correlating to the aforementioned pipeline and two large areas of clustered magnetic anomalies associated with the charted locations of oil/gas platforms recorded within the originally proposed Offshore West Pump-Out Area were responsible for relocation to the current configuration of the Offshore West Pump-Out Area. The majority of the remaining anomalies in the Offshore West Pump-Out Area were isolated and less than 10 gammas in amplitude (OSI 2012). Several of the detected anomalies grouped together on the northern edge of the Offshore West Pump-Out Area's conveyance corridor, which lacked any correlative sonar target(s), may represent shallow water hazards (OSI 2012), but neither they, nor any of the other magnetic anomalies recorded within the Offshore West Pump-Out Area, are interpreted to represent probable submerged cultural resources. In the Offshore East Pump-Out Area, recorded magnetic anomalies ranged from 1.8 to 2,320.2 gammas in amplitude and from approximately 33 to 316 ft (10 to 100 m) in duration (OSI 2012). The majority of the anomalies in the Offshore East Pump-Out Area were less than 10 gammas; only 16 anomalies exhibited amplitudes greater than 20 gammas (OSI 2012). Most anomalies detected in the Offshore East Pump-Out Area appeared to be isolated and were detected on just a single survey line (OSI 2012). None of the magnetic anomalies recorded within the East option are interpreted to represent probable submerged cultural resources.

Analysis of the sidescan sonar data recorded a total of 65 individual sidescan sonar targets in the West option and 86 targets in the Offshore East Pump-Out Area (see tables and drawings in OSI 2012, included in Appendix B). In the Offshore West Pump-Out Area, targets ranged in size from approximately 1.8 to 169 ft (0.5 to 51.5 m) long and less than 1 ft (0.3 m) to 46.6 ft (14 m) wide (the 46.6 ft- [14 m-] wide target was identified by OSI [2012] as an oil/gas platform). Many of the targets identified within the Offshore West Pump-Out Area were detected southeast of the proposed pump-out area and, as in the case of the magnetic anomalies, correlate to a pipeline and charted oil/gas platforms in the area. The remaining targets, some of which have correlative magnetic anomalies, appear to be relatively small linear features with minimal relief (less than 1 ft [0.3 m]) and width, measuring in most cases (n=42) less than 2 ft (0.6 m) wide. None of the sonar targets recorded within the Offshore West Pump-Out Area was interpreted to represent probable submerged cultural resources. In the Offshore East Pump-Out Area, targets ranged in size from less than 1 ft (0.3 m) to approximately 127 ft (36 m) long, and less than 1 ft (0.3 m) to approximately 43 ft (13 m) wide. Most of the recorded sidescan sonar targets appear to be relatively small with minimal relief (less than 1 ft [0.3 m]) and width (n=58 targets less than 3 ft [1 m] wide). The majority of sonar targets identified appear to be linear features. Several sonar targets had correlative magnetic anomalies associated, but none of the sidescan sonar targets recorded within the Offshore East Pump-Out Area was interpreted to represent probable submerged cultural resources.

Analyses of the subbottom profiling data recorded in the Offshore West and East Pump-Out Areas documented the upper 5 to 15 ft (3.5 to 5 m) of the substrate below the seafloor surface throughout all of surveyed Offshore West and East Pump-Out Areas with the exception of a relatively small area crossing the conveyance corridor portion of the Offshore West Pump-Out Area where near-surface gaseous sediments inhibited penetration of the subbottom profiler's acoustic signal (see OSI 2012). The subbottom data records a high degree of variability both along-line and from line-to-line in the substrate, suggesting that it is not composed of a single sediment type that can be distinctly mapped, but is instead characterized by mixed/disturbed sediments (OSI 2012). A small, isolated/discontinuous segment of what may possibly be the bottom of a buried relict channel was detected six to 18 ft (2 to 5.5 m) below the seafloor surface along a short portion of a single survey line in the Offshore East Pump-Out Area conveyance corridor, approximately 1,200 ft (365 m) offshore.

Review of OSI's 2012 geophysical/remote sensing data acquired for the project in the Offshore West and East Pump-Out Areas, combined with an examination of historic and current navigational charts depicting the rapidly retreating position of the headland's shoreline and modern infrastructure related to the development of the offshore oil/gas industry, resulted in the assessment that while the Offshore Pump-Out Areas contain a relatively large number of magnetic and sidescan sonar anomalies, all of these anomalies and targets appear to be associated with modern activities and infrastructural development of the offshore oil/gas industry. None of the detected anomalies or targets was suggestive of probable and potentially significant submerged cultural resources. Review of subbottom data acquired in the Offshore West and East Pump-Out Areas confirmed broader observations made as a result of OSI's 2010 subbottom survey (described above), indicating that sediments comprising the substrate of the Offshore Pump-Out Areas, like those observed in the 2010 data from the nearshore waters surrounding the Offshore Pump-Out Areas, were mixed/disturbed with only small, isolated, and discontinuous segments of non-archaeologically sensitive buried paleochannel beds (with truncated archaeologically sensitive natural levees) surviving the marine transgression process. Consequently, the Offshore West and East Pump-Out Areas were considered to have low marine archaeological sensitivity and no additional investigation was recommended (Fathom 2012). Implementation of the UDP, included in Appendix B, was recommended.

3.4.3 Ship Shoal Borrow Area

Geophysical/geotechnical/marine archaeological identification survey of the Ship Shoal Borrow Area and Expansion Area situated within the BOEM's South Pelto Lease Blocks 13 and 14 was performed for the project in 2011 (OSI 2011) (see Appendix B). Primary survey track lines for the geophysical/marine archaeological survey were spaced 98 ft (30 m) apart with secondary survey tie-lines oriented perpendicular to the primary lines were spaced a 1,000-ft (305 m) apart. Equipment utilized during the geophysical survey consisted of:

- Trimble 212 DGPS
- Odom Echotrac depth sounder
- Klein 3000 100/500 kHz dual-frequency digital side scan sonar system
- Geometrics G882 cesium marine magnetometer
- EdgeTech 3100 CHIRP subbottom profiling system equipped with an SB512 tow vehicle
- EdgeTech Geostar CHIRP subbottom profiling system equipped with an SB216 tow vehicle.

Analysis of hydrographic data recorded water depths ranging from approximately 27 ft to 41 ft (8 m to 12.5 m) below NAVD88 and a relatively featureless bottom with no bathymetric targets suggestive of an intact shipwreck or scattered shipwreck materials extending above the seafloor.

Analysis of the magnetometer data identified a total of 98 magnetic anomalies (see tables and drawings in OSI 2011), as well as four linear alignments of anomalies that correlate with charted pipelines located outside of the proposed borrow area limits (i.e., two along the southwestern edge, one along the western edge, and one along the northeastern edge of the surveyed borrow area). Most (i.e., 59) of the magnetic anomalies were small (less than 15 gammas), isolated, and scattered throughout the survey area. These anomalies were interpreted to be associated with small, isolated ferrous objects, rather than potentially significant submerged cultural resources (i.e., shipwrecks), for which avoidance (for historic preservation purposes) is not recommended. Of the remaining 39 magnetic anomalies, four were distributed in two clustered anomaly pairs (M64/M67 & M70/M73) (Table 3-7) identified as potential shipwrecks/shipwreck materials. Although these anomalies are located over 2,400 ft (732 m) outside (southwest) of the proposed borrow area, avoidance using a 500-ft (152-m) radius buffer zone centered on each pair, or additional archaeological investigation to ascertain their source(s), was recommended. These anomaly pairs and their associated buffer zone are designated as Avoidance Area 'A' on OSI Project Drawings 1–5 (OSI 2011). The remaining 35 inventoried magnetic anomalies either correlate with the previously identified anomalies in buffer zones *6*, *8*, and *9*, identified during a 2003 survey of Ship Shoal/South Pelto Area Block 13 by C&C Technologies (Braud-Samuel *et* *al.* 2003), for which continued maintenance of C&C prescribed buffer zone is recommended, or have characteristics that are suggestive of isolated ferrous objects, rather than shipwrecks or shipwreck materials, for which avoidance (for historic preservation purposes) is not recommended.

Table 3-7. Magnetic Anomalies of Cluster Area A and Cluster Area B (OSI 2011)

Magnetic Anomaly	Easting* (ft)	Northing* (ft)	Type	Amplitude (Gammas)	Duration (ft)	Sensor Altitude (ft)	Sonar Target
Cluster Area A							
M64	3508761	148241	-M	5.3	224.3	23.9	SS20
M67	3508819	148162	+M	103.3	223.3	24.2	SS20
Cluster Area B							
M70	3509043	148162	-M	82.2	136.4	21.0	
M73	3509089	148093	-M	53.3	84.9	23.2	
*Coordinates are in feet referenced to the Louisiana State Plane South Zone (LA-1702). +M is positive monopole, -M is negative monopole							

Analysis of the side scan sonar data identified a total of 79 acoustic targets on the seafloor's surface (see tables and drawings in OSI 2011). Most (61) of the side scan sonar targets are very small (less than 10 ft [3 m] long) and appear to be isolated debris. Fifteen of the targets are associated with magnetic anomalies. One of them (SS20) lies within Avoidance Area A and appears to be associated with the magnetic anomaly pair M64/M67. The remaining side scan sonar targets have no associated magnetic anomalies and are all considered to be single objects, cable, pipe or geological features that are not recommended for avoidance for historic preservation purposes.

Analyses of the subbottom profiling data identified no evidence of relict channels or other archaeologically sensitive buried paleo-landforms in the survey area, as illustrated in OSI Project Drawing 4 (OSI 2011). This interpretation was ground-truthed through geotechnical sampling survey performed in 2011, which also produced no evidence of archaeologically sensitive buried paleo-landforms (see Appendix B).

Based on Fathom's archaeological assessment of OSI's remote-sensing data, all of the magnetic anomalies and side scan sonar targets identified as potential shipwrecks or shipwreck materials can be protected by maintaining the recommended 500-ft radius buffers zones (Fathom Research, 2012); none of them lies within the proposed borrow area. Provided that the recommended buffers are maintained, the proposed dredging activities will not impact any anomalies or targets identified as potential submerged cultural resources, and no additional investigation was recommended. Implementation of the UDP prepared for the project and included in this document's appendices was recommended.

3.5 SOCIOECONOMIC AND HUMAN RESOURCES

Socioeconomic and human resources for the Caminada Headlda H project were incorporated from USACE (2012) and DOI-MMS (2004).

3.5.1 Population and Housing

The project area is located in a remote and uninhabited coastal headland in Lafourche Parish and the Ship Shoal area offshore of Terrebonne Parish. No communities or human populations are present in the project area. However, Port Fourchon is near the project area and Grand Isle is on a nearby barrier island.

3.5.2 Employment and Income

The project area is located on a remote and uninhabited coastal headland in Lafourche Parish. There are no communities or human populations in the project area and therefore no employment or income base. The area supports sources of income related to oil and gas exploration and production and commercial and recreational fishing. Port Fourchon services over 90 percent of the Gulf of Mexico's deepwater oil production (Greater Lafourche Port Commission 2011) and over 250 companies use Port Fourchon as a base of operation. In 2006, ongoing and construction activities in Port Fourchon were estimated to affect the economy of the Houma area by $1,501 million in business sales; $351.4 million in household earnings; 8,169 jobs dependent on the port; and more than $12 million in sales taxes were collected by local governments (Loren C. Scott & Associates 2008).

3.5.3 Environmental Justice

Executive Order (EO) 12898 of 1994 and the Department of Defense's Strategy on Environmental Justice of 1995 direct Federal agencies to identify and address any disproportionately high adverse human health or environmental effects of Federal actions to minority and/or low-income populations. Minority populations are those persons who identify themselves as Black, Hispanic, Asian American, American Indian/Alaskan Native, and Pacific Islander. A minority population is defined when the percentage of minorities in an affected area either exceeds 50 percent or is meaningfully greater than the general population. The poverty line was defined in 2010 as $22,050 in annual income for a family of four. In 2009, 15.5 percent of Lafourche Parish residents lived below the poverty level (U.S. Census Bureau 2012).

The Caminada project area does not have a minority and/or low-income population. The project area is located in a remote and uninhabited coastal headland in Lafourche Parish and the Ship Shoal area offshore of Terrebonne Parish. No communities or human populations are present in the project area. However, Port Fourchon is near the project area. The nearest populated areas to the Caminada Headlands are Port Fourchon and Grand Isle is on a nearby barrier island.

3.5.4 Commercial Fisheries

The total U.S. commercial landings in 2010 were nearly 8.2 billion pounds valued at nearly $4.5 billion (NOAA Fisheries 2012). Louisiana's total commercial landings in 2010 were over 1 billion pounds valued at $248 million. The Port of Golden Meadow-Leeville on Bayou Lafourche had 2010 landings of 14.8 million pounds valued at $21.9 million (Table 3-8; NOAA Fisheries 2012).

Table 3-8. 2010 Louisiana Commercial Fishery Landings

Louisiana Port	Pounds (millions)	Dollars (millions)
Empire-Venice	353.5	$59.4
Dulac-Chauvin	32.8	45.1
Intracoastal City	334.6	31.4
Golden Meadow-Leeville	14.8	21.9
Lafitte-Barataria	14.9	20.4
Delacroix-Yscloskey	13.4	19.7
Cameron	204.7	Not available

Source: NOAA Fisheries 2012.

The Port Fourchon area is important to Louisiana's commercial seafood industry. Because of the shallow drafts of the fishing boats and the traditional residence patterns of fishing families, commercial vessels dock along the banks of Bayou Lafourche.

Menhaden and shrimp fisheries are important in the area during some times of the year. Important Louisiana fisheries in 2009 included Atlantic menhaden (862,144,140 million pounds; $57,600,050); black drum (2,798,764 million pounds; $2,322,908); blue crab (30,802,439 million pounds; $30,519,472); Eastern oyster (6,799,712 million pounds; $24,694,100); red snapper (826,802 pounds; $2,308,555); and swordfish (259,537 pounds; $486,786) (NOAA Fisheries 2011).

Finfish

Estuarine-dependent commercial finfish are found on the Louisiana continental shelf and on or around Ship Shoal. Reef fishes are volumetrically less important than pelagic species but have higher values. Important reef and pelagic fishes are caught in 25 to 100 ft (7.6 to 30.5 m) depths; these depths are typical over much of the crest and flank areas of Ship Shoal.

Pelagic fishes are found throughout the water column from the beach to the open ocean; demersal species remain near the bottom. Coastal pelagic and demersal species are found from the shoreline to the shelf edge, generally delineated by the 656-ft (200-m) isobath. Coastal pelagic and demersal fishes of commercial importance in the northeastern Gulf include sheepshead, red snapper, scad, ladyfish, sardines, grouper, and menhaden.

Popular reef fish include groupers, snappers, gray triggerfish and amberjacks, which are fished over rough bottoms in shelf waters 65 to 656 ft (20 to 200 m) deep. Natural outcroppings or manmade reefs are not present on Ship Shoal. Although numerous bottom-anchored oil and gas surface structures on Ship Shoal attract reef fishes, none are located in the proposed borrow area.

Oceanic pelagic fishes live near the edge of the continental shelf. Commercially important oceanic pelagic fisheries include coastal water species, such as Spanish and king mackerel, amberjack, and several species of tuna and billfishes. Oceanic pelagics make seasonal movements along the continental shelf parallel to shore, and between the nearshore and the shelf edge. Few oceanic pelagic fishes are likely to be present in the shallow nearshore area of Ship Shoal.

Bottom-dwelling demersal fishes landed by commercial fishermen in the northeastern Gulf were taken almost exclusively from inland (estuarine) waters. Key species in demersal landings were striped mullet and spotted seatrout.

Shellfish
The Gulf of Mexico shrimp fishery is one of the most valuable fisheries in the US; oysters and blue crab are also important fisheries. In Louisiana, shellfish were almost exclusively fished in inland (estuarine) waters or on the Louisiana continental shelf.

Shrimp
From January to November 2011, Louisiana shrimp landings represented 42 percent of the Gulf shrimp catch for that period, nearly 47 million pounds NOAA Fisheries 2012). The fishery is based on two species, white and brown shrimp; additional species include sea bobs (*Xiphopenaeus kroyeri*); pink shrimp; and royal red shrimp (*Hymenopenaeus robustus*).

Blue Crab
In 2009, an estimated 51.2 million pounds of blue crabs worth $36,417,566 were taken in Louisiana (NOAA Fisheries 2011), making it one of the largest crab fisheries in the U.S. in terms of biomass.

Ship Shoal is a nationally important, although unprotected, offshore blue crab spawning/hatching/foraging ground from at least April through October, and an offshore blue crab mating site. During April through October, mature female crabs appear to be in a continuous spawning cycle, producing new broods approximately every 21 days while actively foraging to supply the necessary energy for this continuous reproductive activity. Blue crab egg production may decline slightly as the season progresses, perhaps due to limited ovary growth with a decline of infaunal prey densities. Blue crab condition factor on Ship Shoal is comparable to that of other, nationally recognized inshore spawning grounds. The lack of a directed blue crab fishery on Ship Shoal likely enhances the stability of Louisiana's traditional blue crab fishery (Stone *et al*. 2009).

Oyster

Louisiana harvests more oysters than the other Gulf States and oysters have been harvested in Louisiana for commercial sale for at least 150 years. In 2009, oyster landings were an estimated 14.7 million pounds worth $49,961,759. The number of water-bottom acres leased for oysters in Louisiana state waters for February 2006 was reported as 392,118 with 8,167 leases (LDWF 2007). The most common factor limiting the harvest of oysters is high bacterial or coliform counts in bays and inlets, especially where the water is confined or receives limited Gulf tidal flushing.

Oysters are an important resource in the Barataria Basin. Oyster leases are near the project area; the nearest oyster seed grounds are in Caillou (Sister) Lake and Bay Junop at the southern end of Bayou du Large. Seed grounds are managed by the LDWF to produce a ready supply of seed oysters that can be placed on private leases for later harvest. In 2006, there were 18,093 acres of oyster leases in Jefferson Parish (503 leases) and 23,448 acres in Lafourche Parish (555 leases), of the 392,118 total acres (8,167 leases) in Louisiana (LDWF 2007). Oyster leases near the project area are shown in Figure 3-7. No oyster leases are within 1,000 feet of the project and none will be crossed for access (James Wray, CPRA, pers. comm. Sept.21, 2011).

