E C O L O G I C A L   R E V I E W

Riverine Sand Mining/Scofield Island Restoration
CWPPRA Priority Project List 14
State No. BA-40

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This document reflects the project design as of the 30% Design Review meeting, incorporates all comments and recommendations received following the meeting, and is current as of March 30, 2010.

ECOLOGICAL REVIEW
Riverine Sand Mining/Scofield Island Restoration (BA-40)

In August 2000, the Louisiana Department of Natural Resources (LDNR) initiated the Ecological Review to improve the likelihood of restoration project success. This is a process whereby each restoration project's biotic benefits, goals, and strategies are evaluated prior to granting construction authorization. This evaluation utilizes monitoring and engineering information, as well as applicable scientific literature, to assess whether or not, and to what degree, the proposed project features will cause the desired ecological response.

I. Introduction

Louisiana's Barataria/Plaquemines barrier island complex system extends approximately 25 miles from West Grand Terre Island to Sandy Point (Figure 1; Penland et al. 2005). The Riverine Sand Mining/Scofield Island Restoration (BA-40) project is located in Plaquemines Parish about 10 miles southeast of Empire on the southeastern edge of the Barataria Basin extending 2.4 miles in length from Scofield Bayou to Bay Coquette (Figure 2).

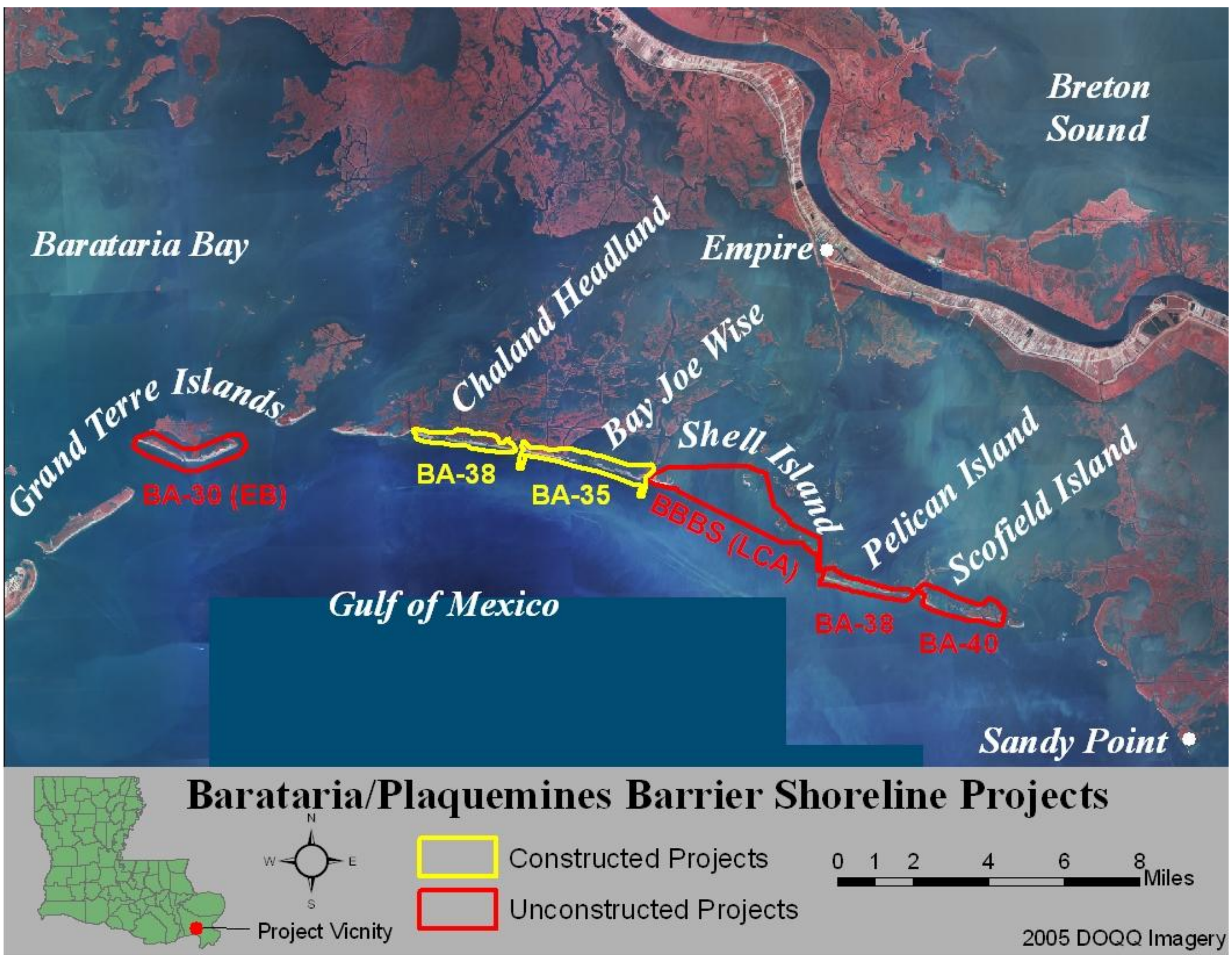

Figure 1. Location of Riverine Sand Mining/Scofield Island Restoration (BA-40) project and other barrier island restoration projects in the vicinity of the Barataria/Plaquemines barrier shoreline.