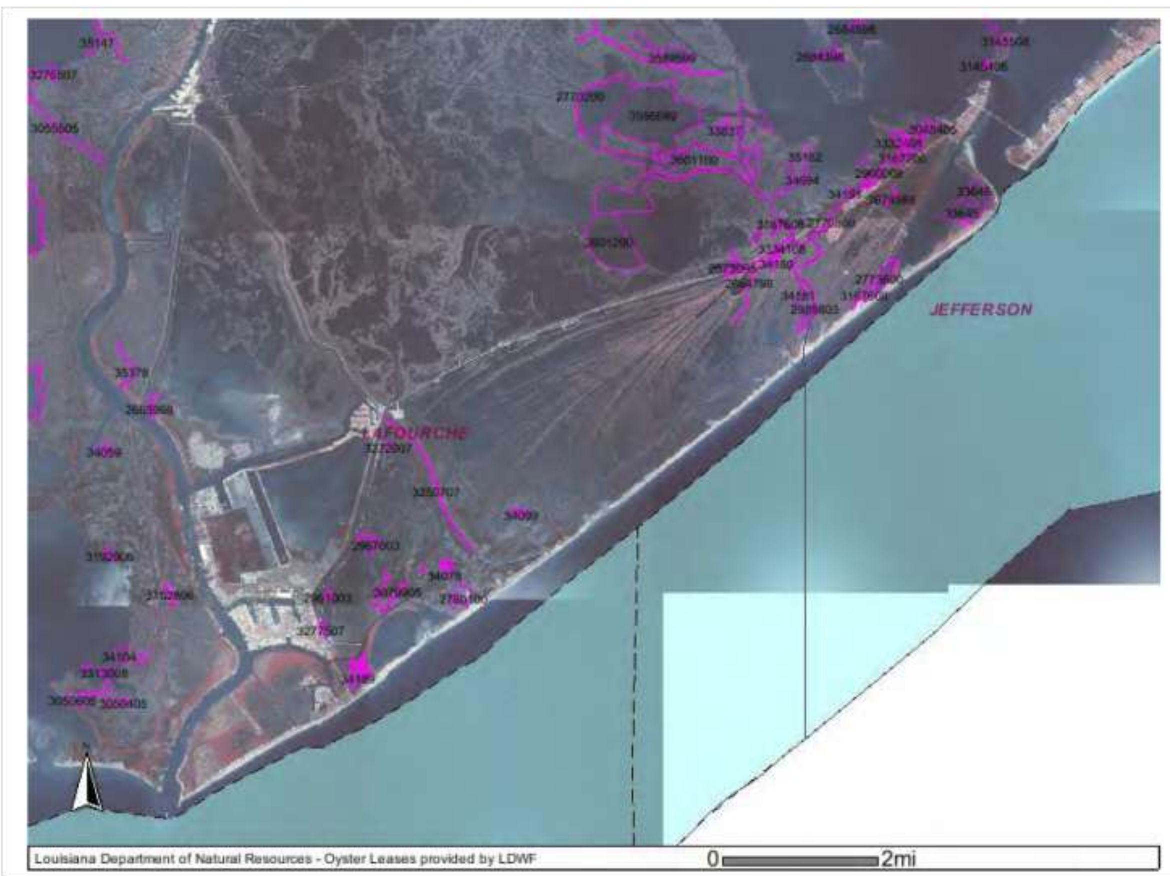


Figure 3-7. Oyster Lease Map for the Caminada Headland
(from USACE 2012, Source: LDWF)

3.5.5 Infrastructure

Port Fourchon has substantial assets of the shipping, oil, and gas industries, and significant personal property. The port area's assets, estimated by the Lafourche Parish Assessor's Office, had a value of nearly half a billion dollars (Table 3-9).

Table 3-9. Estimated Value of Assets in Port Fourchon, Louisiana

Type	Assessed Value	Fair Market Value
Watercraft	$50,275,780	$335,171,867
Public Service	1,657,930	6,631,720
Personal Property	13,944,860	92,965,733
Real Estate	2,378,030	23,780,300
	$68,256,600	**$458,549,620**

Source: Lafourche Parish Assessor (from USACE 2012).

The major roadway nearest the project area is LA Hwy. 1, which leads into Leeville, Port Fourchon, and Grand Isle. This road is used to bring supplies to the port; traffic studies have shown that over 1,000 trucks move in and out of the port daily. More than 1,200 trucks travel in and out of Port Fourchon each day (Greater Lafourche Port Commission 2011). Cargo typically consists of pipe, tools, machinery, and personnel, along with the supplies and services necessary to support industry workers (food and water, trash removal, etc.). LA Hwy. 1 is also important to commercial and recreational fishermen and is the only evacuation route for nearby areas during emergencies.

The Caminada Headland provides the first protective land for hundreds of pipelines from offshore platforms in the Gulf of Mexico that transport gas and oil to the mainland. Port Fourchon serves as the inter-modal support hub for 90 percent of Gulf of Mexico drilling, 16 percent of U.S. domestic oil and gas production, and is the land base for the nation's only offshore oil terminal, the LOOP. In 2006, approximately $63.4 billion worth of oil and natural gas was estimated to be tied to Port Fourchon via the LOOP and the offshore platforms the port helps to service (Loren C. Scott & Associates 2008).

3.5.5.1 Onshore Infrastructure

Onshore oil and gas infrastructure includes service bases that are communities of businesses that load, store, and supply equipment and personnel for offshore work sites. Port Fourchon is the closest major Louisiana port to the Gulf of Mexico. The port covers 3.6 thousand acres and extends approximately three miles along the east side of Bayou Lafourche from its junction with Belle Pass and Pass Fourchon to the Flotation Canal (USACE and GLPC 1994). Port Fourchon services 90 percent of all deepwater platforms in the Gulf of Mexico and roughly 45 percent of all shallow water platforms in the Gulf. OCS production in the Gulf of Mexico was nearly 566.7 million barrels of oil and nearly 2.26 trillion cubic feet of natural gas (BOEM 2011). The LOOP is the second component of Port Fourchon's economic contribution. LOOP's onshore facilities, the Fourchon Booster Station and Clovelly Dome Storage Terminal, are located just onshore in

Fourchon and 25 miles (40.2 km) inland near Galliano. The Fourchon Booster Station has four 6,000-hp (4.5 MW) pumps, which increase the pressure and crude oil flow en route to the Clovelly Dome Storage Terminal.

3.5.5.2 Offshore Infrastructure

Offshore oil and gas exploration and production activity in State waters takes occurs inshore of the State/Federal boundary. Activity on the Federal OCS takes place from this boundary to the outer limit of the Exclusive Economic Zone, [approximately 200 mi (322 km) from shore]. Until recently, most activity has been concentrated on the continental shelf off Texas and Louisiana. Future activity is expected to extend into progressively deeper water up to and beyond abyssal depths [i.e., 3,000 m (9,843 ft)], and into the Eastern Planning Area to date where only exploration activities have taken place. No OCS bottom-founded surface structures are in either the borrow area, although several are nearby.

Pipelines

Pipelines are the primary means of transporting produced hydrocarbons from offshore oil and gas fields to distribution centers or onshore processing points. Currently, there is over 34,600 mi (54,718 km) of pipeline on the Gulf OCS. The project area is crossed by numerous oil and gas pipelines of various sizes; some pipelines are near or cross the templates and corridors.

The most important pipelines are the LOOP and Mars pipelines. The LOOP is 19 miles southeast of Port Fourchon, and is the unloading and distribution point for all supertankers coming into the gulf. The LOOP is the only port in the U.S. capable of handling Ultra Large Crude Carriers (ULCC) and Very Large Crude Carriers (VLCC). The 48-inch diameter LOOP has unloaded more than 11 billion barrels of oil of foreign and domestically produced crude oil since its inception (LOOP 2012). The LOOP pipeline is loaded continuously and transmits about 15 percent of the country's foreign oil and considerable domestic oil from the Gulf. Oil stored at the Clovelly Dome provides over 30 percent of the nation's refining capacity. The 24-inch diameter Mars pipeline comes ashore at the Caminada Headlands carrying oil from Gulf platforms in the Mississippi Canyon area to the LOOP Clovelly terminal. The Mars pipeline was initially capable of handling 250,000 barrels of oil per day, with expansion plans of up to 500,000 barrels per day (Shell 2012).

Pipelines are anchored and installed by dynamically-positioned lay barges. Pipeline sections are typically welded at fabrication sites onshore and spooled onto a large mounted roller (stinger) on the lay barge. The stinger unrolls a continuous length of pipeline into position on the sea bottom. The pipeline is laid into a depression created by a plow or water jet sled towed by the lay barge. The pipeline is buried as it settles into the bottom sediment. All pipelines near the borrow area are buried (DOI-MMS 2002). MMS regulation at 30 CFR 250.1003(a)(1) requires that OCS pipelines in water depth less than 200 ft (60 m) be placed at least 3 ft (1 m) below the mudline.

The pipeline infrastructure near the Caminada Headland and Ship Shoal borrow area ranges from small-diameter gathering lines linking individual production facilities to larger trunklines that transport to shore. Pipelines can range in diameter from 4 to 36 inches (10 to 91 cm). Pipelines can be coated in concrete for weight and can include cathodic protection to enhance corrosion resistance. The pump-out areas and conveyance corridors were sighted to avoid pipelines (Figure 3-8). No pipelines are within the borrow area, although several are adjacent (Figure 3-9).

Fixed Platforms and Caissons

Fixed, jacketed platforms are the most common structure on the surface of the Gulf; over 2,375 units located on the shallow continental shelf account for 60 percent of bottom-founded surface structures. A fixed platform consists of a welded tubular steel jacket, deck, and surface facility with one or more levels. The jacket and deck are the foundation for manned and unmanned surface facilities. Piles driven into the seafloor anchor the jacket. Fixed platforms are generally limited to depths less than 1,500 ft (457 m). Caissons are the second most numerous surface structures in the Gulf; over 1,215 units are located primarily on the shallow continental shelf and account for about 30 percent of bottom-founded, surface structures. No caissons or fixed jacketed platforms are located in the borrow area.

3.5.6 Waterborne Commerce

Port Fourchon supports considerable internal waterborne commerce (Hughes *et al.* 2001). Bayou Lafourche is navigable from upstream of the northern end of the Federal navigation project in Lockport, Louisiana, to the Gulf of Mexico. This waterway links the Louisiana communities of Raceland, Lockport, Larose, Golden Meadow, and Leeville to the Gulf Intracoastal Waterway (GIWW). The GIWW intersects Bayou Lafourche at Larose (GIWW mile 35) (USACE and GLPC 1997). Waterborne commerce on Bayou Lafourche averaged approximately 1.15 million tons annually from1987 to 1990 (Hughes *et al.* 2001). Approximately, 270 large supply boats travel in the port’s channels daily (Greater Lafourche Port Commission 2011).

3.5.7 Oil, Gas, and Minerals

The Gulf of Mexico OCS has one of the highest concentrations of oil and gas activity in the world. Onshore infrastructure includes gas processing plants, navigation channels, oil refineries, pipelines and pipeline landfalls, pipecoating and storage yards, platform fabrication yards, separation facilities, service bases, terminals, and industry-related installations such as landfills and disposal sites for drilling and production waste. In addition to onshore service and support facilities, offshore oil and gas facilities have an extensive development of bottom-founded pipelines, surface platforms, caissons, well protectors, and casing stubs (wellhead structures from temporarily plugged and abandoned wells) (DOI-MMS 2002).

3.5.8 Aesthetic Resources

Unlike most coasts, Louisiana's islands and headlands are not completely developed for settlement. Principal developments on the coast are associated with the mineral and fishing industry. Grand Isle, a nearby barrier island, is inhabited, but does not have extensive hotels, motels, high-rise buildings, or single-family residences compared to more highly developed coasts.

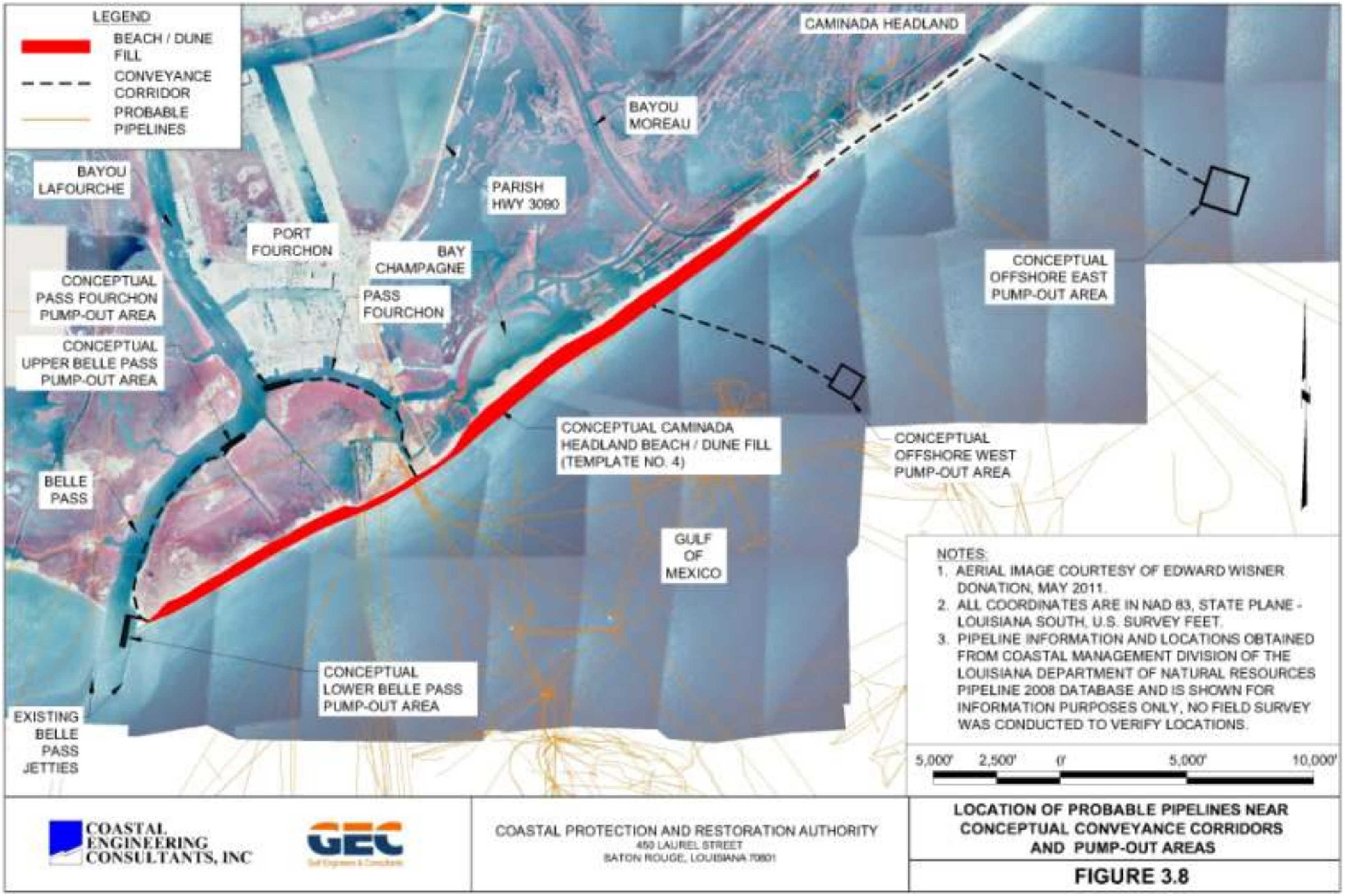


Figure 3-8. Location of Probable Pipelines near Conceptual Conveyance Corridors and Pump-Out Areas

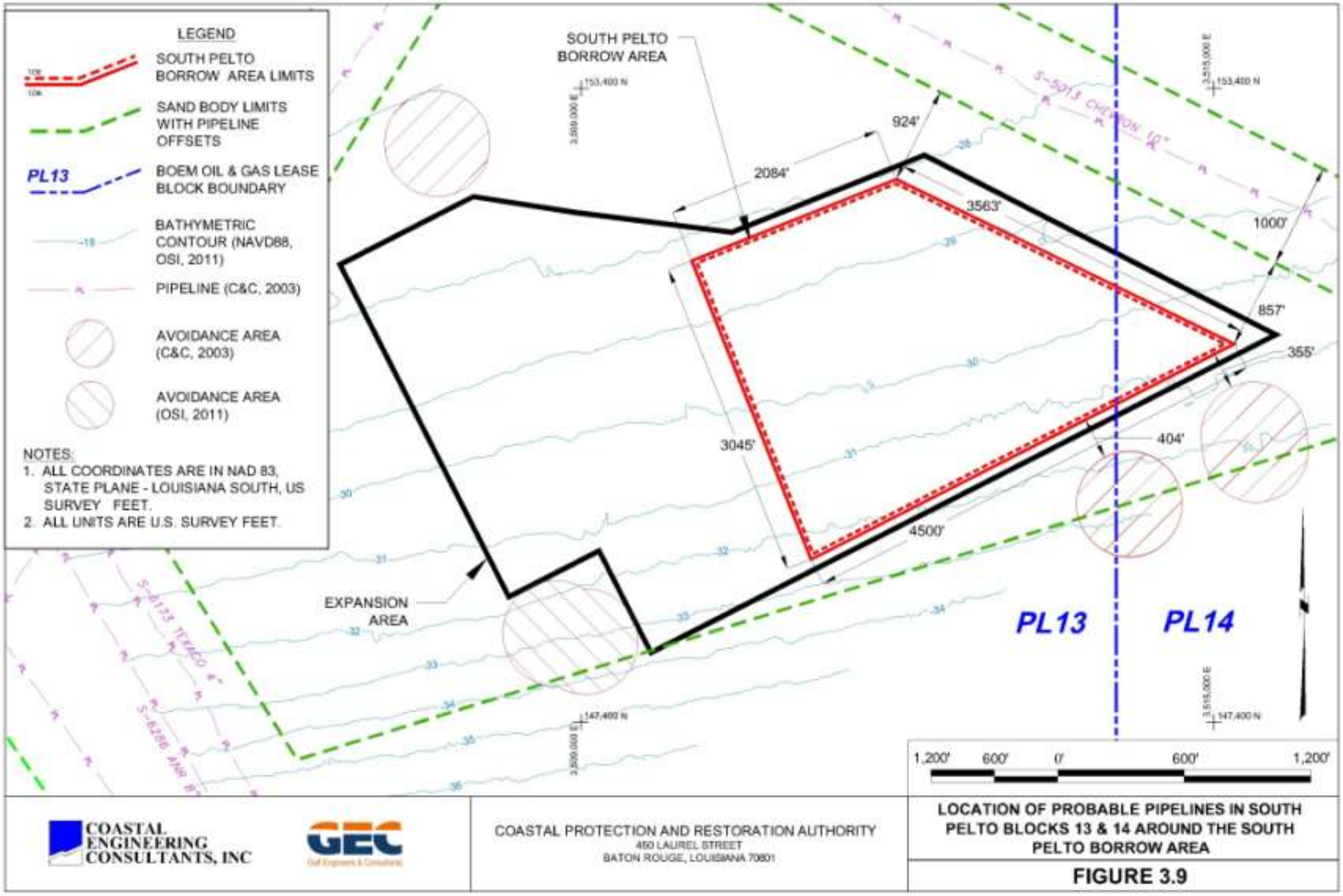


Figure 3-9. Location of Pipelines in South Pelto Blocks 13 and 14, in the Vicinity of the South Pelto Study Area

Since World War II, Louisiana's coastal lowlands have experienced rapid economic growth. Much of this growth can be attributed directly to development of hydrocarbon resources. A complex of canals was constructed as oil exploration and development moved across the coast. These canals have evolved into the most visible structural modification of the coastal zone. Scattered recreational dwellings and petroleum-related industries currently dominate the man-made landscape on the barrier islands and headlands, detracting from the aesthetics of the area.

3.5.9 Recreational Resources

The extensive marsh wetlands, water bodies, beaches, and barrier islands of Louisiana’s coastal area are well suited for outdoor recreational activities. The biological productivity of these natural resources supports many native plant and animal species, and maintains a variety of recreational pursuits. Major recreational activities occurring in and around the headland and adjacent barrier islands include recreational and commercial angling, recreational and commercial shrimping and crabbing, boating and sailing, wading and swimming, picnicking, hiking and beachcombing, camping, and bird and wildlife viewing. Most of the land on the Caminada Headland is privately owned. However, Elmer’s Island (Goat Island) between Bayou Thunder and Caminada Pass on the eastern end of the headland is owned by the state of Louisiana and is operated by the LDWF as a wildlife refuge (Elmer’s Island Wildlife Refuge).

Spotted seatrout, redfish, flounder, crabs, and shrimp are recreationally important species. Waterfowl are hunted in the wetlands protected by the headland and barrier islands. These marshes are in the Mississippi Flyway, which is used extensively by many migratory birds. The headland and barrier islands are also a resting area for migratory Neotropical songbirds and waterfowl.

Most recreational users of the project area are residents of southeastern Louisiana. Many local and out-of-state sportsmen use marsh camps seasonally or on weekends for various outdoor activities; numerous camps are near the project area.

3.5.10 Navigation and Public Safety

Authorized navigation channels near the Caminada Headland area include Bayou Lafourche. The 3,600-acre Port Fourchon services domestic deepwater oil and gas producers operating in the Gulf of Mexico. Over 95 percent of the port’s cargo is oil and gas industry related. Approximately 30 percent of the cargo is moved by barge to and from more inland areas; and 70 percent is moved by vehicle. The importance of the port was underscored by the aftermath of Hurricanes Katrina and Rita, when oil and gas valued at about $10 billion dollars was unavailable to the nation for a two-month period (Port Review 2005), raising gasoline prices nationwide. The port’s facilities also include the South Lafourche Leonard Miller Jr. Airport in Galliano, Louisiana.

Recreational and commercial fishing is common around the Caminada Headland and marinas and boat launches are located in Port Fourchon and on the bay side of the adjacent Grand Isle.

Many commercial and recreational fishing boats are also docked along Bayou Lafourche in various communities.

3.6 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Hydrocarbons are the highest concern in terms of Hazardous, Toxic, and Radioactive Waste (HTRW). Hydrocarbons in the Gulf of Mexico come from natural seeps and anthropogenic shore-based and offshore sources.

Notably, on or about April 20, 2010, the mobile offshore drilling unit *Deepwater Horizon,* which was being used to drill a well for BP Exploration and Production, Inc. (BP) in the Macondo prospect (Mississippi Canyon 252 – MC252), experienced an explosion, leading to a fire and its subsequent sinking in the Gulf of Mexico. This incident resulted in discharges of oil and other substances from the rig and the submerged wellhead into the Gulf of Mexico. An estimated 5 million barrels (210 million gallons) of oil were subsequently released from the well over a period of approximately 3 months (Oil Budget Team 2010). In addition, approximately 771,000 gallons of dispersants were applied to the waters of the spill area in an attempt to minimize impacts from spilled oil. Dispersants do not remove oil from the ocean. Rather, they are used to help break large globs of oil into smaller droplets that can be more readily dissolved into the water column.

The U.S. Coast Guard responded and directed Federal efforts to contain and clean up the spill (hereafter referred to as the *Deepwater Horizon* oil spill). At one point, nearly 50,000 responders were involved in cleanup activities in open water, beach and marsh habitats. The magnitude of the oil spill and response was unprecedented, causing impacts to coastal and oceanic ecosystems ranging from the deep ocean floor, through the oceanic water column, to the highly productive coastal habitats of the northern Gulf of Mexico, including estuaries, shorelines and coastal marsh.

Fourchon Beach experienced heavy oiling as a direct result of the *Deepwater Horizon* oil spill. The oiling at Fourchon Beach is characterized by both surface and buried oil in various forms occurring throughout the intertidal and supratidal zones.

Several protective measures were undertaken at Fourchon Beach with the goal of minimizing the amount of oil that reached the marsh and back bays. One of the protective measures included the installation of sand bags, rock, and sheet pile bulkheads to close breaches along the beach. The breach closure structures were installed under Emergency Use Authorization (EUA) 10-036-1, which includes a condition requiring their removal by no later than July 1, 2012. The follow-up Coastal Use Permit, P20100670, is currently in the application process and will include the same removal date condition.

Cleanup activities at Fourchon Beach have included both manual (e.g., rakes and shovels) and mechanical (e.g., excavators) methods to remove surface and buried oil. As of February 2012, patrolling and maintenance activities with manual removal of surface oil continue in some areas along Fourchon Beach, while other areas along Fourchon Beach continue to be monitored and surveyed.

4.0 ENVIRONMENTAL EFFECTS

This section is the scientific and analytic basis for the comparisons of the effects of the alternatives on the environment. It summarizes changes that may occur to the existing environment including direct, indirect, and cumulative effects and compares these effects for the No-action Alternative (Future Without-Project Conditions) and the proposed project (Future With-Project Conditions). The project includes the Caminada Headland (Fill Templates 1-4 and Pump-Out Areas) and the Ship Shoal Borrow Area. These environmental effects were developed and integrated from USACE (2012), DOI-MMS (2004), and other documents.

4.1 PHYSICAL RESOURCES

4.1.1 Oceanographic and Coastal Processes

No-action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct
Existing conditions include continued barrier island deterioration, fragmentation, and degradation of the barrier islands. Existing dune, supratidal, and intertidal habitats will convert to subtidal habitats.

Indirect
Without any action, the Caminada Headland barrier system would continue to deteriorate, degrade, fragment and eventually convert into shallow open water. The barrier system would continue to experience higher wave energy levels and associated shoreline erosion. The interior estuarine bays and beach ridges would continue to be transformed into marine open water habitat. Penetration of salt water into areas previously isolated from direct exchange and increased tidal flows could enhance erosion of some marsh types.

The indirect impacts of not implementing the project are associated with changes in coastal processes and include the following. Natural and human-induced changes to coastal processes of water flows and levels would continue. Natural subsidence, barrier shoreline erosion due to waves and storms, construction of oil and gas exploration canals, construction and maintenance of navigation channels, as well as mineral extraction would continue to contribute to alteration of the natural coastal processes and flow and water levels.

The land losses described above would adversely affect important transitional habitat between estuarine and marine environments; essential fish habitat; unique wildlife habitat (e.g., nursery, nesting, feeding, and roosting habitats) and critical wintering habitat for the threatened piping plover. The continued degradation would result in the loss of fish and wildlife habitat which would likely increase competition between and within various fish and wildlife species for diminishing habitat resources. The loss of vegetated wetlands would also result in a loss in primary productivity. The No-action Alternative would result in a loss of stopover habitat for migrating Neotropical birds; and increased inter- and intra-specific competition between resident and migratory fish and wildlife species for decreasing coastal barrier island resources.

The existing infrastructure would be more vulnerable to storm events as the headland degrades. This infrastructure includes the Port Fourchon, highways, structures, utility lines, and pipelines. Damage to this infrastructure could negatively affect oil and gas production, and subsequently negatively affect the Nation's economy.

Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct or indirect impacts on the physical oceanographic and coastal processes at the borrow area on Ship Shoal.

Future With-Project Conditions

Caminada Headland

Direct
The project would restore the geormorphological form of the beach and dune, enabling the barrier shoreline to absorb wave energy during storms and fair-weather conditions and provide some storm surge protection, reducing storm damage to upland areas landward of the beach and dune; and decreasing land loss rates.

Placement of borrow area sediment would unavoidably bury existing dune, supratidal, gulf intertidal and gulf subtidal habitats, altering the topography and bathymetry within the Fill Template.

Use of the Offshore Pump-out Areas for temporary mooring of the dredge plant and equipment via anchoring systems or spud barge will not have measurable direct impacts on the physical oceanographic and coastal processes. Temporary disturbance of the Gulf bottom will be negligible during anchor, piling/spudding, and sediment pipeline installation and removal. Anchor lines, spuds, and pilings will not alter the wave field or sediment transport patterns. Use of the Lower and Upper Belle Pass and Pass Fourchon Pump-out Areas requires dredging to provide access and mooring of dredge plant and equipment. This sediment would be placed within the Fill Template, these impacts are described above. Dredging these areas will alter the bathymetry but will not affect the wave field or sediment transport. These effects are minor and short-term.

Indirect
Indirect impacts would include geomorphological benefits associated with the deposition and natural redistribution along the headland and to the adjacent sediment-deprived barrier systems. The borrow area sediment will be subjected to physical and coastal processes that would, over time, begin to more closely resemble the sediment they are covering on the headland. The restoration would reduce potential adverse impacts associated with increased storm surge and

wave potential to the interior estuarine wetlands and beach ridges. This project would reduce the potential for storm damage to the existing and expected infrastructure.

Other indirect impacts would include marine organisms (especially benthos) that presently utilize the Gulf bottom substrates would have to adapt to changes in Gulf bottom topography; restoration construction activities could cause short-term disruption of commercial and recreational fishing; and alteration of Gulf water bottoms may change littoral drift dynamics; and creation of depressions, furrows, and pits could impact recolonization by the benthic community (Nairn *et al.* 2004).

Ship Shoal Borrow Area

Direct

Excavation of the borrow area would directly impact the existing water bottoms by altering the bathymetry within the dredge footprint and side slopes of the dredge cut. Physical removal of sediments at the borrow area would alter the bathymetry of the seabed, creating pits. Bathymetry changes can locally reduce currents, lower dissolved oxygen levels, and increase accumulation of fine sediments. These effects would be minor and short-term.

Dredging of borrow material could destroy any slow-moving or sessile benthic organisms found within the borrow area. Impacts to benthic organisms as a result of the dredging involve food web dynamics and shifts of benthic species composition resulting from physical disturbance of dredging as well as the environmental changes that follow such as changes in water depths, turbidity, and sediment characteristics. Eventually, these organisms would recolonize; therefore, these effects would be minor and short-term.

Small-scale sand mining on Ship Shoal would have minor and short-term effects. Wave modeling to evaluate the effects of large-scale removal of sand from various portions of Ship Shoal was conducted by Stone *et al*. (2009). MIKE21 SW, a spectral wave model, and MIKE3 HD, a 3-dimensional hydrodynamic model, were employed to model two bathymetric scenarios, with and without Ship Shoal. Without Ship Shoal data were generated by interpolating between the bathymetries of the north and south edges of the shoal. Conditions, from fair weather to severe storm were used in the model runs. Wave and current dynamics over Ship Shoal were addressed. The models predicted different results, depending on the strength and direction of the forcing parameters. Wave and current fields varied considerably over the west, central, and eastern ends of the shoal, because of the irregular bathymetry and topography. As expected, their behavior was very different with the shoal removed. Five sand mining scenarios, ranging from removal of 8 to 18 mcy were also investigated. Stone *et al*. (2009) concluded that small-scale sand mining was not expected to have profound impacts on hydrodynamics and sediment transport over the shoal.

Removal of up to 5 mcy for restoration of the Caminada Headland from Ship Shoal is considered small-scale mining in the context of various Ship Shoal model studies (Stone 2000; Stone *et al.* 2004, 2009) and is not expected to alter wave patterns and resultant sediment transport patterns on the Isles Dernieres or Timbalier Island barrier systems.

Indirect
Regional suspended sediment from the significant Atchafalaya River loads are expected to be preferentially deposited into deeper pits, reducing the effect of the slopes eroding and/or slumping to a gentler stable slope (Nairn *et al.* 2004). The excavation of deeper cuts would result in more rapid infilling (Nairn *et al.* 2004). The episodic transport to Ship Shoal of a layer of fluid mud emanating from the Atchafalaya River is discussed in the Geology Section (Section 4.1.2). Although the project will not affect the timing or occurrence of this episodic transport, during the passage of frontal storms a discrete layer of fluvial mud carried south onto the inner shelf and over Ship Shoal would likely deposit into the borrow pit. These effects would be minor and short-term.

4.1.2 Geology

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct
Under the No-action Alternative, the historic land loss and erosion rates will continue and the barrier shoreline will eventually convert to shallow open water bottoms. Sand resources within the beach and dune system will be overwashed into the back-barrier system or lost offshore during significant storm events. The headland will lose its geomorphological form and function.

Indirect
Under the No-action Alternative, the headland will continue to erode and migrate landward. Sedimentary modifications produced by Headland migration would include textural changes, steepening, and reorientation of stratification. The reworking of sediments, which accompany Headland migration, could potentially alter the texture of sediment, depending on the material available for deposition and the composition of the sediment being reworked. In absence of restoration, the interior bay and beach ridge system along with their sediment resources will continue to be transformed into marine open water habitat.

Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct or indirect impacts on the geology and sand resources of the borrow area on Ship Shoal.

Future With-Project Conditions

Caminada Headland

Direct
Restoration of the headland by placement of over 2 mcy of beach and dune compatible sand will improve the ability of the headland to resist shoreline erosion, wave overtopping, and breach

formation. Installation of sand fencing and dune vegetation would provide a mechanism for future aeolian sand transport and dune enhancement for additional shoreline protection.

Following placement, consolidation of borrow area sediment would occur; consolidation is predicted to take about one year. Adverse direct impacts of placing borrow area sediment into the dynamic high-energy barrier system would generally be minimized by placement of compatible sediments in this sediment-starved barrier system.

Use of the Lower and Upper Belle Pass and Pass Fourchon Pump-out areas require dredging to provide for access and mooring of the dredge plant and equipment. Dredge volumes range from 11,200 to 157,500 cy. This sediment would be placed within the Fill Template; the direct impacts on geology and sand resources are described above. Dredge depths were set equal to or shallower than the existing navigation channel depths. Infilling of these areas is expected from natural tidal flow carrying suspended sediments, thus the impacts will be minor and temporary.

Indirect
Indirect impacts on the geology of the project area would include the geomorphological benefits associated with the deposition and natural redistribution along the headland and to the adjacent sediment-deprived barrier systems.

Ship Shoal Borrow Area

Direct
Removal of up to 5 mcy of sand from 220 acres of Ship Shoal for restoration of the Caminada Headland is considered small-scale mining in the context of the various Ship Shoal modeling studies (Stone 2000; Stone *et al.* 2004, 2009). Ship Shoal contains an estimated 1.57 billion cy of very fine- to medium-grained sand (DOI-MMS 2004; USACE 2012). The project represents 0.3 percent of the total volume. The sand body encompasses approximately 76,600 acres. The project represents 0.3 percent of the total surface area of the sand body.

Indirect
The project would not contribute to any indirect impacts to the geology and sand resources at the borrow area.

4.1.3 Air Quality

No-action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts, and would not contribute to any indirect impacts, on air quality. Existing conditions would persist.

Future With-Project Conditions – Fill Templates 1-4, Ship Shoal Borrow Area

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Although Ship Shoal is approximately 27 nm from the Caminada Headland, movement of vessels between these areas would occur during the proposed project, and the same direct and indirect impacts would be imposed on air quality across the entire project area.

Air emissions associated with the proposed Caminada Headland project would result from diesel engines powering the dredging activities, propulsion between the dredge site and pump-out operations. Additional emissions would result from equipment used in the placement and relocation of the mooring buoys. Air emissions on the beach would result from bulldozers, graders, and other equipment. Emissions would occur over an estimated maximum period of about 502 days; most emissions would occur at the dredge site and pump-out areas. The principal emissions would consist of nitrogen oxides (NOx), with smaller volumes of carbon monoxide (CO), sulfur dioxide (SO2), particulate matter (PM), and volatile organic compounds (VOC).

Air emissions associated with the proposed project would result from dredging activities, barge transport, and unloading and transfer operations. These operations would involve a variety of equipment including a dredge vessel, barges, bucket cranes, and bulldozers. Sand would be transported to onshore construction sites. Bulldozers and graders would be used for beach and dune construction. The dredging would take place over 502 days. The quantity of emissions are difficult to project, but would be considerably larger than quantities associated with the other proposed projects because of the longer distances from the dredge site to the onshore construction sites and the large scale of the project. Most emissions would occur over OCS waters, with smaller volumes in Lafourche Parish. Emissions of NOx and VOC are potential precursors to ozone, primarily during June through September.

4.1.4 WATER QUALITY

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts, or contribute to any indirect effects, on water quality. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland

Direct

Pump-out operations would produce temporary minor changes in water quality at the pump-out locations. Turbidity levels in the pump-out areas would be elevated above normal during dredging within the mixing zone. Visible plumes at the water surface are expected in the immediate vicinity of the operation. Similar water quality effects are expected at the beach nourishment location. During placement, sand slurry will be pumped onto the beach through a temporary pipeline. Fine-grained sand will settle out rapidly and water will separate from the slurry and drain off the beach into the surf zone or percolate into the sand. If silt- or clay-sized sediments are part of the slurry, the settling velocity of these suspended solids will control the amount of silt and clay that is deposited on the beach or remains in suspension to drain into the surf zone. Elevated turbidity levels are expected to dissipate rapidly, returning to background levels in a short period. The Contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material for the borrow area.

Indirect

Exhumed contaminants, or trash and debris present in the dredged sand could also be deposited on the beach. The placement area for dredged sand is expected to total hundreds of acres, but only an area of 5-10 ac would be active at any one time as the sand slurry is discharged and new beach and dune platform area is created and graded with bulldozers. Although suspended particulate matter levels in the receiving water could temporarily increase, it would take place in a limited emplacement area and is expected to have minimal effects on water quality.

Ship Shoal Borrow Area

Direct

Dredging operations would produce the same temporary and minor changes to water quality as those described above for pump-out and fill template locations. Ship Shoal is located in OCS waters, and is therefore exempt from Louisiana's water quality standards. The Contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material for the borrow area. No long-term adverse impact on water quality is expected to occur because of the use of Ship Shoal.

During dredging, sand would likely be collected from the dredge site with hopper dredges. A turbidity plume, or dredge plume, results as water is decanted overboard onto the sea surface from the dredge vessel as the vessel hopper is filled with sand. The target of the dredge operation is a sandy rather than a muddy substrate, and the turbidity plume would not be expected to be as severe as the discharge plume from dredging mud. Silt or clay that may be present in the sandy substrate would remain suspended in the water discharged overboard. Discharges would occur in approximately 9 to 30 ft (3 to 9 m) deep shoal waters. Silt, clay, contaminants, or organic matter in the sediment would settle over a period of hours to days, depending on currents.

If the disturbed sediments have a high organic content, the biological oxygen demand of the dredge plume would likely be greater than surrounding seawater. The decrease in dissolved oxygen that accompanies high biological oxygen demand could result in a localized hypoxic water column or bottom-water conditions.

Aquatic organisms can be further stressed from increased dissolved ammonia. The pH of seawater is maintained at about 7.5 to 7.8 by an efficiently buffered chemical system. Slight changes in pH can occur when perturbations, such as high nutrient loads and phytoplankton photosynthesis, are introduced, thereby affecting the availability of toxic or nutritive substances to aquatic organisms. As the pH decreases (acidity increases), the toxicity of most metals, cyanides, and sulfides increase. Ammonia is produced through microbial decomposition of nitrogen-rich organic matter in waters with high nutrient loads. The oxidation of ammonia to nitrites and nitrates under aerobic conditions does not deplete dissolved oxygen. However, under hypoxic conditions, ammonia content can increase, particularly under stagnant conditions, warmer temperatures, and increased pH levels, and can have toxic effects on aquatic life. The general aeration of the shallow waters on the shoal crest would ameliorate the development or maintenance of hypoxic conditions or elevated ammonia in shoal waters over protracted periods.