The highest rates of shoreline erosion in the Gulf of Mexico are found along Louisiana's barrier island and headland shores associated with the Mississippi delta (Morton et al. 2005). Louisiana's barrier islands are experiencing island narrowing and land loss due to the complex interaction of sea level rise, compaction, wave and storm damage, oil and gas activities, and insufficient sediment supply due to the channelization of the Mississippi River (Dean 1997, McBride et al. 1989, McBride and Byrnes 1997, Penland et al. 1988, van Heerden and DeRouen 1997, Williams et al. 1992). Several hurricanes have impacted the Plaquemines island chain: Andrew (1992), Opal (1995), Danny (1997), Earl (1998), Georges (1998), Isidore (2002), Lili (2002), Ivan (2004), Katrina (2005), Rita (2005), Gustav (2008), and Ike (2008). Hurricane Katrina made landfall near Scofield Island. Louisiana's barrier islands have decreased in land mass by more than 50% over the last 100 years (Penland et al. 2003). In some locations, shoreline erosion exceeds 65 feet per year (Penland and Boyd 1981). The Barataria/Plaquemines region is one of the most rapidly disappearing areas in Louisiana; the average erosion rate has increased from a long-term rate of -23.1 feet per year between 1884 and 2002 to a short-term rate of -42.3 feet per year between 1988 and 2002 (Penland et al. 2005). Plaquemines barrier islands have been so severely eroded in the past century that they are approaching a point of complete breakdown, and many of the barrier islands have been reduced to fragmented relics (Campbell et al. 2005a).

Scofield Island was originally a single barrier island that extended approximately 10,000 feet eastward of its present position (ATM 2004). However, due to dramatic loss of back-barrier marsh and dune habitat and breaching of the island in several places, including a recent breach created by Hurricane Lili in 2002, Scofield Island now consists of a western or main island, central islands, and an eastern island (ATM 2004, CEC and SJB 2008, NMFS 2004). According to results of the Barrier Island Comprehensive Monitoring (BICM) program, the average shoreline loss rate for Scofield Island has increased from an historic rate (1855-2005) of approximately -14.9 per year, to a short-term rate (1996-2005) of approximately -34.1 feet per year and a near-term rate (2004-2005) of -111.4 feet per year (Martinez et al. 2009). Without action, it is predicted that Scofield Island will disappear by 2044; however, the Riverine Sand Mining/Scofield Island Restoration (BA-40) project would result in significant improvements in reducing shoreline recession and maintaining existing and created marsh habitat (SJB 2010).

The objectives of the Riverine Sand Mining/Scofield Island Restoration (BA-40) project are to restore beach and back-barrier marsh habitat, repair breaches in the shoreline, and re-establish a sandy dune along the length of the shoreline to protect the marsh platform from sea-level rise and storm damage (ATM 2004, CEC and SJB 2008). The project will increase the width of the island and maintain shoreline integrity through the introduction of riverine sand and offshore fine sediment in order to increase island longevity (ATM 2004, CEC and SJB 2008, NMFS 2004). The project will preserve the newly placed sediment through the construction of dune sand fencing and the planting of vegetation on the newly created back-barrier marsh and dune platforms (ATM 2004, CEC and SJB 2008, NMFS 2004).

There are several other coastal restoration projects in the planning and design phases that are an integral part of the overall effort to restore and reinforce the Barataria/Plaquemines barrier shoreline (Figure 1). A Coastal Impact Assistance Program (CIAP) project, EB – East Grand Terre Island Restoration [BA-30 (EB)], located at the mouth of Barataria Bay in Plaquemines Parish, is currently under construction and should be completed in 2010. Other nearby projects include two Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) projects that were developed out of the comprehensive Barataria Shoreline Complex project: (1) Pass Chaland to Grand Bayou

Pass Barrier Shoreline Restoration (BA-35; also known as Bay Joe Wise) and (2) Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration (BA-38) (ATM 2004). Construction of the Bay Joe Wise (BA-35) project was completed in 2009. The BA-38 project is composed of two sections: the Chaland Headland segment, which was completed in 2007; and the Pelican Island segment, which has not yet been constructed. The restoration of Scofield Island (BA-40) would provide a synergistic effect for the Pelican Island project by increasing the amount of sand moving towards Pelican Island through longshore drift (NMFS 2004). An additional project planned for the Barataria/Plaquemines barrier shoreline is the Shell Island project, which is a component of the Louisiana Coastal Area (LCA) Barataria Basin Barrier Shoreline (BBBS) Restoration project.

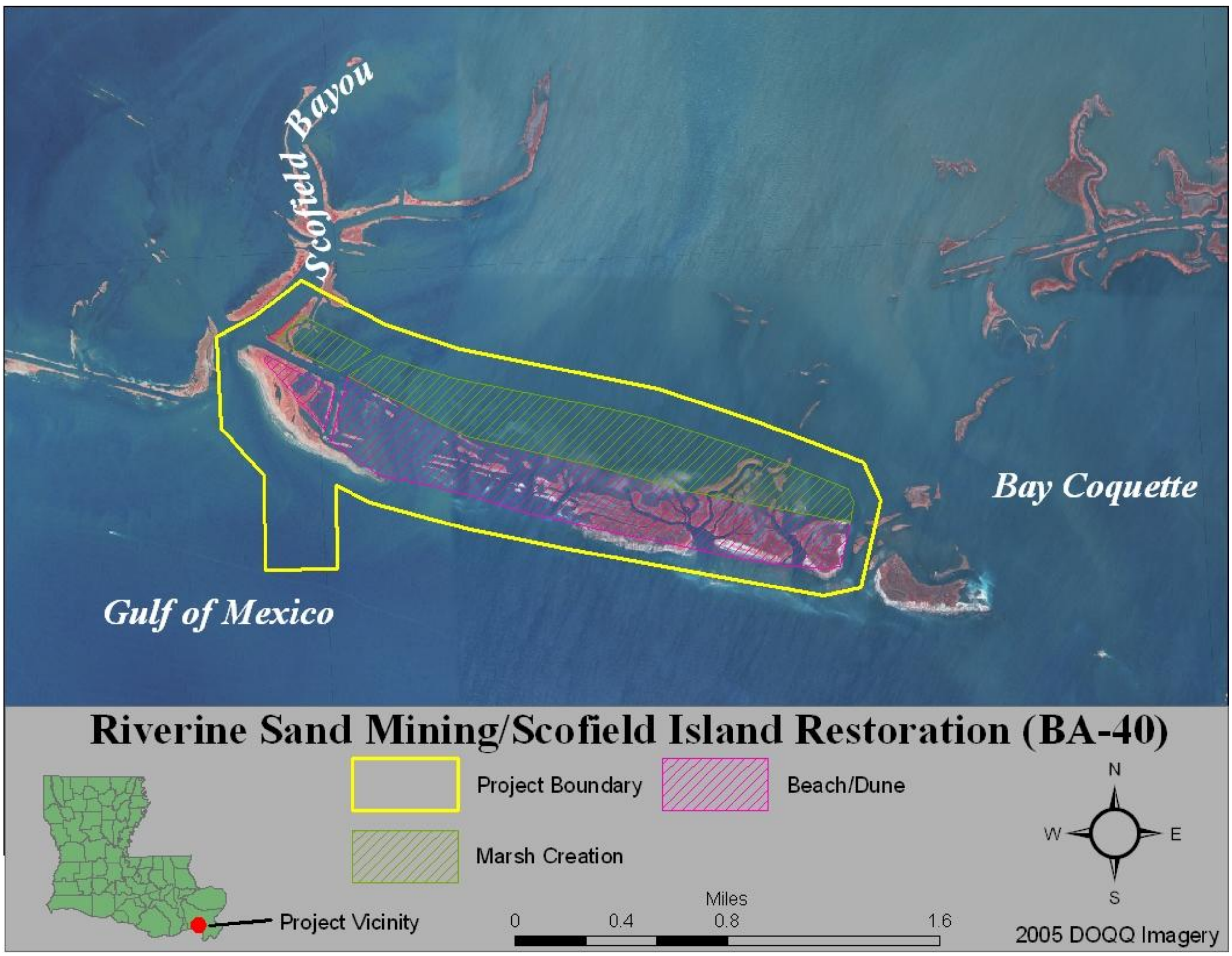

Figure 2. Riverine Sand Mining/Scofield Island Restoration (BA-40) project boundary and restoration features.

Coast 2050 has identified restoration and maintenance of barrier islands and the barrier shoreline, dedicated dredging to create marsh, and vegetative planting as Region 2 ecosystem strategies that will maintain the integrity of the estuarine system (Louisiana Coastal Wetlands Conservation and Restoration Task Force and the Wetlands Conservation Restoration Authority 1999). The state's Master Plan has identified restoration of the Barataria Basin's barrier shoreline as a method for providing hurricane protection to coastal Louisiana and for restoring and maintaining ecologically important habitat for migratory birds and threatened and endangered species (CPRA 2007b). Furthermore, the FY2008 Annual Plan listed barrier shoreline restoration of the Barataria Basin as an Urgent Early Action (UEA) that would help to stabilize critical landforms, improve the structure and integrity of the landscape, and restore the hydraulic regime in an area with a high projected future land loss (CPRA 2007a).

II. Project Features

The Design Report should be referred to for a detailed description of the restoration alternatives that were considered in the Preliminary Design Phase (SJB 2010); however, the project features of the preliminarily preferred alternative are briefly described below. Alternative 4-Optimized was the preferred alternative based on analysis of cost to benefit, shoreline recession, post-storm dune elevation, and beach and marsh habitat acres created and sustained over time (SJB 2010).

- Offshore Borrow Area: Because the river sand is too coarse to be suitable for marsh creation, a local source of marsh material was identified based on previous sand searches in the Barataria Basin area (CP&E 2004, SJB 2010). The proposed borrow area contains approximately 3.3 million cubic yards of a mixture of fine sand, silt, and clay, and lies approximately 3 miles south of Scofield Island (Figure 3). Assuming a cut to fill ratio of 1.6, this project will require approximately 2.70 million cubic yards of material for marsh creation (SJB 2010).
- Marsh Creation: Material from the offshore borrow area will be used to construct a 273 acre back-barrier marsh platform approximately 12,000 feet long and 1,000 feet wide, with a construction target elevation of +3.0 feet NAVD 88 (Figure 2) (SJB 2010).
- Containment Dikes: Approximately 20,000 feet of earthen containment will be constructed along the northern edge of the marsh fill platform, and a second dike approximately 11,800 feet in length will be constructed along the interface between the beach/dune fill and marsh platform to contain and separate the two fill sections. The dikes will have a crest elevation of +4.9 feet NAVD 88 (approximately 2 feet above the marsh platform) and width of 10 feet, and will be constructed using dredged sediment from a nearby borrow/flotation canal (SJB 2010).
- Riverine Borrow Areas: The area of focus for selecting a borrow area for the beach and dune features of this project was between mile markers 32 and 22 above Head of Passes in the Lower Mississippi River, due to this river segment's proximity to the project area and the lack of adequate sand supplies in the nearby offshore areas (CP&E 2004, Alpine 2008). The borrow area alternatives that were chosen, MR-B-09 and MR-E-09, contain about 3.77 and 5.86 million cubic yards of sand, respectively (Figure 3) (CEC and SJB 2008). Overall, the project will require approximately 2.44 million cubic yards of sand (with a cut to fill ratio of 1.3) for beach and dune fill; therefore, both potential borrow areas contain an adequate amount of sand (SJB 2010). Both potential borrow areas will be carried forward to the 95% design level (SJB 2010). The sand will be transported approximately 20 miles from the river to the project area via pipeline along the Empire Waterway (Figure 3).
- Dune and Beach Nourishment: Riverine sand will be used to construct dune, beach, and supratidal habitat (SJB 2010). The dune will be constructed to an elevation of +6 feet NAVD 88 with a 50 foot crest width (SJB 2010). The 261 acre beach platform will be

approximately 925 feet wide, with a construction elevation of +4 feet NAVD 88. The dune and beach will extend for approximately 10,600 feet along the island's Gulf shoreline (Figure 2).

- Sand Fencing: Sand fencing will be installed along the entire length of the dune following construction to capture wind-blown sand and to help stabilize and build the dunes. The fencing will be 4 feet high with 50% porosity (SJB 2010).
- Vegetation Plantings: Planting of the dune and back-barrier marsh platforms with appropriate vegetation is planned to take place following construction.