At any one time, dredging would occur in a very limited area, but it would occur over a long period (up to 502 days for Fill Template 4). Turbidity and suspended particulate levels in Ship Shoal waters normally fluctuate due to seasonal river inputs and discharge rate. Dissolved oxygen levels in bottom water decrease in the summer when a stratified water column typically forms. The increased turbidity is expected to impact water quality only in the immediate area of dredging in a plume covering a surface area of approximately 5 to 10 acres.

Indirect

Indirect impact-producing factors of dredging include uncovering buried trash and debris, and dredge vessel discharges. Materials buried in the sediment, such as drilling mud and trace contaminants, could be resuspended, or trash and debris could be exhumed and exposed through the dredging operation.

Sanitary and domestic wastewater discharges from the dredge vessel will contribute nutrients, suspended matter, and chlorine into the receiving water. Wastewater consists of sewage and gray water generated from shipboard sinks, showers, laundries, and galleys. USEPA and USCG regulations require that sanitary waste be treated prior to discharge and prohibit the disposal of trash or debris into the marine environment. The discharge of food waste is prohibited within 12 nm (22 km) from the nearest land. Other discharges include drainage from the deck surface that may hold small quantities of oil or grease and uncontaminated seawater from cooling, both of which are benign.

The relatively infrequent trips by the support vessels to the dredging vessel may also contribute discharges into waters crossed in transit and at the dredge site. During a trip (trip duration was estimated at four days for a round trip twice a month), a crew (crew size estimated at 30 for a service vessel) would contribute an estimated total discharge of 237,600 gallons of combined domestic and sanitary wastes over 16.5 months of continuous dredging operation. Overboard discharges permitted by regulation occur over time and space that diminishes potential impacts and renders them benign.

4.1.5 NOISE

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts, or contribute to any indirect effects, on noise. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland

Direct/Indirect
Pump, transport, deposition, and ship/machinery noise would be present during operations at the Caminada Headland and pump-out areas. Noise associated with the Fill Template would result from barge transport, and unloading and transfer operations. These operations would involve a variety of equipment including a dredge vessel, barges, bucket cranes, and bulldozers. Sand would be transported to onshore construction sites. Bulldozers and graders would be used for beach and dune construction. The dredging would take place over 502 days.

Ship Shoal Borrow Area

Direct/ Indirect
Dredging noise can result in the localized, minor, and short-term effect of displacing bird populations. Dredging noise can affect marine mammals, sea turtles, and fishery organisms. Possible effects vary depending on a variety of internal and external factors, and can be divided into masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, and discomfort, hearing loss and injury (Thomsen *et al.* 2009). Direct effects would be discomfort, hearing loss, and injury. Deeper water operations can propagate sound over greater distances than activities in confined nearshore areas (Hildebrandt 2004).
Noise associated with dredging is predominately low frequency (below 1 kHz); estimated source sound pressure levels range between 168 and 186 dB re one upa at 1 m. The noise is generally continuous. The limited available data indicates that dredging is not as noisy as seismic surveys, pile driving, and sonar; but it is louder than most shipping, operating, offshore wind turbines, and drilling. Studies to date have been limited, undertaken on a few dredges and at a limited number of sites. Dredging to create new waterways or channels or to extract marine aggregates produces broadband and continuous sound, mainly at lower frequencies (Thomsen *et al.* 2009).

Noise associated with dredging activities can be placed in five categories (Thomsen *et al.* 2009). Collection noise arises from the collection of material from the sea floor and is dependent on the structure of the sea floor and the type of dredge used. Pump noise arises from the pump driving the suction through the pipe. Transport noise arises from the material being lifted from the sea floor to the dredge. This is the noise of the material as it passes up the suction pipe for trailing suction hopper dredges and cutter suction dredges. Deposition noise is associated with the placement of the material in the barge or hopper. Ship/machinery noise is associated with the dredging ship itself. For stationary dredges, the primary source will be the onboard machinery; most of this energy will appear in discrete spectral lines. Mobile dredges will also have propeller and thruster noise. The proposed project would create collection, transport, and ship/machinery noise at Ship Shoal and possibly cause masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, and discomfort, hearing loss and injury in wildlife (Thomsen *et al.* 2009).

4.2 BIO-PHYSICAL ENVIRONMENT

4.2.1 Vegetation Resources

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct
The No-action Alternative would not have any direct effect on vegetation resources on the Caminada Headland.

Indirect
Existing conditions, including habitat degradation and loss, would persist. Without implementation of the proposed coastal barrier system restoration, vegetation resources, including beach pioneer, frontier zone, dune, barrier grassland, salt flats, salt marsh, intertidal mud flats, and spoil banks associated with barrier and coastal wetland habitats would be expected to decrease in the project area, and throughout coastal Louisiana.

Indirect impacts would include a decline in wetland vegetation as well as net primary productivity within the project area. The ongoing conversion of existing fragmented emergent wetlands to shallow open water would continue with associated indirect impacts on coastal vegetation, fish and wildlife resources, EFH, recreation, aesthetic, and socioeconomic resources. Other indirect adverse impacts that would result from the loss of important and essential vegetated habitats used by fish and wildlife are the loss of shelter, nesting, feeding, roosting, cover, nursery, and other life requirements for fish and wildlife; loss of productivity; loss of transitional habitat between estuarine and marine environments; and increased inter- and intra-specific competition between resident and migratory fish and wildlife species for decreasing wetland resources. This would also reduce the availability of important stopover habitats used by migrating Neotropical birds.

Ship Shoal Borrow Area

Direct/Indirect
There are no submerged aquatic vegetation resources on Ship Shoal.

Future With-Project Conditions

Caminada Headland

Direct
The direct effects of implementing the Caminada Headland project would create from 201 to 328 acres of beach and dune habitat, providing for essential vegetated habitats used by wildlife for shelter, nesting, feeding, roosting, cover, nursery, and other life requirements; increased vegetation growth and productivity; and reduced inter- and intra-specific species competition between resident and non-resident fish and wildlife species for limited coastal vegetation. The project would restore and rehabilitate dune, supratidal and intertidal vegetated coastal barrier habitats; reduce conversion of these habitats to open water habitat; and provide nursery habitat for several species, including brown and white shrimp, and blue crab.

Indirect
Indirect effects would include providing stability and support for the surrounding habitats and adjacent headlands.

Ship Shoal Borrow Area

Direct/Indirect
There are no submerged aquatic vegetation resources on Ship Shoal.

4.2.2 Aquatic Resources and Communities

4.2.2.1 Benthic Resources

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/ Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have direct impacts on benthic resources. Existing conditions would persist. Continued erosion of the Caminada Headland may affect infaunal benthic communities.

Future With-Project Conditions

Caminada Headland

Direct

Sediment placement temporarily affects the benthic fauna in intertidal systems by covering them with a layer of sediment. Some benthic species can burrow through a thin layer (from 15 to 35 inches for different species) of additional sediment since they are adapted to the turbulent environment of the intertidal zone; however, thicker layers (greater than 40 inches) of sediment are likely to smother the benthic fauna (Greene 2002). After beach renourishment or sediment placement, benthic fauna can take anywhere from six months to two years to recover (Rakocinski *et al.* 1996; Peterson *et al.* 2000, 2006). Such delayed recovery of benthic prey species temporarily affects the quality of piping plover foraging habitat. Additional impacts can result from laying sand transport pipeline from pump-out areas to the Fill Template. As described in Section 4.2.2, placement of borrow area sediment could destroy any slow-moving or sessile benthic organisms within the Fill Template. These effects would be minor and short-term; these benthic resources would reestablish from adjacent undisturbed areas.

Indirect

The proposed project would include the deposition of dredged material at the headland and could create physical disturbances and indirect impacts such as those described below for Ship Shoal.

Ship Shoal Borrow Area

Direct

The primary impact-producing factor affecting benthic resources would be from mechanical disturbance of the sea bottom. Direct impacts would be mid-term; it would take two to three years for the dredged area to recover to existing conditions. Physical disturbances at Ship Shoal include disruption of the sea bottom by sand removal, suspension of fine-grained sediments at the bottom and in a surface dredge plume, and dispersion and persistence of turbidity.

Removal of sand resources can expose underlying sediment and change the sediment structure and composition of a borrow area, consequently altering its suitability for burrowing, feeding, or larval settlement for some benthic organisms. Decreases in mean grain size, and in some cases, increases in silt and clay in borrow sites can follow dredging (NRC 1995). Changes in sediment composition could potentially prevent recovery to an assemblage similar to that which occurred in the borrow area prior to dredging and could affect the nature and abundance of food organisms for commercial and recreational fishery stocks (Coastline Surveys Limited 1998; Newell *et al.* 1998). Thickness of the sand resource varies from zero on the edges to more than 5 m (16 ft) on the shoal crest (Kulp *et al.* 2001). Portions of the borrow areas dredged to depths greater than 4 m may expose underlying sediments of a different character with a greater quantity of silt and clay.

The influence of sediment composition on benthic community composition has long been recognized (Peterson 1913; Thorson 1957; and Sanders 1958). However, more recent studies suggest that precise relationships between benthic assemblages and specific sediment characteristics are poorly understood (Snelgrove and Butman 1994; Newell *et al.* 1998). Sediment grain size, chemistry, and organic content can influence recolonization of benthic organisms (McNulty *et al.* 1962; Snelgrove and Butman 1994), although the effects of sediment composition on recolonization patterns of various species are not always significant (Zajac and Whitlatch 1982). The composition of benthic assemblages are likely controlled by a wide array of physical, chemical, and biological variables that interact in complex ways that vary with time.

Ship Shoal is about 3 m (9 ft) deep in the shallowest areas and is surrounded by deeper waters and may serve as a fish refuge from hypoxic conditions. Dredge activities could slightly reduce the value of Ship Shoal as a refuge for benthic fauna from hypoxia. Reduction of shoal elevation or creation of depressions could increase the possibility of hypoxic conditions at dredged sites. Dredged areas will be relatively small compared to the surface area of the entire shoal; furthermore, the duration of stagnant or poorly oxygenated water in dredged depressions or swales on the shoal would be temporary.

Removal of sediments from borrow areas can alter seabed topography, creating pits, trenches, or craters that may refill rapidly or remain persistent to cause detrimental impacts for extended periods. Borrow areas can remain well defined 8 years after dredging (Marsh and Turbeville 1981; Turbeville and Marsh 1982). In general, shallow dredging over large areas causes less harm than small but deep pits, particularly pits opening into sediment layers of different characteristics (Thompson 1973; Applied Biology Inc. 1979).

Deep pits, greater than 3 m (10 ft), can harm bottom communities (Thompson 1973). Deep borrow can reduce bottom current velocities, resulting in deposition of fine particulate matter; this can change the biological assemblage. The reduced bottom circulation in deep dredge pits can decrease dissolved oxygen to hypoxic or anoxic levels and increase hydrogen sulfide levels (Murawski 1969; Saloman 1974; NRC 1995). Summer hypoxic zones in the Ship Shoal area can worsen this potential problem. Bottom areas projected to be disturbed in the proposed borrow area are on the order of hundreds of acres, and dredge areas are expected to be broad enough to allow current flow to follow bottom contours and prevent hypoxic water from being trapped in a borrow site.

Dredging causes suspension of silt and clay in bottom sediments at the draghead and forms a dredge plume on the surface when the excess water is decanted from the dredge vessel. This fine-grained sediment increases turbidity at the bottom and in the water column while it disperses and drifts with the current. The extent of suspension/dispersion depends primarily on sediment composition, currents and sediment transport processes, the type of dredging equipment and operating techniques, amount of dredging, and thickness of the dredge cut. Suspended sediment concentrations in near bottom waters can be elevated up to several hundred meters laterally from the draghead (LaSalle *et al.* 1991). A dredge plume affecting the surface and water column is estimated to be 5 to 10 ac in size, depending on currents and local circumstances. A turbidity plume could cover twice as much bottom area or more in poorly circulated bottom waters.

Increased turbidity interferes with the food gathering process of filter feeders and organisms that feed by sight while inundated with nonnutritive particles. Bottom sediment put into suspension decreases light penetration and changes the proportion of wavelengths of light reaching the bottom, leading to decreases in photosynthetic activity. Suspension and dispersion of sediment may cause changes in sediment and water chemistry, as nutrients and other substances are released from the substrate and dissolved during the dredging process.

Sediment on the crest areas of Ship Shoal and in the proposed borrow area is composed of homogenous, clean sand (Kulp *et al.* 2001). Release of nutrients would be of little concern. The turbidity plume from dredging in this sandy substrate is expected to be relatively low. Dispersion should be localized with significant sedimentation only in the immediate vicinity of the borrow area. The area normally experiences very high turbidity levels due to the proximity of the Atchafalaya and Mississippi Rivers and their normally turbid discharge, and deposition from dredging activity would likely be similar to conditions normally experienced by the benthos. Impacts should be evaluated in terms of average background conditions as well as occasional high-level disturbances associated with storms, floods, hypoxia, or trawling (Herbich 1992). Physical disturbance of the bottom and resulting biological impacts from dredging are similar to effects caused by storms, but at a much smaller spatial scale.

In benthic areas that undergo frequent perturbations, benthic invertebrates tend to be small bodied, short-lived, highly fecund, and adapted for maximum rates of population increase. They also tend to have efficient dispersal mechanisms, dense settlement patterns, and rapid growth rates (MacArthur 1960; MacArthur and Wilson 1967; Odum 1969; Pianka 1970; Grassle and Grassle 1974). The rate of recolonization depends on numerous physical and biological factors. Physical factors include the time of year, depth of borrow cuts, water currents, sediment composition, bedload transport, temperature and salinity, natural energy levels in the area, and frequency of disturbance.

Borrow areas can be recolonized by transport of larvae from neighboring populations by currents and subsequent growth to adults, immigration of motile species from adjacent areas, organisms in bypassed areas or that slump from the sides of borrow pits, or return of undamaged organisms from the dredge plume. The rate of recolonization depends on the size of the pool of available colonists (Bonsdorff 1983; Hall 1994). Other biological factors such as competition and predation determine the rate of recolonization and the composition of resulting benthic communities. Many benthic species have distinct peak periods of reproduction and recruitment. Because larval recruitment and adult migration are the primary recolonization mechanisms, biological recovery from physical impacts generally should be most rapid if dredging is completed before seasonal increases in larval abundance and adult activity (Herbich 1992). Recovery of a community disturbed after peak recruitment will be slower than one disturbed prior to peak recruitment (LaSalle *et al.* 1991). Seasonality and recruitment patterns indicate that removal of sand between late fall and early spring would stress benthic populations less.

The general pattern of succession of marine benthic species following cessation of dredging or other environmental disturbance begins with initial recolonization. Initial recolonization occurs relatively rapidly by small opportunistic species that reach peak population densities within months of the availability of a new habitat after catastrophic mortality of the previous assemblage. The population density of the initial colonizers declines as adult species migrate into the disturbed area from adjacent undisturbed areas. This transitional period and assemblage with higher species diversity and a wide range of functional types may last for years, depending on numerous environmental factors. If environmental conditions remain stable, some members of the transitional assemblage would be eliminated by competition, and the species assemblage would form a recovered community of larger, long-lived, and slow-growing species with complex biological interactions with one another.

Benthic recolonization and succession have been reviewed for a wide variety of habitats throughout the world (Thistle 1981; Thayer 1983; Hall 1994; Coastline Surveys Limited 1998; Newell *et al.* 1998). Recolonization is highly variable, ranging from months (Saloman *et al.* 1982) to more than 12 years (Wright 1977), depending on the habitat type and other physical and biological factors. In general, recovery times from dredging of six to eight months are characteristic for many estuarine muds, two to three years for sand and gravel, and five to 10 years as the deposits become coarser (Coastline Surveys Limited 1998; Newell *et al.* 1998).

Recovery of dredged areas can occur in one year (total taxa, total number of individuals, species diversity, evenness, and richness). These parameters, however, do not necessarily reflect the complex changes in community structure and composition that occur during the recovery process. Major changes in species assemblages and community composition usually occur shortly after dredging, resulting in a different type of community. Although the number of individuals, species, and biomass of benthic infauna may approach pre-dredging levels within one to three years after dredging in fine-grained sand, recovery of community composition and trophic structure may take longer.

When long-term changes in sediment structure and composition occur from dredging, long-term differences in the composition of benthic assemblages inhabiting those sites may occur as well. The recovery time for benthic assemblages after dredging depends largely on the degree and duration of the sediment alteration (Van Dolah 1996). Recolonization success and recovery are also controlled by compaction and stabilization processes involving complex interactions between particle size, water currents, waves, and biological activities of the benthos following sediment deposition (Oakwood Environmental Ltd. 1999). Although the abundance and diversity of infaunal assemblages in dredged areas can recover relatively rapidly, it can take years to recover in terms of sediment composition of the original substrate and the original species composition of the benthic community. Perturbations to infaunal communities in dredged areas are generally considered negligible because burrowing organisms recolonize rapidly (Wilber and Stern 1992). This conclusion is often based on densities, species diversity/evenness indices, relative distribution of classes or phyla, and species-level dendrograms. For example, borrow and reference area infaunal communities can differ considerably at the species level, although these differences are usually considered insignificant because species diversity is high. Reliance on these studies may lead to a premature conclusion that impacts to dredged area infauna are minimal because these measures are relatively superficial and because the characteristics of infaunal communities are ambiguous. Infaunal communities that recolonize dredged areas can remain in an early successional stage for two to three years or longer as opposed to being completely recovered in shorter timeframes (Wilber and Stern 1992)

The borrow area is bordered by oil and gas pipelines that will restrict dredging activity in buffer areas around pipelines. Tracts of undisturbed sand would be bypassed in areas set back from pipelines. These undisturbed areas of *seed sand* harbor native organisms that would furnish larvae for recolonization and/or may immigrate to the unpopulated dredged sites. Adjacent areas of seabed outside the borrow area have very similar grain-size characteristics and would provide a source of larvae and juveniles for initial benthic infauna recolonizers and transitional assemblages that follow.

Indirect
Dredging would have some indirect effects in nearby areas; these effects would be short-term and minor. Far-field impacts from suspension and deposition of sediment can be detrimental or beneficial. Deposition of sediment can smother and bury benthic fauna, although some organisms are able to migrate vertically to the new surface (Maurer *et al.* 1986). Dredging effects can extend to nearby areas (McCaully *et al.* 1977; Johnson and Nelson 1985). Conversely, biodiversity of benthos can increase downstream of the dredge site (C-CORE 1995). In some areas, population density and species composition of benthic invertebrates increased rapidly outside dredging sites; the level of enhancement decreased with increasing distance from the dredged area up to a distance of 1.2 mi (2 km) (Stephenson *et al.* 1978; Jones and Candy 1981; Poiner and Kennedy 1984). The enhancement was attributed to the release of organic nutrients from the dredge plume (Ingle 1952; Biggs 1968; Sherk 1972; Oviatt *et al.* 1982; Coastline Surveys Limited 1998; Newell *et al.* 1998).

4.2.2.2 Plankton Resources

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have direct effects on plankton resources. Existing conditions would persist. Plankton populations continue to respond to changes in environmental conditions (Day *et al.* 1989). In particular, changes in salinity and nutrients can change plankton abundance and community structure. Future human population growth in Louisiana would likely result in greater nutrient flux to coastal waterbodies, such as non-point source pollution and sewerage discharges. However, improvements in sewerage collection and treatment could offset this trend and reduce nutrient flux. Increased development would tend to increase storm water runoff and application of fertilizers could increase over time as well, thus increasing the nutrient load on coastal waterbodies.

Future With-Project Conditions

Caminada Headland

Direct

Localized and short-term adverse impacts could occur, including mortality of some plankton populations due to construction activities associated with placement of borrow. During construction, there would be a localized and short-term decrease in available dissolved oxygen and an increase in turbidity, temperature, and biological oxygen demand. Following construction and dredging operations, the area would return to ambient conditions and be re-colonized by plankton populations.

Indirect

Existing shallow open water and fragmented barrier habitats would be converted to beach, dune, supratidal, and intertidal habitats. Protection, creation, and nourishment of transitional barrier habitats would enhance and increase, to some undetermined level, aquatic productivity and nutrient transformation functions.

Ship Shoal Borrow Area

Direct/Indirect

Dredging would cause localized and short-term adverse impacts, including mortality of some plankton populations. As with placement of borrow, available dissolved oxygen would temporarily decrease and turbidity, temperature and biological oxygen demand would temporarily increase.

4.2.2.3 Fishes and Macroinvertebrates

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct

The No-action Alternative would have no direct effects on fishes and macroinvertebrates. Existing conditions would persist. Without implementation of the proposed coastal barrier restoration, the loss of the barrier systems and coastal wetlands throughout coastal Louisiana, in particular the project area, would continue to adversely impact essential spawning, nursery, nesting, and foraging habitats for commercially and recreationally important species of fishes and macroinvertebrates, as well as other aquatic organisms.

Indirect

Over the short-term, land loss and predicted sea level, changes are likely to increase open water habitats available to marine species. Over the long-term, as open water replaces barrier and wetland habitats and the extent of marsh-to-water interface begins to decrease; fishery productivity is likely to decline (Rozas and Reed 1993). Browder *et al.* (1989) predicted that brown shrimp catches in the Barataria, Timbalier, and Terrebonne basins would peak around the year 2000 and may fall to zero within 52 to 105 years.

Other considerations on the Future Without-Project impacts to fishes and macroinvertebrates are predator/prey relationships; water quality, salinity, and temperature; harvest rates; wetland development activities (dredge/fill); habitat conversion (e.g., wetland to open water); and access blockages. Habitat suitability, diversity, population size, and harvest rates influence the future condition of fisheries. Habitat suitability for fishes and macroinvertebrates varies by species, and depends on different water quality and substrate types. Restoration efforts in the State (e.g., CWPPRA) have aided fisheries habitat, and are likely to continue. Economic interest in fisheries and interest in Louisiana as a fishery resource for the Nation has increased significantly, especially since the widespread impacts of Hurricane Katrina. This increased interest is expected to continue, leading to changes in fishing technology, fishing pressure, and fishing regulations in order to maintain sustainable commercial fisheries. Likely, as land loss continues, existing fisheries habitat may directly convert from habitat supportive of fishery species to unsupportive areas.

Ship Shoal Borrow Area

Direct/Indirect
Due to the interconnectivity of the pelagic community within the Barataria, Timbalier, and Terrebonne Basins and the relative proximity of Ship Shoal to the Caminada Headland, the same direct and indirect impacts of the Caminada Headland Future Without-Project Conditions would be imposed on the fishes and macroinvertebrates across the entire project area.

Future With-Project Conditions

Caminada Headland

Direct
The proposed project would not likely adversely affect fishes and macrocrustaceans. Restoration and preservation of the headland would reduce coastal erosion, preserving habitat and providing some benefit to the marine fishery resources. There would be some minor and short-term effects associated with the sand placement. Sessile or slow-moving fishes and macrocrustaceans would likely suffer some mortality or injury during borrow material placement.

Indirect
Indirect effects would be minor and short-term; construction activities would create temporary and localized increases in turbidity, temperatures, and biological oxygen demand; and decreases in dissolved oxygen. These temporary conditions would likely displace more mobile fishes and macrocrustaceans from the construction area. Following construction, displaced species would likely return to the project area. Benthic resources that serve as prey for marine fishery organisms may be disrupted for a short period. The fishery resources could move to other areas to forage.

Ship Shoal Borrow Area

Direct
The primary impact-producing factor affecting fishes and macroinvertebrates could include entrainment of organisms during dredge operation. Larger animals such as crabs and fishes that move over the surface of the sand bottom are highly mobile and could move away from the path of the dredge draghead. Most adult epifaunal and demersal fish populations would have a low probability of adverse impact directly by dredging because of their mobility; however, adult entrainment is possible. Some species release eggs on the bottom; the eggs would be vulnerable to removal with the sediment. Only the less motile species of fish, or those that feed exclusively on nonmotile prey would be expected to experience affects from dredging (Van Dolah *et al.* 1992). Sessile benthic invertebrates and demersal species that are swept into the dredge draghead would be killed. Shelled invertebrates, such as bivalves and gastropods, can be removed and destroyed in great numbers during sand dredging projects. Organisms that avoid entrainment may experience deleterious effects or be smothered as the resuspended sediment settles from water decanted by the dredge vessel.

Indirect
Indirect effects would include behavioral alterations due to sound, light, and structure; increased turbidity and sedimentation; and changes to soft bottom bathymetry in the borrow area during dredging. A reduction of infaunal biomass resulting from sediment removal could also have an indirect effect on the distribution of certain demersal ichthyofauna and other epibenthic predators.

Impacts on shrimp are expected to be negligible because brown and white shrimp prefer mud bottoms (Defenbaugh 1976; Williams 1965). Although pink shrimp are believed to prefer sand bottoms, they select for calcareous sediments and are only present in the Ship Shoal area in low densities. Estuarine-dependent fish species and demersals inhabit Ship Shoal, but no managed fish species require this habitat or substrate and most do not exhibit preferences for the habitat type found in the borrow area.

Benthic habitat in the dredging area will be disturbed, but the depth of sand removal is not expected to reach sediment layers that are substantially different. The bottom habitat remaining after dredging activities should continue to be a high percentage of sand (less than 75 percent). Ship Shoal, an area of shoal water about 4 m (13 ft) deep in the shallowest areas, that is surrounded by deeper waters of about 10 m (33 ft) depth, is likely an attraction for fish because it offers different habitat and prey items than the surrounding continental shelf bottoms, and may serve as a fish refuge from hypoxic conditions. Dredge activities could reduce the value of Ship Shoal as a fish refuge from hypoxia. Reduction of shoal elevation or creation of depressions could increase the possibility of hypoxic conditions at dredged sites.

Dredged areas would be relatively small compared to the surface area of the entire shoal; and the duration of stagnant or poorly oxygenated water in dredged depressions or swales on the shoal would be temporary because of water-column mixing above fair-weather wave base. A reduction of infaunal biomass resulting from sediment removal could have an indirect effect on the distribution of certain demersal fish and other epibenthic predators due to the depletion of food resources. Depending on the recovery rate of the benthic communities in the dredged area and the extent of the area dredged, this could have short-term or long-term effects.

4.2.2.4 Invasive Fish and Macroinvertebrate Species

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative, not implementing coastal barrier system restoration, would not have effects on invasive fish and macroinvertebrate species. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The proposed project would not affect invasive fish and macroinvertebrate species.

4.2.3 Wildlife Resources

4.2.3.1 Amphibians, Reptiles, Terrestrial Mammals, and Invasive Wildlife Species

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct or indirect impacts on amphibians, reptiles, terrestrial mammals, and invasive wildlife species. Existing conditions would persist. Continued erosion of the Caminada Headland would decrease available habitat. The continued loss of barrier and wetland habitats would likely become a general limiting factor for amphibians and reptiles, terrestrial mammals, and invasive wildlife that utilize the project area. This would likely result in increased inter- and intra-specific competition for decreasing barrier and wetland habitats and associated resources.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct
Generally, there are low populations of amphibians, reptiles, terrestrial mammals, and invasive species in the entire project area. No direct impacts would be expected for these populations.

Indirect
The preservation of barrier and wetland habitats would likely improve the habitat for amphibians and reptiles, terrestrial mammals, and invasive wildlife that may utilize the project area.

4.2.3.2 Marine Mammals

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any effects on marine mammals. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct
One of the primary impact-producing factors affecting marine mammals is collision by vessels. Collisions between a marine mammal and a service or dredge vessel can be lethal or result in crippling injuries. Marine mammals are unlikely to be physically injured by dredging because they generally do not rest on the bottom and most can avoid contact with dredge or service vessels. Blue, fin, or sei whales would not be adversely affected by hopper dredging operations because these are deepwater species unlikely to be found near hopper dredging sites. There has never been a report of a whale taken by a hopper dredge.

The marine mammals most likely to be found in the nearshore waters off Louisiana, such as bottlenose dolphins and Atlantic Spotted dolphin, are agile swimmers and are presumed capable of avoiding physically injury during dredging. The Florida manatee is extralimital in Louisiana coastal waters. Sightings off the Louisiana coast or strandings on Louisiana shorelines are rare. The manatee is not expected to be impacted by dredging operations. Sand mining poses no foreseeable threat to migratory and highly mobile marine mammals (Virginia Institute of Marine Science 2000).

Indirect
Dredging can indirectly affect marine mammals due to noise and turbidity plumes. Some concerns about the effects of dredging noise on marine mammals include animals avoiding intense sounds, some mammals could be attracted to sounds, mammals could change their behavior in response to sound, and habituation can occur where the response of mammals wanes when exposed repeatedly to sounds (Ocean Studies Board 2005). Proper maintenance of dredge equipment could help reduce effects of noise (Hammer *et al*. 2003). Suspended sediment generated by the dredging could temporarily interfere with marine mammal feeding or other activities; however, marine mammals could leave the area and turbidity is unlikely to have a significant effect.

Visual and acoustic disturbance from construction could result in the temporary modification in the behavior of bottlenose dolphins. Although dolphins and other marine mammals could temporarily vacate the area, dredging is expected to have a negligible impact on the animals. No take by injury and/or death or incidental harassment of bottlenose dolphins is anticipated. Impacts would be short-term and temporary and should have no lasting effects on marine mammal populations in the area.

4.2.4 Avian Communities and Resources

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct
The No-Action Alternative would not have any effect on coastal, marine, and colonial nesting birds on the Caminada Headland. Deteriorating existing conditions would persist.

Indirect
Without implementation of proposed coastal barrier system restoration, the fragmentation and loss of the Caminada Headland barrier systems and back-barrier marsh would continue to adversely impact foraging, nesting, wintering, resting, refugia, and other important habitats for all resident and migratory birds.

Ship Shoal Borrow Area

Direct/Indirect
The No-Action Alternative would not have any effect on coastal, marine, and colonial nesting birds over Ship Shoal.

Future With-Project Conditions

Caminada Headland

Direct
The proposed project would not have any direct impacts on coastal and marine birds on the Caminada Headland. Implementation of the bird abatement program would minimize effects on colonial nesting birds. The CPRA will continue to coordinate with the USFWS to implement specific actions to avoid and minimize potential impacts to these species and their critical habitat. Therefore, abatement measures to prevent colonial wading bird nesting should not disturb piping plovers on their wintering habitat.

Indirect
There could be a temporary loss of prey items and foraging habitat for some bird species in the subtidal zone adjacent to the headland due to fill placement; however, similar undisturbed habitat is adjacent to the headland. Effects would be short-term and localized. Additional project factors

that could affect coastal and marine birds include air emissions; water quality degradation from the dredge plume at the dredging site and slurry discharge at the beach nourishment site; dredge or vessel noise; light attraction; and discarded trash and debris from dredge or service vessels.

Emissions of pollutants into the atmosphere from dredge and service vessel activities are expected to have minimal effects on air quality because of the prevailing atmospheric conditions, emission heights, and pollutant concentrations. Emissions from dredging and pump-out operations and bulldozers and other equipment onshore are below the exemption criteria. Therefore, no impacts on birds on or behind the shoreline from emissions related to the proposed action are expected.

Seabirds (e.g., laughing gulls) could be attracted by lights on the dredge vessel or to the vessel itself. Coastal and marine birds can ingest or become entangled in discarded trash and debris; such interactions can lead to serious injury and death. The USCG prohibits the disposal of trash and debris into the marine environment. The BOEM prohibits disposal of OCS equipment, containers, and other material into offshore waters by lessees (30 CFR 250.300). MARPOL (Annex V, Public Law 100-220; 101 Statute 1458; effective January 1989) prohibits the disposal of any plastics at sea or in coastal waters.

4.3 CRITICAL BIOLOGICAL RESOURCES

4.3.1 Essential Fish Habitat

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts on EFH. Existing conditions would persist. Continued erosion of the Caminada Headland would likely result in loss of, or changes, to EFH.

Future With-Project Conditions

Caminada Headland

Direct/Indirect

The project would not likely adversely affect EFH and associated marine fishery resources adjacent to the Caminada Headland portion of the project (Virginia M. Fay, NMFS, pers. comm., Nov. 18, 2011). There could be a temporary loss of prey items and foraging habitat in the subtidal zone adjacent to the headland due to fill placement; however, similar undisturbed habitat is adjacent to the headland. Effects would be short-term and localized.

Ship Shoal Borrow Area

Direct/Indirect

The project would not likely adversely affect EFH and associated marine fishery resources on Ship Shoal (Virginia M. Fay, NMFS, pers. comm., Nov. 18, 2011). Impacts to EFH on Ship Shoal include changes to soft bottom bathymetry in the borrow area due to dredging and temporary loss of prey items and foraging habitat. Effects would be short-term and localized; similar undisturbed habitat is adjacent to the borrow area.

4.3.2 Threatened and Endangered Species

4.3.2.1 Gulf Sturgeon

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any effects on Gulf sturgeon. Existing conditions would persist.

Future With-Project Conditions – Fill Templates 1-4, Ship Shoal Borrow Area

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Gulf sturgeon, the only threatened fish species in the Gulf, inhabit riverine and estuarine environments in the spring during breeding, and either move offshore or parallel to shore between adjacent estuary systems during winter months. The Gulf sturgeon is unlikely to be present in the project area and is not likely to be adversely affected by this project (NMFS 2005).

4.3.2.2 Sea Turtles

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts on sea turtles. Existing conditions would persist, the potential sea turtle nesting habitat would continue to erode, and eventually all potential nesting habitat in the area would be lost. Sea turtles rarely nest on the Caminada Headland.

Future With-Project Conditions

Caminada Headland

Direct

There would also be a potential for incidental takings of sea turtles during dredging operations, despite all possible precautions being taken (e.g., use of turtle exclusion devices, observers, etc.) to avoid, minimize and reduce any such impacts. Collisions with service vessels may pose a threat to sea turtles at the headland; however, the species of sea turtles in the project area that might be affected by the proposed actions are highly migratory. No individual turtles of any species are likely to be year-round residents in the project area, although some individuals may be present at any given time. The period of greatest sea turtle activity in the project area is spring and summer. The CPRA will continue to coordinate with the NMFS to implement specific actions to avoid and minimize potential impacts to sea turtles.

Indirect

The indirect impact-producing factors affecting sea turtles at the headland include degradation of benthic feeding areas, and discarded trash and debris from dredge or service vessels. Sediment plumes created by dredge operations would be minor and short-term; consequently, effects to sea turtles should be minor and short-term as well.

Activities including beach renourishment can result in sand compaction. Compaction negatively affects site selection, and may discourage nesting along the affected area. Sand placed on the beach that differ in characteristics such as grain size, sorting, and moisture content can alter incubation temperatures, reduce egg hatching, reduce survivorship, and affect sex ratios of hatchlings. Once sand is placed on the beach, physical reworking of the material will occur that can initially cause the creation of escarpments. These escarpments may initially impair the ability of adult turtles to reach the upper beach and cause the nesting turtles to abandon nesting attempts (DOI-MMS 1997). However, in the long term, beach nourishment can improve habitat for nesting turtles. Sea turtles rarely nest on the Caminada Headland.

Sea turtles have been known to consume plastic bags, tar balls, and other discarded trash or litter. Regulations reduce the accumulation of plastic and other debris in the marine environment, thereby reducing the likelihood of causing adverse impacts on sea turtles.

Ship Shoal Borrow Area

Direct

Collisions with vessels are a particular concern for marine turtles because they mate, bask, and forage on the surface. Approximately 400 sea turtles per year are estimated to be killed by boat collisions off coastal beaches (NRC 1990). Most collisions involve propeller and boat strikes by commercial transport and recreational boat traffic.

The proposed project could impact sea turtles at Ship Shoal through entrainment and dismemberment in dredge suction draglines, or collisions with dredge or service vessels. Hopper dredge dragheads can catch and kill turtles. Historically, sea turtle takes associated with sand mining activities for beach restoration have been few compared to channel dredging, especially for projects in OCS Waters. Dredging with hopper dredges for Gulf beach nourishment projects could occasionally kill sea turtles, particularly loggerheads and Kemp's ridleys. The chances of the proposed project affecting hawksbills are discountable (NMFS 2005). Leatherbacks are unlikely to be found associated with relatively nearshore, shallow borrow areas such as Ship Shoal and thus are unlikely to be impacted by hopper dredging activity or relocation trawling associated with the proposed action (NMFS 2005). Mitigation measures such as turtle observers and relocation trawling will minimize the potential for collisions with sea turtles and incidental turtle takes. All terms and conditions and conservation recommendations of the NMFS biological opinion (NMFS 2005) will be adhered to for this project.

Indirect

The indirect impact-producing factors affecting sea turtles at Ship Shoal are the same as those described above for the headland, degradation of benthic feeding areas, and discarded trash and debris from dredge or service vessels. Sea turtles are highly mobile and can move to better forage areas until the affected area becomes recolonized by benthic organisms. Because of the relatively small area to be disturbed, compared to the surrounding area and the expected recolonization (3 to 24 months) of the proposed project area, impacts to sea turtles are expected to be temporary. Possible indirect impacts include interference with underwater resting habitats, disturbance to benthic foraging habitats, and disruption of the prey base. Sea turtles feed on benthic invertebrates, fish, crabs, jellyfish, sponges, and sea grasses. Dredging in shallow areas can destroy sea turtle foraging habitat.

4.3.2.3 Piping Plover

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would have minor effects on piping plover. Existing conditions would persist and the piping plover roosting and foraging habitat would continue to erode.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct
The proposed project would not have any direct impacts on piping plover within or around the project area. Implementation of the proposed action is not likely to kill any piping plovers since the birds are highly mobile and can quickly move out of harm's way. The project is not likely to jeopardize the continued existence of non-breeding piping plover.

Indirect
Most of the headland barrier shoreline is designated as critical wintering habitat for the endangered piping plover. The Endangered Species Act prohibits unauthorized taking of endangered or threatened species. Section 7 of the ESA requires Federal agencies to ensure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or modify their critical habitat.