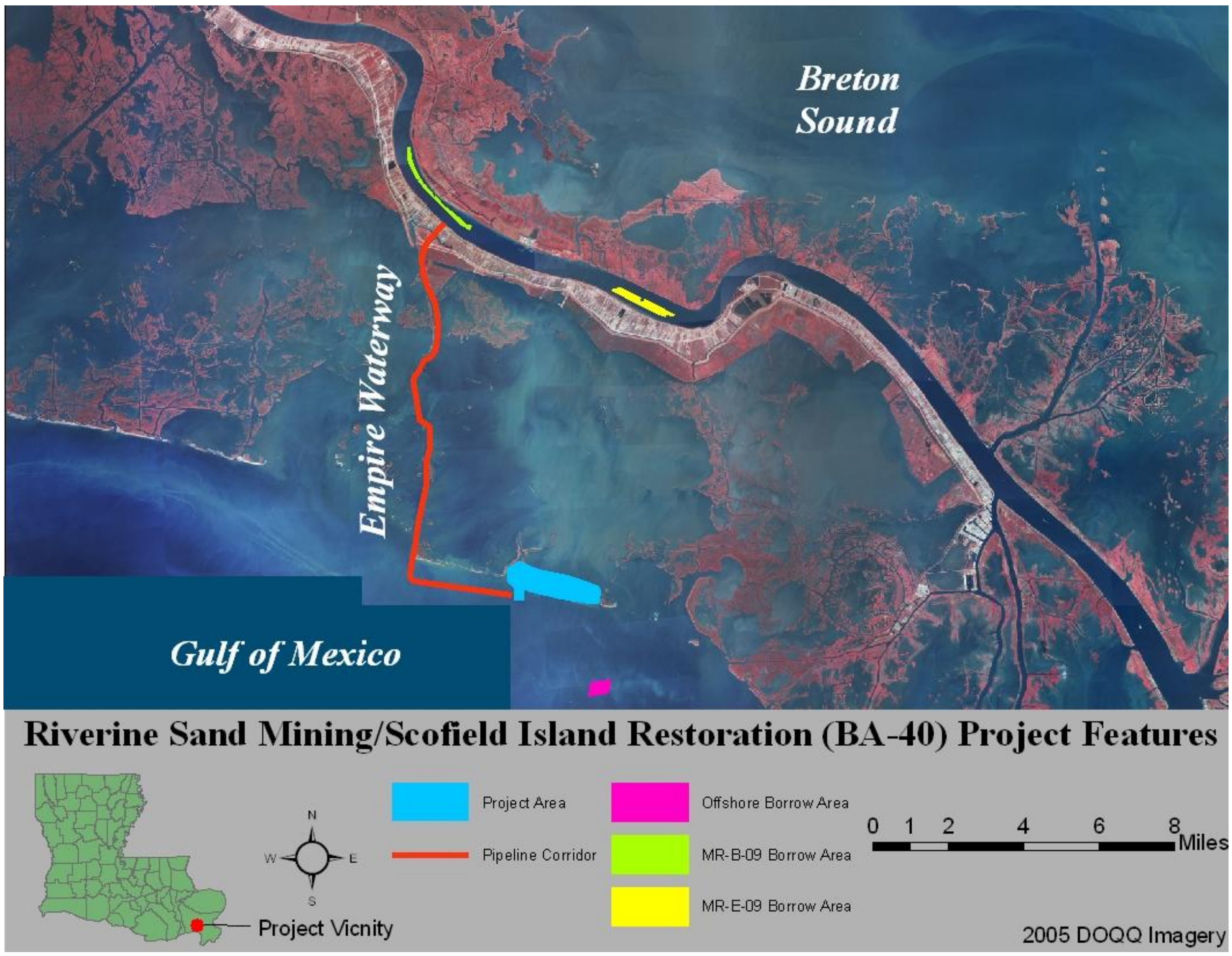

Figure 3. Location of Riverine Sand Mining/Scofield Island Restoration (BA-40) project area, pipeline conveyance corridor, and borrow areas.

III. Assessment of Goal Attainability

When addressing the likelihood that the proposed project features will provide the desired ecological response, it is important to evaluate the lessons learned from scientific research and past projects that are similar in scope to the Riverine Sand Mining/Scofield Island Restoration (BA-40) project. The findings of this review are detailed below.

Project Area

Scofield Island was originally a single barrier island; however, due to a reduction in the sediment supply from the Mississippi River and because of breaching of the island in several places, Scofield now consists of a western or main island, central islands, and an eastern island (ATM 2004, CEC and SJB 2008, NMFS 2004). The BA-40 project area will terminate at the eastern end of the central islands because the width of the channel between the central islands and the eastern island would not make closure feasible (Figure 2; ATM 2004). However, the eastern island is expected to provide a long-term sediment source and protection to the constructed project (ATM 2004).

This project was designed in a way to minimize environmental impacts to pre-existing ecologically sensitive areas. For example, the western perimeter of the project area was moved to the eastern border of a stable black mangrove colony. However, sediment deposition on the approximately 40 acres of existing, robust *Spartina alterniflora* marsh was considered a necessity for rebuilding a sustainable island (SJB 2010).

Back-Barrier Marsh Creation

Approximately 54% of the total barrier island habitat in Louisiana is made up of back-barrier marsh, and it plays the essential role of significantly reducing the overall erosion of barrier islands by acting as the structural foundation of the islands as material is eroded from the shoreline and deposited in the back-barrier marsh during overwash events (Fearnley 2008). There have been a number of constructed barrier island restoration projects in Louisiana whose goals included increasing island width and longevity through the construction of back-barrier marsh platforms (see Appendix A for design features of a selected list of constructed barrier island restoration projects). Several of these projects were reviewed by Penland et al. (2003), including: the Isles Dernieres Restoration East Island (TE-20), Isles Dernieres Restoration Trinity Island (TE-24), Whiskey Island Restoration (TE-27), and East Timbalier Island Restoration, Phase 1 and Phase 2 (TE-25 and TE-30) projects. This review determined that the projects successfully increased the width and, therefore, longevity of the islands relative to background rates of erosion. However, with the exception of TE-25 and TE-30, the projects created very little marsh, but instead created a large amount of scrub/shrub habitat and bare land. The types of vegetation that grew from natural colonization on the restored back-barrier marshes were more indicative of habitats found at the higher barrier island elevations rather than habitats found at natural back-barrier marsh elevations (Fearnley 2008). This was because the elevations of the constructed platforms were generally too high to establish back-barrier marsh (Penland et al. 2003). Consequently, Penland et al. (2003) recommended that future back-barrier marsh creation projects not exceed a platform elevation of +2.0 feet NAVD 88.