The construction activities may lead to temporarily diminished quantity and quality of intertidal foraging and roosting habitats within the project area, resulting in decreased survivorship of migrating and wintering plovers and temporary adverse affects to critical habitat. Ultimately, the project goal is to restore the diversity of coastal barrier headland and island habitats, but the temporary effects of construction will require time for natural recovery and would extend beyond one wintering season.

Without the project, there would be little or no piping plover critical habitat remaining on the Caminada Headland. The prolonged existence and restoration/creation of foraging and roosting habitat for piping plovers along the headland would be the overall result of the project. Much of the existing system is sediment-starved, and the proposed action would introduce sediment into that system that would be reworked and redistributed through natural processes, thus maintaining and/or enhancing the features of critical habitat. The additional sediment (within the sediment-starved Barataria Basin barrier system) would be re-worked by wind and wave action and storm events to allow for natural shoreline nourishment and repair along the headland; this should result in the natural reformation of optimal piping plover habitat in the form of over-wash areas, sand flats, mud flats, and sand spits. The restoration and maintenance of intertidal habitat is important for the restoration of the piping plover population to healthy levels.

Temporary adverse affects to piping plovers and their critical habitat are anticipated throughout the project area from increased human activity during construction. The nearest suitable habitats to the headland into which piping plovers can disperse are located on East Timbalier Island (located between Timbalier Island and the West Belle Pass headland), the West Belle Pass Headland (located west of Belle Pass), and Grand Isle (located east of Elmer's Island and Caminada Pass). The next closest suitable habitat areas to the Caminada Headland consist of the Isles Dernieres to the west and the Grand Terre Islands to the east; both are greater than 10 miles away from the project area.

4.3.2.4 Florida Manatee

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative, not implementing the project, would not have any direct impacts on the Florida manatee. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Florida manatees are unlikely to be present in the project area. Standard manatee protection procedures would be followed to decrease the chances of injury. The project is unlikely to adversely affect the Florida manatee (Jeffrey D. Weller, USFWS, pers. comm., Feb. 28, 2012).

4.3.2.5 Whales

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct and negligible or indirect impacts on whales. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/ Ship Shoal Borrow Area

Direct
Whales are unlikely to be in the project area. The proposed Caminada Headland project would be expected to have negligible effects on whales. No collision fatalities are expected. The most likely impacts on whales would be restricted to behavior modifications, possibly the avoidance or temporary displacements from preferred feeding or resting areas caused by the temporary disturbances associated with dredging. There has never been a report of a whale taken by a hopper dredge. Based on the unlikelihood of their presence, feeding habits, and very low likelihood of hopper dredge interaction, whales are unlikely to be affected by the project.

Indirect
Dredging can be a significant source of continuous underwater noise in nearshore areas, particularly in low frequencies (1,000 Hz) (Richardson *et al.* 1995). This noise is typically diminished to background levels within about 20-25 km of the source. These noise levels are not sufficient to cause hearing loss or other auditory damage to marine mammals (Richardson *et al.* 1995). However, some observations near dredging operations and other industrial activities have documented avoidance behavior, while in other cases; animals seem to develop a tolerance for the industrial noise (Malme *et al.* 1983; Richardson *et al.* 1995). Due to the frequency range of their hearing, whales are more likely to be affected by low-frequency noise than odontocetes (dolphins).

4.4 CULTURAL RESOURCES

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct/Indirect

Existing conditions would persist and erosion of the coastal headland would continue. This could potentially lead to impacts on cultural resources as the shoreline recedes.

Ship Shoal Borrow Area

Direct/Indirect

There would be no direct or indirect effects on cultural resources.

Future With-Project Conditions

Caminada Headland

Direct/Indirect

Since there are no known sites within the proposed dredge or pump-out areas, no effects on cultural resources are anticipated. Any terrestrial cultural resource sites on the headland would be benefited because they would be covered and protected for a period from future shoreline erosion.

Ship Shoal Borrow Area

Direct/Indirect

There are no known cultural resources in the proposed borrow area; therefore, adverse effects on cultural resources are not anticipated. However, despite completing a cultural survey of the borrow area; there remains a potential for cultural or historic relics to be disturbed or lost during dredging operation. Avoidance buffers will be applied to identified targets near the borrow area. An unexpected finds clause would be implemented.

4.5 SOCIOECONOMIC AND HUMAN RESOURCES

4.5.1 Population and Housing

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct or indirect impacts on population and housing. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The proposed project would create temporary jobs and the need for short-term housing in adjacent areas. However, the fluctuations in jobs and housing are common in this area due to the oil and gas industry.

4.5.2 Employment and Income

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on demographic patterns and employment. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The proposed action is expected to have a negligible economic impact in Lafourche and Terrebonne parishes and throughout all of the coastal Louisiana parishes. The project would restore a portion of the natural services (e.g., recreation and aesthetics) and productivity (e.g., fish and shellfish) thereby reducing, to some unknown extent, the annual economic loss to Louisiana and the nation. The impact region's population will continue to grow slowly (less than 1.5 percent per year) according to regional trends. Minimal effects on population are projected from activities associated with the proposed projects. While some of the labor force is expected to be local to the onshore service base in Houma, crewmembers are not expected to require new permanent local housing, although a small number of month-to-month or apartment rental units

may be leased. The proposed project would be expected to have negligible economic effects on Lafourche and Terrebonne parishes.

4.5.3 Environmental Justice

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts on environmental justice. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Federal agencies are directed by Executive Order 12898 to assess whether their actions would have a disproportionate and negative effect on the environment and health of people of ethnic or racial minorities or those with low income. No disproportionate impacts on ethnic or racial minorities or poor people would result from the project.

4.5.4 Commercial Fisheries

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct or indirect effects on commercial fisheries. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland

Direct
The proposed Caminada Headland project would not be expected to have adverse effects on commercial fisheries. Temporary and minimal disturbances to commercial fishing could occur, particularly within Belle Pass and Pass Fourchon from use of the pump-out areas during construction. A pipeline would remain in place on the bottom between the hopper dredge offloading location and the shore during each proposed project period. The presence of this pipeline on the sea bottom will preclude trawling activities in the area occupied by it. The pipeline obstruction could be in place for an extended period. Damage to fishing gear could also

occur without proper marking or avoidance of the sand transport pipeline and mooring buoy. Adverse impact would be caused more by obstruction and competing space usage than by alteration of habitat. Adult shrimp would be expected to move away from the operating draghead and the sea-bottom disturbance it causes.

Indirect
Indirect effects would be minor and short term. Dredging the bottom substrate to the projected depth is not expected to alter the bottom texture from the original fine-grained sand; however, new bottom topography would be created and an increased silt and clay-sized grain fraction is possible in areas subjected to deep dredging. Topographic lows, trenches, or pits may restrict circulation, pond hypoxic water, or create a deleterious habitat for bottom-dwelling commercial species. Benthic invertebrates used as food sources by bottom-dwelling commercial species would be absent for some months until recolonization begins and a semblance of the original benthic community structure is re-established. Very few longline sets are known to occur this close to shore, although a few have been reported in the vicinity during the 1990s (CSA 2002). The presence of the hopper dredge and scows will preclude any longline sets in the vicinity for the duration of dredging and sand transport to shore. Commercially valuable fish populations are not expected to be adversely affected by dredging activities due to the ability of adult fish to avoid the dredging operations and the abundance of equivalent and undisturbed habitat in the vicinity.

Ship Shoal Borrow Area

Direct
The project would not likely have any adverse effects on commercial fisheries. No managed fish species specifically requires Ship Shoal or a sandy bottom substrate to sustain its life cycle. Although estuarine-dependent fish and invertebrates can be found on Ship Shoal, most do not exhibit preferences for the habitat type found in the borrow area as opposed to extensive adjacent shoal areas with equivalent habitat. Shrimp and demersal fisheries may be slightly affected by a combination of removed or degraded bottom substrates, creation of bottom topography that restricts circulation or ponds hypoxic bottom water, and temporary removal of invertebrate food sources that inhabit the borrow area. The primary impact-producing factor affecting commercial fisheries would be impacts from mechanical disturbance of the sea bottom on those fish or shellfish species with benthic lifestyles inhabiting the featureless sandy bottoms on Ship Shoal. Impacts to the shrimp fishery are expected to be negligible because brown and white shrimp appear to prefer mud bottoms (Defenbaugh 1976; Williams 1965). Although pink shrimp are frequently found on sand bottoms, they appear to select for calcareous sediments and are only present in the Ship Shoal area in low densities. Due to the small area, commercial fishing is unlikely to be adversely affected with respect to fisheries dependent on the bottom habitat of the borrow area, primarily shrimp trawling. Ship Shoal is an important offshore habitat for blue crab, providing spawning/hatching, foraging habitat from April to October; however, only a small portion of Ship Shoal would be dredged.

Indirect
Indirect effects are minor and short-term. These effects include the possible relocation of some fishing vessels during the dredging. It may take two to three years for the benthos to return to the area; however, forage for commercial fishery species would be available in adjacent areas.

4.5.5 Infrastructure

4.5.5.1 Onshore Infrastructure

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on onshore infrastructure. Existing conditions would persist. Erosion of the Caminada Headland, if it continues, could adversely affect onshore infrastructure.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The Ports of Terrebonne and Fourchon can provide the relatively low level of support services necessary for this project. No onshore expansion would be expected to result from the proposed project. Navigational channels, turning basins, and other docking and harbor areas would require routine maintenance or upgrades whether or not the proposed action is carried out. The proposed fill templates and sediment pipelines would cross oil and gas pipelines and two cables; however, these pipelines and cables are buried and the fill would provide additional protection.

4.5.5.2 Offshore Infrastructure

The No-action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts on offshore infrastructure. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The proposed Caminada Headlands project is expected to have negligible impacts on existing offshore infrastructure. Dredging and other associated activities can impact pipelines if the dredge draghead crosses a buried pipeline. Existing OCS pipelines near the borrow area would be protected by use of a 1,000 ft (304 m) pipeline buffer. No pipelines are in the borrow area; pump-out areas and conveyance corridors were sited to avoid offshore pipelines. The proposed offshore East Pump-Out Area Conveyance Corridor would cross one offshore OCS pipeline; however, this pipeline is buried and no damage is expected from laying the sediment pipeline.

Direct impacts from the dredging operation itself on pipelines are possible. Indirect impacts caused by exhumation of pipeline segments making them more vulnerable to both the dredging operation itself and to other potential hazards are also possible. Direct and immediate impacts could include exhuming a pipeline while removing sand, snagging or damaging a pipeline with the dredging draghead, and damaging a pipeline's corrosion protection and increasing the chance for early failure or the need for early replacement. Exhumation can make a pipeline more vulnerable to damage by subsequent and unrelated activities such as snagging on fishing nets, rupturing or damage caused by anchor drops, and exposing the pipeline to position shifting or rupture potential during hurricanes and storms.

The most serious accident scenario from the dredging operation would be a pipeline rupture followed by an oil spill. Such an event is unlikely but warrants consideration because the position of OCS pipelines can shift due to strong wave activity and currents during storms or hurricanes. Inadvertent damage to a pipeline could occur if a pipeline is not located where it was originally placed. However, the borrow area and pump-out areas have been surveyed for the presence of pipelines; surveying coupled with adequate setback distances should alleviate the possibility of such an accident. No platforms are located in the proposed borrow area; therefore impacts on platforms are not expected. BOEM regulations require wellhead structures, such as casing stubs, to be removed to a depth below mudline up to or exceeding 15 ft (4.6 m) within one year of lease termination.

4.5.6 Waterborne Commerce

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The No-action Alternative would not have any direct impacts on waterborne commerce. Existing conditions would persist. The erosion of the headland may increase sediment in the navigation channel.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Temporary and minimal disturbances to navigation in Belle Pass and Pass Fourchon from use of the pump-out areas during construction. The Ports of Terrebonne and Fourchon are capable of providing the relatively low level of support services necessary for the project. No onshore expansion would be expected from the proposed project. Port Fourchon is heavily used for oil and gas activities, commercial fishing and recreational activities, and the increase in waterborne commerce would be negligible. The Port of Terrebonne is also an oil and gas service port.

4.5.7 Oil, Gas, and Minerals

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on oil, gas, and mineral resources. Existing conditions would persist. Indirect impacts of not implementing the barrier restoration would result in the continued deterioration of existing conditions for oil and gas infrastructure.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Implementing these alternatives would have no direct impact on oil, gas and mineral reserves. Indirect effects would include the additional protection against erosion of existing pipelines in the project area. Despite extensive surveys of the borrow area, there remains a potential for disturbing oil and gas infrastructure (pipelines, platforms, and other structures). The proposed fill templates and onshore sediment pipelines would cross oil and gas pipelines and two cables; however, these pipelines and cables are buried and no damage is expected.

No pipelines are in the borrow area; pump-out areas and conveyance corridors were sited to avoid offshore pipelines. A staircased dredge cut is proposed to provide the opportunity to excavate sandy sediments within 1000 ft of the eastern constraining pipeline.

4.5.8 Aesthetic Resources

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland

Direct/Indirect
The no-action alternative would not have any direct impacts on aesthetic (visual) resources. Existing conditions would persist. Without implementation of wetland creation and shoreline protection measures, continued bank line erosion and sloughing of the shoreline and conversion of existing fragmented wetlands to open water habitats would persist. Degradation of the land would convert existing viewsheds of marsh, wetland, dune, and beach to more open water views.

The linear viewpoint that delineates the northern portion of the study is located along State Route 1. It is the only road that allows access to (and storm evacuation from) the historical recreational setting that encompasses Grand Isle; thereby it is maintained accordingly. Land loss would also affect this scenic byway and views into the project area. Panoramic views to the south, southeast, and northwest would most likely be lost. Viewsheds typical of a beachfront recreational area, foreground views of near-shore breakwaters, back-beach dunes, and the occasional shrub line and wetland grasses may also be lost. Middle ground views of wetland areas broken up by Bay Champagne and small ponds, woody vegetation, and the Gulf of Mexico's marine environment may also be lost.

Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on aesthetic resources at Ship Shoal. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland

Direct
The implementation of the Caminada Headlands project would greatly increase the visual interests in the area by improving beach and dunes, mixed with some vegetation. Preserved vegetation and marsh could enhance the intrinsic scenic quality of the drive along LA Hwy 1. This mixture of physical environmental elements creates borders and frames for potential views to the Gulf of Mexico and other inland water features, which act as the focal point to any given scene. During dredging, equipment used for dredging would be visible, resulting in a temporary reduction in the aesthetic value offshore. During construction, bulldozers and other equipment would be visible.

Indirect
Indirect impacts to aesthetic (visual) resources may include increased traffic volumes along LA Hwy 1 and increased tourism. These increased traffic volumes, although good for the local and state economies, may damage the ecosystem by increasing foot traffic and human interference in the restored environment.

Ship Shoal Borrow Area

Direct/Indirect
During dredging, equipment used for dredging would be visible, resulting in a temporary reduction in the aesthetic value offshore.

4.5.9 Recreational Resources

The No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on recreational resources. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland

Direct/Indirect
The Preservation of the headland would provide recreational opportunities for many outdoor activities, such as fishing, boating, and camping. There would be some negative impact-producing factors associated with transport, and beach nourishment that could have minor and short-term effects on recreational resources at the Caminada Headland and pump-out areas. These include: (1) increased turbidity and water quality degradation from resuspended organic matter in the dredge plume, (2) material spills from vessels, (3) visual impacts from shore, and (4) temporary unavailability of preferred recreational fishing space due to presence of the dredge vessel or dredge plume.

Visitors attracted to the northern Gulf coast are responsible for thousands of local jobs and billions of dollars in regional economic activity. Most recreational activity occurs along shorelines and includes such activities as beach use, boating, camping, water sports, recreational fishing, and bird watching. The location of the offshore dredge operations limits the affects that the dredge plume (i.e., increased turbidity and water quality degradation from resuspended organic matter) or diesel spills can have on recreational resources. Because dredging will be taking place in relatively clean offshore environments, no chemical contaminants would be expected in the dredge plume.

Only waterborne recreational activities such as boating, fishing, or diving would potentially be affected by the offshore presence of the dredge vessel, dredge plume, or service vessel. Pleasure craft may encounter the dredge vessel while in operation, but motorboats are highly mobile and can relocate to equivalent, unoccupied areas. The dredge vessel or surface plume may disturb surface waters and occupy space sought by recreational fishermen in private boats or charters; however, the footprint of these temporary impacts is so small and the undisturbed equivalent area that is available is so vast that the impact is negligible. There are no artificial reef sites near the proposed borrow area; therefore, this potential diving attraction does not exist. The consequences of boaters encountering the dredge vessel in operation are insignificant and may consist of nothing more than experiencing unpleasant odors.

Ship Shoal Borrow Area

Direct/Indirect
The impact-producing factors associated with sand dredging at Ship Shoal include all of those stated above for the Caminada Headland as well as degradation of dredged areas that may be habitat for fish desired by recreational fishermen. Recreational fishermen may be impacted by degraded sea-bottom areas subject to dredging. Game fish dependent on vital and healthy sea bottom may be temporarily displaced until bottom conditions and food source trophic structure is reestablished in two to three years (Coastline Surveys Limited 1998; Newell *et al.* 1998).

4.5.10 Navigation and Public Safety

No-Action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on navigation and public safety. Existing conditions would persist. Continued erosion may increase the need for dredging of navigation channels in the area.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
During dredging operations, it may be necessary to restrict watercraft access to the construction area in the interests of public safety. These restrictions would be of short duration and are expected to be minor to boat operators. During dredging and placement, the use of the area immediately surrounding the borrow area and the Caminada Headland in the vicinity of the shore restoration would be temporarily restricted due to public safety. All U.S. Coast Guard regulations will be adhered to during construction.

4.6 CUMULATIVE IMPACTS

4.6.1 Future Projects in the Project Area

Future projects for the headland area include the continued maintenance dredging of Bayou Lafourche, the Geo Tube Project, and the BBBS Project.

The Fourchon Beach Repair Renourishment (Geo Tube Project) (scheduled for 2012) would place sand-filled geotubes along 5,500 linear feet of Fourchon Beach at a height of six feet on a +2 elevation and cover the geotubes with sand to create a dune built to a +10 total elevation (Ports Association of Louisiana 2012). DNR EUA 09-22 was granted for the proposed geotubes; however, no work was completed under the Emergency Authorization (LDNR 2011)**.**

The BBBS project was identified as a critical near-term restoration project in the *Louisiana Coastal Area, Louisiana Ecosystem Restoration Study Report* and was Federally authorized under the Water Resources Development Act of 2007. The Recommended Plan for this project restores and protects the shorelines, dunes, and marshes of the Caminada Headland and Shell Island, east of Grand Isle. On the Caminada Headland, approximately 880 acres of beach and dunes and 1,186 acres of marsh will be restored or created. The Recommended Plan will include renourishment of the Caminada Headland and Shell Island, sustaining the benefits created by the project construction. Over each 10-year period, a minimum of 3.9 million cubic yards of material will be returned. Material from the Bayou Lafourche, Louisiana navigation project will be placed in the littoral drift south of Bayou Moreau where the long shore transport of material splits going east and west, allowing the longshore transport and wave action to move and place the sediment along the headland. The renourishment will benefit the Headland as longshore transport nourishes the beach and adds width to the shoreline.

4.6.2 Cumulative Effects

The cumulative impacts would mainly include the restoration of the headland to offset some the coastal land loss in Louisiana. Since most of the effects on resources are short-term and minor, the overall cumulative effects are minor. Compared to the no-action alternative, cumulative impacts would be: (1) the synergistic effects of restoring coastal land forms that are estimated to be lost at a rate of 6,600 acres per year over the next 50 years, and (2) the removal of sand resources from the borrow area as part of other planned Federal and State utilization of Ship Shoal for restoration efforts. Ship Shoal has about 1.57 billion cubic yards of sand; therefore, the cumulative effect is minor. Cumulative effects on the Caminada Headlands are beneficial. Cumulative effects on the pump out area and Ship Shoal are minor and localized, and short-term.

The proposed placement of over two mcy of beach and dune compatible sand would create 201 to 328 acres of barrier headland beach and dune, improving the ability of the headland to resist shoreline erosion, wave overtopping, and breach formation. Installation of sand fencing and dune vegetation will provide a mechanism for future aeolian sand transport and dune enhancement, which furthers shoreline protection through fostering the nourishment of downdrift shorelines. The creation and protection of shoreline provides for some storm damage reduction.

Cumulative effects on the Ship Shoal sand resources would be minor, even in combination with other planned Federal and State utilization of Ship Shoal for restoration efforts. Ship Shoal encompasses approximately 76,600 acres and contains an estimated 1.57 billion cubic yards of very fine- to medium-grained sand (DOI-MMS 2004; USACE 2012). This project would affect 220 acres and dredge 5 mcy. When this project is combined with other proposed projects, the cumulative effects would only represent approximately 9,200 acres, or 12 percent of the estimated Ship Shoal sand body acreage. The designated borrow areas for the LCA-Barataria Basin Barrier Shoreline Restoration (BBBS) and the LCA-Terrebonne Basin Barrier Shoreline Restoration Project (TBBSR) (USACE 2010) have been located on portions of Ship Shoal Lease Blocks 88 and 89 and South Pelto Lease Blocks 12, 13, and 14. The cumulative estimated excavation volume for both the BBBS and TBBSR projects is 43.2 mcy or 2.8 percent of the total volume.

Some minor effects on the benthic community would occur, including turbidity, burial, changes in sediment parameters and suitability, and sediment resuspension. These effects are minor and short-term, and there would be little to no cumulative effects.

Long-term benefits and short-term adverse environmental impacts represent tradeoffs between local short-term use and long-term stability and productivity of the environment. Long-term enhancements in productivity result from the storm protection provided to the public by the restoration of beaches and barrier islands. Direct and indirect effects of the project include disruption of the soft-bottom benthic community and increased turbidity in construction areas. These indirect impacts would be short-term in duration and may cause minor temporary impacts.

Impacts from potential future projects, as well as maintenance projects, would be similar to those from the individual projects described above. The cumulative impacts from all proposed and potential future projects would be about the same as impacts from the individual projects. This is because, except for ozone, air quality impacts are generally localized to a small area; thus, there is very little interaction among different projects. Furthermore, at any particular site, potential maintenance projects would occur at discrete points in time and there would not be any cumulative air quality effects. Other sources of air emissions in the proposed project area are mainly associated with the oil and gas industry as well as commercial vessel traffic and commercial fishing activities. Emissions will change depending upon the amount of activity in these sectors. Overall, the trend in the future is for decreasing emissions because of more stringent control technologies applied to marine vessels as well as to on-road and off-road vehicles. The air quality in the area is therefore expected to be the same or better than the present.

Implementing these alternatives would have the cumulative impact of protecting oil and gas reserves and both covered and exposed pipelines located at Port Fourchon by reducing the impact of coastal deterioration by providing an additional layer of soil protection, thereby increasing protection from future storm surges.

4.7 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE (HTRW)

The No-action Alternative (Future Without-Project Conditions)

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
The no-action alternative would not have any direct impacts on HTRW. Existing conditions would persist.

Future With-Project Conditions

Caminada Headland/Ship Shoal Borrow Area

Direct/Indirect
Ship Shoal has not had any activities associated with it that would be expected to produce any hazardous or toxic wastes. No evidence of contamination by hazardous or toxic wastes at Ship Shoal was noted during prior surveys or site investigations; therefore, it would not contribute these materials to the beach nourishment location. A sediment sample assessment of the South Pelto Borrow Area for the project was conducted to evaluate for the presence of metals and petroleum-impacted sediment associated with the Deepwater Horizon Oil Spill (BEM 2011). The analytic results for sample locations within the borrow area for nickel and vanadium were below the established sediment (acute and chronic) benchmarks for aquatic life established on USEPA's website (USEPA 2011b). Levels of polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (VOC) were below the practical quantitation limit (PQL) for each of the 10 sample locations and the duplicate sample. The calculated toxicity hazard value for each of the 11 sediment samples (including the duplicate sample) reported cumulative VOC and PAH constituents below the Hazard Index of 1.0 for all sample locations. A Hazard Index of 1.0 or less typically indicates levels at which no adverse effects to aquatic life are expected to occur (BEM 2011).

Accidental spills and releases of waste/fuel, although remote, are possible. The Contractor will prevent oil, fuel, or other hazardous substances from entering the air or water. This will be accomplished by design and procedural controls. All wastes and refuse generated by project construction would be removed and properly disposed. The Contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material for the borrow area. Compliance with U.S. EPA Vessel General Permits would be ensured, as applicable. The use of Ship Shoal would not adversely affect HTRW within the project area.

4.8 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Ship Shoal is the largest of a series of inner shelf sand shoals off the Louisiana coast. The use of the sand from South Pelto Blocks 13 and 14 is unlikely to deplete the supply of sand suitable for future restoration projects. There would be sufficient sand remaining in the dredged areas for recolonization of benthic organisms. Use of the sand from this area is not an irreversible/ irretrievable commitment of resources.

4.9 UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

The Alternatives and the No-action Alternative have minor, short-term, unavoidable, adverse, direct and indirect environmental effects that are discussed in this document. However, many of these effects are temporary and minor.

4.10 COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES

The project is compatible with Federal, state, and local objectives of restoring the Caminada Headland.

4.11 CONFLICTS AND CONTROVERSY

There is public support for the construction of structures to attempt to decrease erosion due to storm surge on the Caminada Headland near Port Fourchon (USACE 2012). Placement of terminal groins would retain sediment on Caminada Headland while breakwaters, geotextile tubes would reduce the wave energy and reduce the amount of erosion. While the impact from breakwaters and other hard structures may appear to be positive as reduced erosion rates along portions of the shorelines could enhance project performance, these benefits could be offset by significant adverse impacts that could result from the interruption of longshore sediment transport. This interference with sediment transport processes could increase the rates of erosion and shoreline retreat to adjacent reaches of the barrier shoreline. The most appropriate approach to restoration projects should be to mimic natural environmental processes and structures. Rock breakwaters and other hard structures do not mimic or reflect natural environmental features or processes in coastal Louisiana. Hard, immobile structures are fundamentally inconsistent with the soft and highly dynamic nature of the coastal system. Fourchon Beach, located on the Caminada Headland at the terminus of LA Hwy 3090, is a local recreation spot. There have been differing opinions between the landowners and the public regarding access to the beach areas. While the shoreline and the beach area south of Bay Champagne are claimed as state lands by the State of Louisiana, access is available only by crossing private property. There has been considerable conflict between the landowners and the public over access to the beach, especially concerning vehicle access on the beach. While the landowners allow pedestrian access, pilings have been placed to prevent vehicle access. Consequently, beachgoers are forced to recreate only in areas near the terminus of Highway 3090. To provide vehicle access to other areas of the beach, the South Lafourche Beach Development District (SLBDD) would like to build a road from Highway 3090 to the beach area at Bay Champagne. There are very few beaches in Louisiana that can be accessed by vehicles, severely limiting the public's access to the seashore. However, vehicular traffic on the beach would be incompatible with the ecosystem goals and objectives of the project and the attainment of the project benefits. This conflict is a microcosm of the larger issue of whether private landowners should benefit from the use of public restoration funds, and whether, due to the use of public funds, the public should have access to restored lands.

There is also controversy resulting from the competing goals of the economic and restoration communities. Whereas the SLBDD would like to develop the project area as a recreational site, the Greater Lafourche Port Commission, which manages Port Fourchon, is concerned with storm damage reduction and erosion. The Commission would like storm surge reduction features such as breakwaters and other hardened structures to protect the infrastructure of the port. The economic and recreational goals potentially conflict with the ecosystem restoration goal to restore shoreline, dune, and marsh habitats for essential fish and wildlife species.

5.0 ENVIRONMENTAL COMMITMENTS

CPRA commits to avoiding, minimizing, or mitigating for adverse effects during construction activities by including the following commitments in the contract specifications. Mitigation and monitoring has been derived through consultation and coordination with Federal and state agencies. The USACE, LDNR, and LDEQ permits contain extensive requirements/conditions to ensure the minimizing and mitigation of adverse effects (see Appendix A).

PROTECTION OF FISH AND WILDLIFE RESOURCES

CPRA will comply with all requirements of any consultation documents associated with this project provided under the Endangered Species Act from the USFWS, the NMFS, and the LDWF. All turtle safety precautions will be maintained to comply with the NMFS Biological Opinion requirements. Mitigation measures that will be incorporated into the project include relocation trawling, the use of turtle observers, floodlights, artificial lighting, turtle deflector devices, turtle reports, and the use of time intervals between dredging.

The Contractor will keep construction activities under surveillance, management, and control to minimize interference with, disturbance to, and damage of fish and wildlife. This project is not anticipated to result in hardbottom impacts. A Bird Abatement Plan will be implemented during this project (see Appendix A).

WATER QUALITY

The contractor will prevent oil, fuel, or other hazardous substances from entering the air or water. This will be accomplished by design and procedural controls. All wastes and refuse generated by project construction will be removed and properly disposed. The contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material. Compliance with USEPA Vessel General Permits would be ensured, as applicable. A Water Quality Certification was issued for this project on Nov. 17, 2011 (WQC 111006-01/AI 178844) (see Appendix A).

CONSTRUCTION MONITORING

Electronic positioning information, production, and volume data will be collected. Pre- and post-dredging hydrographic surveys will be conducted to monitor physical changes in the borrow area. The dredge would be equipped with an on-board global positioning system capable of maintaining or recording the location of the dredge, dragarms, and/or cutterhead. Physical monitoring of the construction profile and the pipeline corridors will be conducted. The construction will be monitored to ensure that the project stays within the design template. Pipelines will be monitored for leaks.

CULTURAL RESOURCES

Potentially significant archaeological areas discovered during cultural resources surveys will be avoided during dredging operations by a 500-meter buffer. A dredge with GPS-positioning equipment would be used. A chance finds clause would be implemented. In the event that the contractors discover any archaeological resource during borrow area dredging, construction will be halted immediately. The discovery would then be reported to SHPO and the BOEM Gulf of Mexico Region, Office of Environment. If human remains are encountered during construction, Section 680 of the Louisiana Unmarked Human Burial Sites Preservation Act (RS 8:671) will be coordinated with the State Archaeologist, coroner and the Sovereign Nation of the Chitimacha**.** Consultation has been conducted between CPRA, SHPO and the Sovereign Nation of the Chitimacha for the beach portion of the project. An Unanticipated Discoveries Plan is presented in Appendix B.

6.0 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

Appendix A contains all correspondence related to USACE, LDNR, and LDEQ permit actions for this project.

NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled, and this environmental document has been prepared. The project is in compliance with the National Environmental Policy Act (NEPA).

ENDANGERED SPECIES ACT OF 1973

Consultation was initiated with the USFWS and NMFS through the USACE Sections 10 and 404 permitting process. Compliance with the Threatened and Endangered Species Act is being closely coordinated with the USFWS and NMFS for those species under their respective jurisdictions. This project has been fully coordinated under the Endangered Species Act and is in full compliance.

The Hopper and Hydraulic Cutterhead Dredging Associated with Sand Mining for Coastal Restoration Projects Along the Coast of Louisiana Using Sand from Ship Shoal in the Gulf of Mexico Central Planning Area, South Pelto Blocks 12, 13, and 19, and Ship Shoal Block 88 NMFS Biological Opinion (Consultation No. F/SER/2003/01247) issued on Sept. 19, 2005, covers hopper dredging associated with sand mining at Ship Shoal for restoration projects along the Louisiana coast, and analyzes and accounts for the effects of sand mining on ESA-listed species. NMFS believes that the existing biological opinion entirely encompasses the scope of this project, and adequately addresses the issues associated with threatened and endangered species under their purview (David Bernhart, NMFS, pers. comm., Jan. 20, 2012). All terms and conditions and conservation recommendations of the NMFS biological opinion will be adhered to for this project.

A Biological Assessment for the project was submitted on Jan. 11, 2012 to the USFWS for the species under their jurisdiction. Because this project is a subset of the BBBSR Project and because this project is scheduled to be completed before the BBBSR Project is implemented, the USFWS amended the Dec. 21, 2011 *Louisiana Coastal Authority Barataria Basin Barrier Shoreline Restoration Project, Jefferson, Lafourche, and Plaquemines Parishes, Louisiana* Biological Opinion to include this project (Jeffrey D. Weller, USFWS, pers. comm., Feb. 28, 2012). All terms and conditions of the USFWS biological opinion will be adhered to for this project.

NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

Archival research, channel surveys, and consultation with the Louisiana State Historic Preservation Officer (SHPO) was conducted for the project. All activities have been conducted in accordance with the National Historic Preservation Act, as amended; the Archeological and

Historic Preservation Act, as amended; and Executive Order 11593. The project is in full compliance with the NHPA as well as the AHPA and EO 11593. Coordination with SHPO and the Sovereign Nation of the Chitimacha for the USACE, LDNR, and LDEQ permit actions is complete. SHPO concurrence was received on April 10, 2012 for the Phase 1 Cultural Resources Investigation of the Caminada Headland portion of the project (Appendix A). SHPO concurrence for the Phase II investigation was received on May 15, 2012 (Appendix A). Marine Archaeological surveys were completed for the OCS portion of the project (see Appendix B). The OSI marine survey reports were reviewed and approved by BOEM archaeologists. Buffer zones were created around potentially significant resources to avoid accidental disturbance from dredging activities. Buffer zone requirements will be specifically detailed in the BOEM NNA. In summary, no significant cultural resources are located within the area of potential effect (APE) for the fill template and no significant cultural resources will be affected in the OCS portion of the project. Therefore, the planned undertaking will have no effect on prehistoric and/or historic properties (36 CFR Part 800.4(d)(1).

CLEAN WATER ACT OF 1972

The project is in compliance:

Sec. 311: A standard spill control plan for the borrow area will be initiated prior to construction.

Sec. 401: This section of the Clean Water Act requires the Water Quality Certification of all Federal licenses and permits in which there is *a discharge of fill material into navigable waters*. The certification is used to determine whether an activity, as described in the Federal license or permit, will impact established site specific water quality standards. A Water Quality Certification was issued for this project on Nov. 17, 2011 (WQC 111006-01/AI 178844) (Appendix A).

Sec 404: Potential project-related impacts subject to these regulations have been evaluated as in compliance with Section 404 of the Clean Water Act. The USACE issued a Section 10/404 permit on May 10, 2012 (Appendix A).

CLEAN AIR ACT OF 1972

The project is in compliance:

Sec. 176: No permanent sources of air emissions are part of the project. No air quality permits would be required for this project.

Sec. 309: The project has been coordinated with the public and agencies.

COASTAL ZONE MANAGEMENT ACT OF 1972

Section 307 (16 U.S.C. 1456(c)(1)(A)) of the Coastal Zone Management Act of 1972 directs Federal agencies proposing activities or development projects (including civil work activities), whether within or outside the coastal zone, to assure that those activities or projects are consistent, to the maximum extent practicable, with the approved state coastal zone management program. Implementation of the project is considered consistent, to the maximum extent practicable, with the approved Louisiana Department of Natural Resources Coastal Use Permit No. P2011274 dated Jan. 11, 2012, and amended on Feb. 2, 2011. The Ship Shoal Borrow Area is located in Federal waters and a consistency determination under Subpart D was granted on Dec. 1, 2011 (C20110372). Federal OCS actions that include oil, gas, minerals (sand), have to be consistent with the coastal management plan (Appendix A).

FARMLAND PROTECTION POLICY ACT OF 1981
WILD AND SCENIC RIVER ACT OF 1968

These acts are not applicable.

MARINE MAMMAL PROTECTION ACT OF 1972

Marine mammals are not likely to be adversely affected by the project. Incorporation of safeguards to protect threatened and endangered species during project construction would also protect marine mammals in the area. The project is in compliance.

ESTUARY PROTECTION ACT OF 1968

The Caminada Headland provides protection for the Barataria-Terrebonne National Estuary; the project would not result in adverse impacts to the estuary.

FEDERAL WATER PROJECT RECREATION ACT

There are no cost-shared recreation features proposed for this project.

MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976, AS AMENDED

An assessment of the effects of the project on Essential Fish Habitat (Section 3) concluded that the project would have minimal adverse impacts on EFH of the species managed under this Act, some of which would be temporary. The project is in compliance. NMFS concurred that the project would not likely adversely affect EFH and associated marine fishery resources (Virginia M. Fay, NMFS, pers. comm., Nov. 18, 2011) (Appendix A).

SUBMERGED LANDS ACT OF 1953

The borrow area is located in Federal waters. Beach nourishment on submerged lands of the State of Louisiana has been coordinated with the State and the project is in compliance.

COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990 COASTAL BARRIER RESOURCES REAUTHORIZATION ACT OF 2000 AND 2005

The Caminada Headland is part of the John H. Chafee Coastal Barrier Resources System (CBRS); however, this project would not affect development. This project is in compliance.

RIVERS AND HARBORS ACT OF 1899

The proposed work would not obstruct navigable waters of the United States. The USACE issued a Section 10/404 permit (MVN-2011-02539-WPP) on May 10, 2012 for this project; therefore, this project is in full compliance.

ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species are not likely to be affected. The project has been coordinated with both the NMFS and the USFWS, and is in compliance.

MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

Migratory birds may be temporarily affected by project activities. Monitoring and mitigation efforts with regard to migratory birds are being coordinated with USFWS and LDWF; a migratory bird abatement plan (see Appendix A) will be implemented. All terms and conditions of the USFWS biological opinion (see Appendices A and C) will be adhered to for this project.

MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The term *dumping* as defined in the Act (3[33 U.S.C. 1402](f)) does not apply to the disposal of material for beach nourishment or to the placement of material for a purpose other than disposal (i.e., placement of rock material as an artificial reef or the construction of artificial reefs as mitigation). Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project. The disposal activities addressed in this EA will be evaluated under Section 404 of the Clean Water Act.

E.O. 11990, PROTECTION OF WETLANDS

No wetlands would be affected by project activities. This project would be in compliance with the goals of this Executive Order.

E.O. 11988, FLOOD PLAIN MANAGEMENT

No activities associated with the project would take place within a floodplain; therefore, this project would be in compliance with the goals of this Executive Order.