Based on the local tidal regime for the Scofield Island project area (Mean High Water of +1.6 feet NAVD 88 and Mean Low Water of +0.55 feet NAVD 88), surveys of the native average marsh elevation (approximately +1.5 feet NAVD 88), and settlement analyses on sediment cores collected from within the marsh creation area, it was determined that a construction fill elevation of +3.0 feet NAVD 88 would yield desirable marsh elevations for most of the project life (SJB 2010). Filling to this elevation and including an estimated relative sea level rise rate of 0.055 feet/year (0.66 inches/year; SJB 2010), the created marsh platform would settle to an elevation of approximately +1.6 feet NAVD 88 within approximately 3 years after construction completion, and would be intertidal for 70.5% of the 20-year project life (Table 1).

Because barrier islands are exposed to harsh, erosive conditions, it is important to quickly establish vegetation in order to stabilize newly-placed sediment and maintain island integrity. Numerous factors are associated with poor plant survival and coverage including inadequate elevation, drought, insufficient planting density, wave fetch and erosion, herbivore threats, planting too soon prior to settlement of newly placed sediment, and many other site-specific conditions (Bahlinger 1995, NMFS 2004). Restored back-barrier marsh habitat with soil conditions more similar to natural back-barrier marshes will produce a more functional and stable system that not only better supports salt marsh vegetation, but is also better capable of recovering from stressful events (Fearnley 2008). The proposed offshore borrow area contains a mixture of fine sand, silt, and clay, with an average grain size of 0.10 mm (SJB 2010). Although this mixture would be inappropriate for beach and dune restoration, it is suitable for marsh creation.

Table 1. Marsh platform duration within tidal zone (from SJB 2010).

Proposed Marsh Fill Elevation (ft. NAVD 88)	Time to Reach MHW (years)	Time to Reach MLW (years)	Time within Intertidal Zone (years)	Percentage of Project Life (%)
+3.5	6.0	20.0	14.0	70.0
+3.0	3.2	17.3	14.1	70.5
+2.5	1.1	13.3	12.2	61.0
+2.0	0.0	9.7	9.7	48.5

Additionally, marsh vegetation has a greater chance of surviving if it is planted after design elevations are achieved following a period of settlement and consolidation of the dredged sediment, which may take 6 months to a year (Campbell et al. 2005b). Marsh vegetation was planted for the TE-20, TE-24, and TE-27 projects after a period of 6 to 12 months, during which the fill material dewatered and consolidated (Penland et al. 2003). Survival rates of these plantings were good; however, after three growing seasons, they had not expanded significantly into the unplanted areas of the project, resulting in a loss of sediment through aeolian processes (Penland et al. 2003). The lack of vegetative expansion may have been related to the unsuitable elevation of the constructed platforms (Penland et al. 2003). The poor growth of vegetation may also have been related to the high percentage of sand present in the projects' fill material, which was significantly greater than that found in natural back-barrier marsh (Fearnley 2008). Sandy substrates typically do not have the nutrient concentrations necessary for rapid plant establishment (Broome et al. 1988). Therefore, fertilizer applications have been recommended to overcome these deficiencies and accelerate marsh development (Broome et al. 1988, Fearnley 2008).

<u>Beach Nourishment and Dune Building</u>

Beach nourishment can be defined as the artificial addition of suitable sediment to an eroding shoreline which has a sediment deficiency in order to rebuild and maintain the shoreline at a width that provides storm protection and/or a recreation area (Campbell et al. 2005b, Campbell and Spadone 1982, Davison et al. 1992, Speybroeck et al. 2006). According to the Louisiana Gulf Shoreline Restoration Report (Campbell et al. 2004), the basic design for beach nourishment should place enough sediment in the island system to produce a volumetrically stable and sediment-rich barrier complex. The most important parameter when developing an optimal design is to compensate for the amount of sediment typically lost naturally by the system. An initial increase in volume placed should be incorporated to minimize those losses and reduce impacts to the existing island (Campbell et al. 2004). When designing a beach nourishment project, it is important to minimize the overall negative ecological impacts by conducting construction during a period of low beach use by birds and other mobile organisms, and by choosing a borrow source that has a sediment composition comparable to that of the natural sediment (Naqvi and Pullen 1982, Speybroeck et al. 2006). The sediment dredged from the river, which is primarily fine sand (average grain size of 0.16 to 0.19 mm), should be compatible for building the gulf beach and dune system for the island, as the native beach sediment is also primarily fine sand, with an average grain size of 0.14 mm (SJB 2010).

A widened beach profile, in combination with protective dunes, can dissipate wave energy and reduce damages from storms (Campell et al. 2005, Davison et al. 1992). Dunes can act as reservoirs of sand that reduce shoreline recession during storms and as flexible barriers to tides and waves (Pries et al. 2008, USDA 1992). Except on the Chandeleur Islands, where dunes may reach 16 feet in height, the dunes on Louisiana's barrier islands are typically 3-6 feet high (Campbell et al. 2005b, Monteferrante and Mendelssohn 1982). There are varying opinions in the scientific community concerning the construction height of dunes in restoration projects; however, dune height should be a function of specific project goals (Campbell et al. 2005b). Campbell et al. (2005a) recommends that restoration of Plaquemines barrier islands contain dunes with elevations ranging from 5 to 10 feet depending on project objectives. If a desired response of the project is to prevent overwashing and breaching and to maintain the shoreline in its current location, it may be preferable to construct higher dunes (Campbell et al. 2005b). Conversely, if a desired outcome of the project is to maximize island and marsh footprints in order to maintain the island as the first line of defense against storms and waves, as is the case for the Scofield Island project, then lower and wider dunes may serve this purpose (Campbell et al. 2005b). Islands with lower dunes will be more similar to natural islands by allowing overwash, which will provide a sediment source to the back-barrier marshes so that they can keep up with relative sea level rise (Campbell et al. 2005b). Building dunes at an elevation that mimics natural barrier island conditions will also facilitate an increase in biodiversity (Penland et al. 2003). For the BA-40 project, dunes will be constructed to +6.0 feet NAVD 88, which will help meet project objectives.

In order to combat the substantial breaching that may occur when a barrier island is exposed to storm events, it is important that a continuous dune of sufficient height and width is maintained. Other than periodically replenishing sediment with dredged material, sand fencing has proven to be an effective technique in rebuilding dunes by capturing wind-blown sediment. Sand fences installed immediately after placement of sand aid in the formation of dunes and capture sand that would be otherwise lost from the system (Khalil and Lee 2004). The orientation of sand fencing is also critical to their performance. Mendelssohn et al. (1991) tested several sand fencing designs on Timbalier Island. Of the three sand fencing designs tested, straight fences with perpendicular spurs initially accumulated the most sand. However, over a 3-year period, straight sand fencing without side spurs were the most successful, both at accumulating a large volume of sand and promoting dune height (Mendelssohn et al. 1991). The East Timbalier Sediment Restoration projects, Phase 1 (TE-25) and Phase 2 (TE-30), included the construction of sand fencing parallel to the shore with spurs placed at various orientations, which resulted in fencing segments resembling either a "V" or an "A" shaped alignment (West et al. 2005). The overall results of these projects, as well as other past barrier island projects, indicates that spur fencing does not aid in dune accumulation and may actually promote scouring. Orienting the sand fencing parallel to the shore and perpendicular to the predominant wind direction will maximize the potential for building and maintaining dunes (West et al. 2005). In addition to placing sand fencing in this orientation, the United States Department of Agriculture (USDA 1992) also recommends installing sand fencing 4 feet high with 50% porosity (i.e., ratio of area of open space to total projected area). The purpose of this design is to slow wind velocity and maximize the amount of wind-blown sand that is captured in order to build and stabilize dunes.

Dune vegetation also plays a critical role in maintaining and improving the stability and functionality of the barrier island and in providing defense against the effects of storm and overwash events by reducing erosion of the barrier shoreline (Hester et al. 2005, Monteferrante and Mendelssohn 1982). Without the interplay of plant establishment and dune formation, the structural and protective role of barrier islands would be diminished (Hester et al. 2005). The Whiskey Island Restoration (TE-27) project demonstrated the importance of planting adequate vegetation and installing sand fences. This project did not initially include sand fencing or aerial seeding, and rapid loss of newly placed sediment occurred as a result of aeolian transport and wave overwash (West and Dearmond 2004c). The presence of vegetation helps determine a dune's stability. When vegetation becomes established on a dune, it creates a positive feedback loop by reducing wind velocity and causing sand deposition, which in turn will stimulate additional plant growth, leading to more dune creation (Hester et al. 2005). However, it is important to combine the use of sand fencing and vegetation, because vegetative plantings without sand fencing will accumulate very little sand (Mendelssohn et al. 1991, USDA 1992). In the Timbalier Island Planting Demonstration (TE-18) project, fenced and planted sections of the project area experienced a 0.7 foot per year increase in average dune height between 1995 and 1999, while the reference areas experienced a 0.4 foot per year increase (Townson et al. 2000).

The type of vegetation present is also significant because dune height and the resulting protection provided by the dune will depend on the vegetative species present. For example, dunes with *Panicum amarum* (bitter panicum), *Uniola paniculata* (sea oats), or *Croton punctatus* (beach tea) can reach a height of over 16 feet, while dunes with *Spartina patens* (marshhay cordgrass) generally form dunes less than 3 feet high. In addition to the species above, dune vegetation that typically occurs on Louisiana's barrier islands can also include *Solidago sempervirens* (seaside goldenrod), *Ipomoea imperati* (beach morning glory), and *Hydrocotyle bonariensis* (pennywort) (Monteferrante and Mendelssohn 1982). The USDA (1992) recommends planting a combination of *Uniola paniculata*, *Spartina patens*, and *Panicum amarum* in dune restoration projects; however, *Panicum amarum* has proven to be the most successful species to plant on barrier islands in Louisiana (Montferrante and Mendelssohn 1982). The advantages of *Panicum amarum* as stabilizing vegetation far outweigh those of *Spartina patens* (Keith Lovell, LDNR, personal communication, October 2003), and *Panicum amarum* often has higher survival rates. According to Mendelssohn et al. (1991), of the three dune species planted in a project on Timbalier Island, *Panicum amarum* had the highest survival rate (73% after 15 months). Similarly, in the TE-18 project on Timbalier Island, *Panicum* had a much higher survival rate than *Spartina*, or 93% compared to 53% (Townson et al. 2000).

IV. Summary/Conclusions

Storm events, subsidence, and gulf and bay erosion have all contributed to the current deteriorated state of Scofield Island. The addition of riverine sand to the island will increase the height and width of the dune, which will extend the longevity of the barrier island by initially protecting the newly created marsh platform and also by allowing the island to migrate landward through the rollover process, thereby allowing the island to naturally respond to sea level rise. As storm events take place, and due to the increased width of the barrier island that will result from this proposed restoration project, the additional material placed on the dune will remain in this barrier island system as it is transported landward and deposited on the bayside of the island. According to Hester et al. (2005), a dune provides protection from wind and wave energy to the landward side of the barrier island. This allows for the establishment of vegetation zones on the landward side of the island, thus increasing the biodiversity of the barrier island ecosystem (Hester et al. 2005).