E.O. 12898, ENVIRONMENTAL JUSTICE

The project would not result in adverse human health or environmental effects, nor would it affect subsistence consumption of fish or wildlife. The project would be in compliance.

E.O. 13089, CORAL REEF PROTECTION

The project would not affect U.S. coral reef ecosystems as defined in this Executive Order. The project would be in compliance.

E.O. 13112, INVASIVE SPECIES

The project would have no effect on invasive species. This E.O. is not applicable.

E.O. 13186, RESPONSIBILITIES OF FEDERAL AGENCIES TO PROTECT MIGRATORY BIRDS

Migratory birds are of great ecological and economic value to the United States and to other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of Americans who study, watch, feed, or hunt these birds throughout the United States and other countries.

This order requires that environmental analyses of Federal actions required by the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, with emphasis on species of concern. In addition, each Federal agency shall restore and enhance the habitat of migratory birds, as practicable. All terms and conditions of the USFWS biological opinion will be adhered to for this project. A Bird Abatement Plan will be implemented during this project (see Appendix A).

7.0 LIST OF PREPARERS

Name	Organization	Role in Preparation
Michael Miner	BOEM	Document Review
Ken Ashworth	BOEM	Document Review
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FINDING OF NO SIGNIFICANT IMPACT

Use of Outer Continental Shelf Sand from Ship Shoal, South Pelto Blocks 13 and 14 for the Caminada Headland Beach and Dune Restoration Project, *Jefferson and Lafourche Parishes, Louisiana*

Introduction

Pursuant to the National Environmental Policy Act (NEPA) and the Council on Environmental Quality's (CEQ) regulations implementing NEPA (40 CFR 1500-1508), the Louisiana Coastal Protection and Restoration Authority (CPRA), in coordination with the Bureau of Ocean Energy Management (BOEM), prepared an environmental assessment (EA) (Attachment 1) to determine whether authorizing the use of Outer Continental Shelf (OCS) sand from Ship Shoal, South Pelto Blocks 13 and 14, would have a significant effect on the human environment and whether an environmental impact statement (EIS) should be prepared. Pursuant to the U.S. Department of the Interior's (DOI) regulations implementing NEPA (43 CFR 46), BOEM has independently reviewed the EA and has determined that the potential impacts of the proposed action have been adequately addressed.

Proposed Action

BOEM's proposed action is the issuance of a negotiated noncompetitive agreement (NNA) to authorize the use of sand from Ship Shoal, South Pelto Area Blocks 13 and 14, located approximately 27 nautical miles (31 miles; 50 kilometers) southwesterly of the Caminada Headland Beach and Dune Restoration Protection Project in Jefferson and Lafourche Parishes, Louisiana. The proposed Caminada Headland Beach and Dune Restoration Project (CPRA Project BA-45) involves the reestablishment of the eroded headland/beach through the creation of a continuous beach and dune system for along 31,000 linear feet of shoreline on the Caminada Headland from Belle Pass eastward to Bayou Moreau. Approximately 5,121,000 cubic yards of sand will be mined from the South Pelto borrow area. Five pump-out/rehandling areas are proposed to facilitate placement of the sand mined from Ship Shoal. Only one or two of these areas will actually be utilized. Each pump-out area will have a corresponding corridor to accommodate a conveyance pipeline for the transport of the sand. Two of these areas are located in Belle Pass to the east of the navigational channel, one pump-out area is located in Pass Fourchon, and two pump-out/mooring areas are offshore in the Gulf of Mexico in the State of Louisiana's territorial waters.

The purpose of BOEM's proposed action is to respond to a request for the use of OCS sand under the authority granted to DOI by the Outer Continental Shelf Lands Act (OCSLA). The legal authority for the issuance of negotiated noncompetitive leases for OCS sand and gravel is provided by OCSLA (43 U.S.C. 1337(k)(2)).

Alternatives to the Proposed Action

The only alternative to BOEM's proposed action is no action. However, the potential impacts resulting from BOEM's no action actually depend on the course of action subsequently pursued by the CPRA, which could include identification of a different offshore or upland sand source. In the case of the no project alternative, habitat deterioration and coastal erosion continue, and the likelihood and frequency of property and storm damage increases.

In past environmental analyses for this restoration project, a number of alternatives related to sand sources have been considered. The alternatives have narrowed over time due to lack of sufficient volume and/or the presence of preexisting pipelines, oil and gas wells, and associated industry structures. The attached EA, prepared by CPRA, also analyzed a no action alternative that notes the same impact.

Environmental Effects

The Caminada Headland Project is an environmental restoration project. The CPRA intends for the design and construction of the Caminada Headland Project to serve as a portion of the State of Louisiana's cost share towards the completion of the U.S. Army Corps of Engineers (COE) Barataria

Basin Barrier Shoreline Restoration (BBBS) Project. The BBBS Project was identified as a critical near-term restoration project in the Louisiana Coastal Area, (see Attachment 1, EA page 172, reference: U.S. Dept. of the Army, COE, 2004a) and was federally authorized under the Water Resources Development Act of 2007. The COE completed its evaluation of potential environmental effects resulting from the proposed project in a 2012 construction report a titled "Louisiana Coastal Area Barataria Basin Barrier Shoreline Restoration Construction Report and Environmental Impact Statement, U.S. Army Corps of Engineers, Mississippi Valley Division, New Orleans District" (see Attachment 1, EA page 172, reference: U.S. Dept. of the Army, COE, 2012a). Additionally, following the issuance of a Louisiana Department of Environmental Quality (DEQ) water quality certification (Attachment 2) and a coastal use permit by the Louisiana Department Natural Resources (LADNR), on February 2, 2012 (Attachment 2), COE issued a Section 10/404 Permit on May 10, 2012 (Attachment 3). Prior to permit authorization, COE completed an Environmental Assessment/Decision Document (Attachment 4), in which it evaluated the entire project to include the proposed use of OCS sand resources. The COE's environmental impact statement, LADNR's Coastal Use Permit/Consistency Determination (Attachments 5 and 6), and COE's Section 10/404 Permit and EA (Attachments 5 and 6) concluded that the proposed project did not result in any significant long-term environmental impacts and that the project is the public's interest.

Based on the effects analysis presented in the attached BOEM environmental assessment (Attachment 1), no significant impacts were identified. The EA identifies all mitigation and monitoring that is necessary to avoid, minimize, and/or reduce and track any foreseeable adverse impacts that may result from all phases of construction. A subset of mitigation, monitoring, and reporting requirements, specific to activities under BOEM's jurisdiction, will be incorporated into the NNA (between BOEM and CPRA for the use of OCS sediment resources) to avoid, minimize, and/or reduce and track any foreseeable adverse impacts.

Significance Review

Pursuant to 40 CFR 1508.27, BOEM evaluated the significance of potential environmental effects considering both CEQ context (such as society as a whole, human, and national; the affected region; the affected interests; and the locality) and intensity factors. The potential significance of environmental effects has been analyzed in both spatial and temporal contexts. The potential effects are generally considered reversible because they will be minor to moderate, localized, and short-lived. No long-term significant or cumulative adverse effects were identified. The primary factors noted below were considered in the EA and are specifically noted below:

1. Impacts that may be both beneficial and adverse

The potential adverse effects to the physical environment, biological resources, cultural resources, and socioeconomic resources have been considered. Adverse effects to benthic habitat and communities in the borrow area are expected to be reversible. Adverse effects on fish habitat and fishes are expected within the dredged area due to the reduction of benthic habitat and changes in shoal topography and in the fill placement area due to the burial of existing benthic habitat. The potential effects to sea turtles, migratory birds, marine mammals, and cultural resources in the vicinity of operations have been reduced through tested mitigation including, but not limited to, avoidance of nesting birds, sea turtle deflector use, marine mammal observers, and cultural resource buffers.

The effects to sea turtles, marine mammals, nesting and courting shorebirds, and water quality will be monitored. No impacts to hard-bottom communities will occur. Temporary displacement of birds near the shoal site or beach shoreline/beach could occur. Birds may be attracted to feeding near the hopper as it is being filled at the borrow area or near discharge pipelines on the beach. Impacts would be short-term, localized, and temporary and they should have no lasting effects on bird populations in the area. Temporary reduction of water quality is expected due to turbidity during dredging and placement operations. Small, localized, temporary increases in concentrations of air pollutant emissions are expected, but the short-term impact by emissions from the dredge or the tugs would not affect the overall air quality of the area. A temporary increase in noise level during construction in the vicinity of the dredging would occur. For safety reasons, navigational and recreational resources located in the vicinity of the dredging operation would temporarily be unavailable for public use. No archaeological/cultural resources will be affected. A dredge with GPS-positioning equipment will be used to ensure the dredge is operating in the authorized location. An unexpected finds clause will be implemented in case any potentially significant unrecorded archaeological/cultural resources are discovered during operations.

2. Degree to which the proposed action affects public health or safety

The proposed activities are not expected to significantly affect public health. Construction noise will temporarily increase ambient noise levels, and equipment emissions would decrease air quality in the immediate vicinity of placement activities. The public is typically prevented from entering the segment of beach under construction; therefore, recreational activities will not be occurring in close proximity to operations. During dredging operations, watercraft access will be restricted in the dredging area in the interest of public safety. These restrictions would be of short duration and are expected to be minor to boat operators. During dredging and placement, the use of the area immediately surrounding the borrow area and the Caminada Headland in the vicinity of the shore restoration would be temporarily restricted due to public safety. The COE's Section 10/404 Permit also requires the CPRA contractors to coordinate and develop a safety plan with the U.S. Coast Guard.

3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas

No prime or unique farmland, designated wild and scenic reaches, or wetlands would be impacted by implementation of this project. Also, there will be no significant impacts to critical habitat or essential fish habitat. The CPRA's dredge contractor and the pipeline corridors will be monitored for effects during dredging operations, pump-out, placement, and beach shaping operations.

4. Degree to which the effects on the quality of the human environment are likely to be highly controversial

No controversial effects are expected. Effects from beach nourishment projects, including dredging on the OCS, are well studied. The effects analyses in the EA have relied on the best available scientific information, including information collected from past COE-contracted dredging and permitted dredging activities in and adjacent to the project area. Negative effects of dredging and beach nourishment activities on shoreline change, benthic communities, nesting and swimming sea turtles, and shorebirds are expected to be minimal, localized, and short-term.

5. Degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks

Coastal/shoreline restoration projects are a common solution to coastal erosion problems along the Louisiana coast. Federally authorized and permitted beach nourishment and emergency shoreline stabilization actions have been ongoing since Hurricane Katrina. No significant adverse effects have been documented during or as a result of past operations. The COE has permitted numerous emergency shoreline restoration projects within the project area, in addition to several dune restoration/revegetation projects and an extensive fixed breakwater system. The project design is typical of beach nourishment activities. Mitigation and monitoring efforts are similar to that undertaken for past projects and have been demonstrated to be effective. The effects of the proposed action are not expected to be highly uncertain, and the proposed activities do not involve any unique or unknown risks.

6. Degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration

No precedent for future action or decision in principle for future consideration is being made in BOEM's decision to authorize use of Ship Shoal sand. BOEM considers each use of a borrow area on the OCS as a new Federal action. The BOEM's authorization of the use of the borrow area does not dictate the outcome of future leasing decisions. Future actions will also be subject to the requirements of NEPA and other applicable environmental laws.

7. *Whether the action is related to other actions with individually insignificant but cumulatively significant impacts*

Significance may exist if it is reasonable to anticipate cumulatively significant impacts that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. The EA identifies those actions and potential impacts related to underlying activities. The EA and previous NEPA/regulatory documents conclude that the activities related to the proposed action are not reasonably anticipated to incrementally add to the effects of other activities to the extent of producing significant effects. Because the seafloor is expected to equilibrate and because moving sediment will accumulate in the Ship Shoal borrow location, the proposed project provides an incremental but localized effect on the reduction of offshore sand resources. Although there will be a short-term and local decline in benthic habitat and populations, both are expected to recover within a few years. No significant cumulative impacts to benthic habitat are expected from the use of the borrow site.

8. *Degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources*

The proposed action will not affect any significant scientific, cultural, or historic resources. Results of both terrestrial and open-water cultural resource surveys determined the absence of significant scientific, cultural, or historic resources within the area of potential effect. Section 106 coordination with the Louisiana State Historic Preservation Officer (SHPO) and the Chitimacha Tribe of Louisiana has been completed and no additional cultural resource investigations are warranted. All of these activities have been completed in accordance with the National Historic Preservation Act (NHPA), as amended; the Archeological and Historic Preservation Act (AHPA), as amended; and Executive Order 11593. The project is in full compliance with the NHPA as well as the AHPA and Executive Order 11593. Additionally, an "Unanticipated Discoveries Plan for Archaeological Properties including Human Skeletal Remains Caminada Headland Beach and Dune Restoration Project (BA-45)" has been prepared and approved by the SHPO.

9. *Degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973*

This project was fully coordinated under the ESA and is in full compliance with the Act. The COE has consulted with the U.S. Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS). The CPRA prepared an EA and Biological Assessment, which were submitted to BOEM and COE. The Biological Assessment was forwarded to FWS and NMFS during the COE Section 10/404 Permit evaluation period. The FWS, in a letter to COE dated February 28, 2012, defaulted to their earlier December 21, 2012 Biological Opinion associated with the Corp of Engineers' BBBS Project (Attachment 7).

The FWS was initially concerned with potential effects on the piping plover, its designated critical habitat, and the West Indian manatee. In the aforementioned Biological Opinion, FWS concurred with COE that the proposed project was not likely to adversely affect the West Indian manatee, not likely jeopardize the continued existence of the piping plover, and not adversely modify its designated critical habitat given the estimated piping plover take. Additionally, COE provided that appropriate mitigations (as noted in the FWS Biological Opinion) would be incorporated as conditions in COE's Section 10/404 Permit (Attachment 5). The CPRA is also working closely with FWS to finalize a migratory bird abatement plan.

The NMFS Protected Resources Division, in a letter dated January 20, 2012, stated that the existing September 2005 Biological Opinion titled *Hopper and Hydraulic Cutterhead Dredging Associated with Sand Mining for Coastal Restoration Projects Along the Coast of Louisiana Using Sand from Ship Shoal in the Gulf of Mexico Central Planning Area, South Pelto Blocks 12, 13, and 14 and Ship Shoal Block 88* (Consultation No. F/SER12003/01247) entirely encompassed the scope of the proposed Caminada Headlands project and adequately addressed the issues associated with threatened and endangered species. They noted that, although lethal takes may occur via hopper dredging and/or relocation trawling during the Caminada Headland project, these takes have already been anticipated, analyzed, and accounted for in the earlier Ship Shoal opinion. In summary, they concluded that these effects where not reasonably expected to jeopardize the continued existence of listed species or their critical habitat (Attachment 8).

10. Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment

The COE's Section 10/404 Permit and LADNR's Coastal Use Permit require that CPRA comply with all applicable Federal, State, and local laws and requirements. The COE and BOEM have completed required ESA and MSA coordination with NMFS and FWS. A Coastal Use Permit and Consistency Determination from the LADNR and a Section 401, Clean Water Act Water Quality Certification from the Louisiana Department of Environment has been issued for the proposed action. Through COE's Section 10/404 Permit, monitoring and mitigation efforts with regard to migratory birds have been coordinated with FWS and Louisiana Department of Wildlife and Fisheries; an approved migratory bird abatement plan will be implemented. The project will be in compliance with these Acts. Monitoring and mitigation efforts with regard to migratory birds are being coordinated with USFWS and LDWF; a migratory bird abatement plan will be implemented (see EA Attachment 1, Appendix A). The proposed action is in compliance with the Marine Mammal Protection Act. Marine mammals are not likely to be adversely affected by the project, and incorporation of safeguards to protect threatened and endangered species during project construction would also protect marine mammals in the area. A water quality certification has been issued by LADNR, and water quality will be monitored to ensure State water quality standards are not violated.

Consultations and Public Involvement

The COE, serving as the lead Federal agency, posted a public notice with a 20-day comment period on October 31, 2011. The LADNR published a public notice in local newspapers and in the Baton Rouge Advocate on October 10, 2011. BOEM was listed in the point-of-contact information for both public notices. Both COE, serving as the lead Federal agency, and BOEM, serving as the lead agency on the OCS portion of the project, have coordinated with FWS, NMFS, the U.S. Environmental Protection Agency, the Natural Resource Conservation Service, the Louisiana SHPO, and the Chitimacha Tribe of Louisiana in support of this leasing decision. Pertinent correspondence with Federal and State agencies are provided in Appendix A of the EA (Attachment 1). The COE permit was reviewed by FWS and NMFS prior to issuance, and all the appropriate mitigations have been included as conditions within the permit. Additionally, to avoid, minimize, and/or mitigate any foreseeable OCS adverse impacts, BOEM will incorporate appropriate terms and conditions (enforceable by BOEM) into the NNA.

After signature of this Finding of No Significant Impact (FONSI), a Notice of Availability of the FONSI and EA will be prepared and published by BOEM in the Federal Register or by other appropriate means. The EA and FONSI will be posted to BOEM's website at http://www.boem.gov/Non-Energy-Minerals/Marine-Mineral-Projects.aspx.

Conclusion

BOEM has considered the consequences of issuing an NNA to authorize the use of OCS sand from Ship Shoal. BOEM jointly prepared and independently reviewed the attached EA (Attachment 1) and finds that it complies with the relevant provisions of the CEQ regulations implementing NEPA, DOI regulations implementing NEPA, and other Marine Mineral Program requirements. Based on the NEPA and consultation process coordinated cooperatively by COE, CPRA, and BOEM, appropriate terms and conditions enforceable by BOEM will be incorporated into the NNA to avoid, minimize, and/or mitigate any foreseeable adverse impacts. The COE's Section 10/404 Permit requirements include U.S. Coast Guard requirements that serve as additional safeguards to reduce risk and to minimize and mitigate foreseeable and unforeseen impacts.

Based on the evaluation of potential impacts and mitigating measures discussed in the EA, BOEM finds that entering into an NNA, with the implementation of the mitigating measures, does not constitute a major Federal action significantly affecting the quality of the human environment, in the sense of NEPA Section 102(2)(C), and will not require preparation of an EIS.

Joseph Christopher, Regional Supervisor
Office of Environment
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region

6/27/2012
Date

Attachments

1. Environmental Assessment for the Issuance of Non-Competitive Negotiated Agreement for Use of Outer Continental Shelf Sands for the Caminada Headland Beach and Dune Restoration (BA-45EB), Lafourche Parish, Louisiana
2. Louisiana Department of Environmental Quality Section 401 Water Quality Certification
3. U.S. Dept. of the Army, Corps of Engineers Section 10/404 Permit MVN-2011-02539-WPP
4. U.S. Dept. of the Army, Corps of Engineers Environment Assessment/Decision Document
5. Louisiana Department of Natural Resources, Coastal Use Permit (P20111274)
6. Louisiana Department of Natural Resources, Consistency Determination (C20110372)
7. Fish and Wildlife Service Biological Opinion (04EL1000-2012-F-0594)
8. National Marine Fisheries Service Biological Opinion

FONSI

Appendix A

Mitigation, Monitoring, and Reporting Requirements