Various strategies can be employed to improve the success of barrier island restoration projects. Two of these strategies includes the construction of sand fences and the establishment of vegetation as soon as possible after dredged sediment placement is completed in order to promote dune formation and stability and to conserve sediment that would otherwise be lost through erosive processes, which would reduce the island's longevity (West and Dearmond 2004a, b, West 2005). Sand fencing should be constructed parallel to the shore and perpendicular to the predominant wind direction (West and Dearmond 2004a, b). Also, the USDA (1992) recommends that to maintain vegetation plantings at the desired density, fertilizer should be applied regularly and vegetation should be replanted annually as needed. Fertilization of planted vegetation is beneficial and can greatly improve vegetation success by improving survival (NMFS 2004). Unlike previous barrier island projects that have used sand for marsh creation, the sediment that will be used to construct the Scofield Island marsh platform is a mixture of fine sand, silt, and clay. Because this finer textured substrate is more likely to have adequate nutrient concentrations (Broome et al. 1988) and is similar in composition to the native sediment, the project's vegetative plantings should become rapidly established, particularly if the plantings are accompanied by fertilizer amendments and if the project's planting approach tailors the types and locations of the plantings to the existing environmental conditions. Dune vegetation is typically fertilized in CWPPRA barrier island projects; however, plants in the intertidal zone are not fertilized because the fertilizer is quickly leached out (Kenneth Bahlinger, OCPR, personal communication, February 2010).

The elevation to which the marsh platform is constructed plays a crucial role in determining the type of habitat that will be created on the newly constructed back-barrier marsh. The constructed marsh platform should be able to accommodate some overwashed sediment and still remain in the intertidal zone for most of the project life. Furthermore, the platform should be high enough in elevation that the developing marsh would not be excessively inundated by tides, which often causes reduced net primary productivity, plant stress, and plant death (Mendelssohn and McKee 1988). According to Penland et al. (2003), the elevation of a back-barrier marsh should not be greater than +2.0 feet NAVD 88. For the Scofield project, the marsh platform will have an initial construction elevation of +3.0 feet NAVD 88, which should settle to an elevation of approximately +1.6 feet NAVD 88 within approximately 3 years after construction completion, and should yield desirable marsh elevations for most of the project life (SJB 2010).

Another important factor controlling marsh development is the maintenance of hydrologic exchange between the marsh and adjacent water bodies. Restricted tidal exchange can slow down the time frame for vegetation establishment in marshes (Williams and Orr 2002). Tidal exchange imports sediments and nutrients to the marsh and prevents harmful sulfide concentrations and hypersaline conditions from developing (Osgood and Zieman 1998). Because of these processes, vegetation in young marshes usually develops faster in areas with consistent hydrologic exchange, such as tidal creeks (Tyler and Zieman 1999). For the BA-40 project, the design report (SJB 2010) states that the containment dikes may be degraded or gapped where settlement is less than anticipated. Openings cut into the containment dikes following a period of settlement and consolidation would promote hydrologic exchange, and tidal creeks would evolve naturally as flow is channeled through the openings (SJB 2010, Williams and Orr 2002).

BA-40 is the first CWPPRA project to propose using Mississippi River bedload sediment as a borrow source for barrier island restoration. Sufficient sand moves down the river annually so that the borrow area is expected to refill fairly quickly and may be considered renewable (CP&E 2004). However, the efficacy of this restoration technique is relatively unknown; therefore, future projects of this kind will greatly benefit from comprehensive documentation and monitoring of the implementation and performance of the BA-40 project.

IV. 30% Design Review Recommendations

Based on the evaluation of available ecological, geological, and engineering information, and a review of scientific literature and similar restoration projects, the proposed strategies of the Riverine Sand Mining/Scofield Island Restoration (BA-40) project will likely achieve the desired ecological goals. At this time, it is recommended that this project progress towards the 95% Design Review pending a favorable 30% Design Review. However, I recommend the following:

- Sand fencing should be constructed as soon as possible following construction.
- Containment dikes should be mechanically gapped following a period of dewatering and consolidation in order to prevent impoundment of the marsh and to ensure adequate tidal exchange.
- If marsh is damaged from the installation and maintenance of the pipeline for transport of sand from the river to the island, the damaged marsh should be restored after project construction is complete.
- In order to maintain vegetation plantings at an adequate density, fertilizer should be applied and vegetation should be replanted as needed.
- Since this is the first CWPPRA project to propose using riverine sand as a source for barrier island restoration, a thorough monitoring plan should be developed in order to inform future projects.

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APPENDIX A

Project Name	Project Number	Construction Date	Project Area (acres)	Dredged Material (cubic yards)	Marsh Platform Constructed Elevation (feet)	Marsh Platform Width (feet)	Dune Elevation (feet)	Dune Width (feet)	Beach Width (feet)	Length of Sand Fencing (linear feet)	Vegetation Planted	Project Summary
Queen Bess (State)	BA-05b	1993		75,000	+3.22 NGVD 29						*Morella cerifera* *Aviccenia germinans* *Baccharis halimifolia* *Lycium carolinianum* *Iva frutescens*	Dredged material was added to increase the size of the island, and a rock dike was installed around the entire perimeter of the island to armor the shoreline.
Raccoon Island Repair (State)	RI	1994		1.2 million							*Avicennia germinans*	Dredged material and vegetation were used to repair damage from Hurricane Andrew.
Barataria Bay Waterway Wetland Restoration (CWPPRA)	BA-19	1996	510		+3.72 NGVD 29							This project intended to create vegetated wetlands adjacent to the Queen Bess project. A 1,650 feet shell dike was constructed and a containment area was filled with material dredged from Barataria Bay Waterway.
Barataria Bay Waterway, Grand Terre Island (Phase I) (WRDA)	N/A	1996		500,000								This project involved the beneficial placement of dredged material from the Barataria Bay Waterway to create wetlands on West Grand Terre Island.
Timbalier Island Repair (FEMA)	DSR-81559	1996				300						A major breach created by Hurricane Andrew was closed, and a marsh platform was constructed.
Isle Dernieres Restoration, East Island (CWPPRA)	TE-20	1999	449	3.9 million	+2.0 to +4.0 NAVD 88	100-350	+8.0 NGVD 29	300-500	200-250	17,500	*Cynodon dactylon* *Spartina patens* *Spartina alterniflora* *Panicum amarum*	Sand was dredged from Lake Pelto and used to build a dune and marsh platform. Sand fences and vegetation were used to stabilize the sand and minimize wind-driven transport.
Isle Dernieres Restoration, Trinity Island (CWPPRA)	TE-24	1999	776	4.85 million	+4.0 NAVD 88	100-350	+8.0 NGVD 29	300	200-250	22,500	*Cynodon dactylon* *Spartina patens* *Spartina alterniflora* *Panicum amarum*	Sand dredged from adjacent waters was used to build dunes and a marsh platform. Sand fences and vegetation were used to stabilize the sand and minimize wind-driven transport.
Whiskey Island Restoration (CWPPRA)	TE-27	1999	4,926	2.85 million	+1.0-4.0 NAVD 88	800-1,500	+3.0 NAVD 88	300	200	N/A	*Spartina alterniflora* *Spartina patens* *Panicum amarum* *Avicennia germinans*	Back-barrier marsh was created, a breach at Coupe Nouvelle was filled using material dredged from the bay north of the island, and vegetation was planted in the back-bay areas.

Project Name	Project Number	Construction Date	Project Area (acres)	Dredged Material (cubic yards)	Marsh Platform Constructed Elevation (feet)	Marsh Platform Width (feet)	Dune Elevation (feet)	Dune Width (feet)	Beach Width (feet)	Length of Sand Fencing (linear feet)	Vegetation Planted	Project Summary
Barataria Bay Waterway, Grand Terre Island (Phase II) (WRDA)	N/A	1999		500,000								This project involved the beneficial placement of dredged material from the Barataria Bay Waterway to create wetlands on the bayside of West Grand Terre Island.
East Timbalier Island Sediment Restoration, Phase I (CWPPRA)	TE-25	2000	45,102	402,000	+2.0 NGVD 29	600	+5.0 NGVD 29	200		13,000	*Panicum amarum* *Spartina patens* *Cynodon dactylon*	Dredged sediment was placed in three embayments along the bayside shore of East Timbalier Island. This project also included aerial seeding and planting of dunes and the installation of sand fencing.
East Timbalier Island Sediment Restoration, Phase II (CWPPRA)	TE-30	2000	9,330	2.45 million	+2.0 NGVD 29	600	+5.0 NGVD 29	200		13,000	*Panicum amarum* *Spartina patens* *Cynodon dactylon*	Dredged material was placed along the bayside shoreline of the island, and additional rock was placed on the existing breakwater on the gulfside of the island.
Timbalier Island Dune and Marsh Creation (CWPPRA)	TE-40	2004	663	4.6 million	+1.6 NAVD 88	800	+8.0 NAVD 88	400	200	22,750	*Spartina alterniflora* *Panicum amarum* *Spartina patens* *Uniola paniculata*	This project restored the eastern end of Timbalier Island through the creation of beach, dunes, and marsh.
Barataria Barrier Island Complex Project: Pelican Island and Pass La Mer to Chaland Pass Restoration (CWPPRA)	BA-38	2007	1,117	2.5 million	+2.5 NAVD 88	>1,000				27,300	*Panicum amarum* *Spartina spartinae* *Spartina alterniflora* *Spartina patens* *Uniola paniculata* *Lycium carolinianum* *Avicennia germinans*	Dredged material mined from an offshore borrow area was used to construct dunes and a marsh platform. This project also included the construction of sand fencing, vegetation plantings, and creation of tidal features. *This project has been partially constructed (Pass La Mer to Chaland Pass portion.)
New Cut Dune and Marsh Restoration (CWPPRA)	TE-37	2007	386	1.0 million	N/A	N/A	+7.0 NAVD 88	300	340	17,050	*Panicum amarum* *Spartina patens* *Spartina alterniflora* *Spartina spartinae* *Phragmites communis* *Uniola paniculata* *Lycium barbarum* *Schizachyrium scoparium* *Sporobolus virginicus*	The objective of this project was to close the breach between East and Trinity Islands that was originally created by Hurricane Carmen (1974) and subsequently enlarged by Hurricane Juan (1985). The project created barrier island dunes, barrier flat, and beach habitat A marsh platform was not constructed because there was already marsh present.

Project Name	Project Number	Construction Date	Project Area (acres)	Dredged Material (cubic yards)	Marsh Platform Constructed Elevation (feet)	Marsh Platform Width (feet)	Dune Elevation (feet)	Dune Width (feet)	Beach Width (feet)	Length of Sand Fencing (linear feet)	Vegetation Planted	Project Summary
Pass Chaland to Grand Bayou Pass Barrier Shoreline Restoration	BA-35	2009	596	3.0 million	+2.6 NAVD 88	1,000	+7.0 NAVD 88	50			*Echinochloa frumentacea* *Urochloa ramosa* *Spartina alterniflora* *Avicennia germinans*	This project included the deposition of dredged material, the creation of 2 1-acre tidal ponds and 10,000 linear feet of tidal creeks, and vegetation plantings. These features will act as a buffer against wave and tidal energy, thereby protecting the mainland shoreline from breaching and continued erosion.
Whiskey Island Back Barrier Marsh Creation	TE-50	2009	1,038	3.1 million	+2.5 NAVD 88		+6.0 NAVD 88	100	N/A	13,000	*Spartina alterniflora* *Avicennia germinans* *Panicum amarum* *Schizachyrium scoparium* *Sporobolus virginicus* *Spartina patens* *Uniola paniculata*	This project will enhance the function of Whiskey Island as a protective barrier for back-bay and inland areas. Dredged material will be deposited on the island's back-barrier area to widen the marsh platform on the central and eastern portions of Whiskey Island. A sand dune will also be created along the gulf side beach shore. Additionally, 10,000 linear feet of tidal creeks and six 1-acre tidal ponds will allow hydraulic exhange and circulation within the new back barrier marsh.